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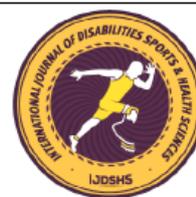
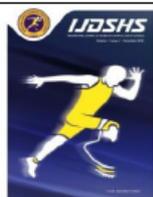
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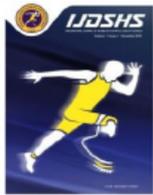
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RESEARCH ARTICLE

Investigation of the Effect of Eight-Week Aqua Fitness Exercises on Some Strength Parameters and Body Composition with Autism Spectrum Disorder

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Abstract

The aim of this study is to examine the effect of eight-week aqua fitness (AF) exercises on some strength parameters and body composition of individuals with Autism Spectrum Disorder (ASD). Twenty children with ASD, aged 5 to 9 years, who participated in basic physical activity training (BMT) for at least three months were enrolled in the study. Participants were randomly divided into two groups: AF exercise group (AFG) and basic movement training group (BMTG). The AFG group was trained for 8 weeks (2 days per week) using AF, while the BMTG group completed basic movement training (BMT) exercises for 8 weeks (2 days per week). Before and after the training programs, the medicine ball throw, flexibility test, vertical jump, standing long jump, and body fat percentage of the participants were determined. The Wilcoxon test was used for statistical analysis of the study. The study measured a significant difference before and after the AF training program medicine ball throw ($p=.005$), sit and reach test ($p=.005$), vertical jump ($p=.005$), standing long jump ($p=.005$) and body fat percentage in AFG, before and after training. medicine ball throw ($p=.564$), vertical jump ($p=.461$), and standing long jump ($p=.674$) did not change in the BMTG group before and after training. Sit and reach ($p=.039$) and body fat percentage ($p=.032$) changed significantly in BMTG. AF exercises had a positive effect on some strength parameters and body composition in individuals with ASD. AF Exercises showed more effective results than BMT exercises in individuals with ASD

Keywords

Aqua Fitness, Strength, Body Composition, Autism Spectrum Disorder

INTRODUCTION

Autism spectrum disorder (ASD) is a type of disability characterized by impairments in social interaction and communication skills, as well as limited mobility and repetitive behavior patterns (Wang et al., 2018; Ulu et al., 2022). Specifically, individuals with ASD avoid eye contact (Chawarska et al., 2009), are hypersensitive to certain objects (Pierce et al., 2016), and prefer to

be alone (Mattys et al., 2018). If precautions are not taken, these negative behaviors begin in childhood (Jones and Klin, 2013) and continue to increase through adulthood, leading to the emergence of new problems (Totsika et al., 2011). Physical activity is an important phenomenon to prevent these problems (Liang et al., 2022).

Individuals with ASD are at higher risk for many clinical and psychiatric conditions, including obesity, compared to the general population

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(McCoy et al., 2016). Phillips et al. reported that individuals with ASD had higher rates of obesity compared to their healthy peers (Phillips et al., 2014). It was also found that individuals with ASD had lower physical fitness compared to their healthy peers (Pan et al., 2016). In this case, it is inevitable that motor skills will be negatively affected (Pan, 2014). Studies have shown that the physical activity level of individuals with ASD is lower than that of their healthy peers (Bandini et al., 2013). This is believed to be one of the most important causes of motor disability and obesity in people with ASD.

Although it is important to be physically active, the type of exercise is equally important. The type of physical activity should be determined after analyzing the characteristics of the work group, standard of living, environmental conditions, and financial capabilities (Healy et al., 2017). Aquafitness exercises (AF), which are commonly used in healthy individuals, have been found to eliminate many health problems, increase the level of physical fitness, and increase vascular compliance (Lee, 2014). When the exercises preferred in AF are performed in different locations, they may be insufficient to develop basic skills such as strength, flexibility, endurance, and speed (Parker et al., 1989). On the other hand, it contributes to the development of motor skills (Goncharova et al., 2020) and functions of the respiratory and circulatory systems (Lee et al., 2018), as well as endurance during resistance exercises in water.

It is known that it is difficult to perform anaerobic exercises and various complicated exercise programs in mentally disabled people (Menear et al., 2015). For this reason, exercises for people with mental disabilities should be simple and not complicated. Although the exercises of AF do not consist of complex exercises, they are generally used for rehabilitation purposes in disabled people. The number of studies investigating the effects of AF exercises on the physical fitness of people with intellectual disabilities is limited. Therefore, the aim of our research is: The aim of this study is to investigate the effects of eight-week AF exercises in individuals with ASD on some strength parameters and body composition.

MATERIALS AND METHODS

Participants

The present study followed a within-subjects design, in which two or more measurements were collected from a sample of subjects and groups. The minimum sample size of the our study was calculated using G-power software 3.1.9.7. (University of Dusseldorf, Dusseldorf, Germany). According to this analysis; a priori and F tests were used to calculate power following our study's design; within-factors; α err prob = 0.05; minimum effect size= 0.25, and power ($1-\beta$ err prob)= 0.95. In a study of 18 participants, there was an actual power of 95.0 % for the current analysis and sample. Therefore, 20 participants with ASD between the ages of 5 and 9 years voluntarily participated in our study. Participants were randomly assigned to an aqua fitness exercise group (AFG=10, 5 males and 5 females) and a basic movement exercise group (BMTG=10, 5 males and 5 females). Participants were selected from individuals with ASD who exercised at least two days per week. Participants with cardiovascular problems, chronic respiratory problems, taking antibiotics, thyroid-like hormone imbalances, water phobia, active infections, open wounds, and an infectious disease in their body were not included in the study. Individuals with ASD who do not participate in the training sessions within the eight-week training period and are unable to perform the specified exercises will be excluded from the study. The families of the participants were informed of the purpose, reason, and possible outcomes of the study. They were informed that participation in the study was on a voluntary basis and that they could leave the study at any point during the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Study Design

In order for participants to have similar physical fitness, all participants were selected from individuals with ASD who had continued BMT for at least 3 months. The AFG group continued the exercises from AF for eight weeks (2 days per week), while the BMTG group continued BMT exercises for eight weeks. Testing was performed before and after the eight-week exercise period. Before BMT exercises, 10 minutes of general warm-up and 5 minutes of stretching were performed. BMT exercises included balance

exercises (walking on a balance board, walking on a moving slide, balancing on one and both feet on a Bosu ball, etc.), jumping exercises (jumping on a trampoline, jumping forward on rings, jumping on a mat above the floor, etc.), and strength and endurance exercises (pulling a rope, pulling a weight ball, legs up to knees, tilting a funnel with a weight ball, crawling on the floor). After the study, 5 minutes of cool down and 5 minutes of stretching were applied.

The AF exercises were performed in a children's pool with a depth of 60 cm. During the exercises, the supervisor in charge was also in the pool. Before the AF exercises, 10 minutes of general warm-up and 5 minutes of stretching were performed. AF Exercises including balance exercises (one-legged balancing in the water, walking on the line under the pool, balancing in manipulatively activated water, etc.), jumping exercises (one-legged and two-legged jumping in the water, jumping to the right and left, etc.), strength and endurance exercises (rope pulling, legs to knees, water resistance exercises, etc.). The study was followed by 5 minutes of cooling down and 5 minutes of stretching. In the study, the ratio of working and resting was applied as 1:1 (1 minute of work and 1 minute of rest).

Data Collection

Before all measurements, participants received a 10-minute general warm-up. This was followed by 5 minutes of stretching movements. Tests were performed according to the warm-up protocol. All tests were performed between 14:00 and 16:00, and participants were asked not to eat or drink anything other than water for at least 3 hours before the tests. The tests were performed and recorded by two different researchers. The similarity between the test results of the two researchers was analyzed as 96.4%. All tests were performed using the show-and-tell technique, and participants were offered a 30-minute familiarization period before testing.

Throwing Medicine Ball

The participant was asked to stop at the starting point determined by the tape. While standing, the athlete was asked to throw the 3 kg medicine ball forward in the throw-in position. The first point where the medicine ball touches the ground is determined. The first point of contact with the starting point was measured and recorded in cm. The participant was given two attempts and

the best value was recorded Van den Tillaar and Neumeier, 2015).

Flexibility Test (Sit an Reach):

For the flexibility, the seat and reach test was used. Testing was performed using a Baseline® brand flexibility stand (Cooper Institute/ YMCA, AAHPERD, New York, USA). Participants removed their shoes and placed them on the '0' reference point. During the measurement, participants were not allowed to bend their knees. The participant was asked to push the tape with an outstretched arm, and after waiting 2 seconds, the value in cm was recorded at the longest point they could reach. The participant was asked to do two repetitions and the best value was recorded (Akinoğlu et al., 2021).

Standing Long Jump

Care was taken to ensure that participants spread their legs at shoulder height and that the tops of their feet did not cross the marked line. With the command "Jump", he was asked to jump forward. The distance between the heel of the foot closest to the marked line and the line was measured and recorded in cm. The participant was asked to do two repetitions and the best value was recorded (Almuzaini and Fleck, 2008).

Vertical Jump Test

The Sargent test protocol was used to determine the vertical jump performance of the participants (Ayán-Pérez et al., 2017). When shooting, the participant waited with both feet in front of a smooth wall. A mark was drawn at the highest point he reached. Then the participant was asked to jump as high as possible and the distance reached was drawn again with chalk in hand. The distance between the two drawings was recorded in cm. The participant had two attempts and the best value was noted (Bui et al., 2014).

Height, Body Weight and Body Fat Percent

In height measurement, the participant's feet were bare, heels were together, and the body and head were measured and recorded. The movable part of the stadiometer was brought to the top of the head, the hair was sufficiently compressed, and the measurement was recorded to the nearest 1 mm. During the measurement, participants were asked to breathe deeply and maintain their upright position. Weight was measured with an electronic scale of SECA brand (Germany) with an accuracy of 0.1 kg, and the participants' feet were bare and they wore shorts and T-shirts during the measurement. Body fat percentage was determined

by Tanita TBF 300 (Japan) brand body analyzer (Padwal et al., 2016).

Statistical Analysis of Data

The data in the research were made with SPSS (Version 25, IBM, USA) package program. The normality analyzes of the data were done using Shapiro-Wilk test because the number of participants was less than 30. In this context, Wilcoxon test, one of the non-parametric tests, was used for statistical analysis. The effect size of the study was determined using Cohen's d formula. In this context, the effect size yielding 0.2 was

accepted as small, 0.5 as medium, and 0.8 as large (Cohen, 1988). The significance level of the study was set at 0.05.

RESULTS

Table 1 shows: Age=7.0 ± 2.10 years, height=118.10 ± 22.77 cm, body weight=24.90 ± 12.62 kg, BMI=14.99 ± 5.78 kg/m² at AFG. Age=6.60 ± 0.96 years, height=103.60 ± 6.61 cm, body weight=18.90 ± 2.02, and BMI=17.62 ± 1.36

Table 1. Descriptive information of participants

Parametes	AFG (n=10) (5 male, 5 female) x̄±SD	BMTG (n=10) (5 male, 5 female) x̄±SD
Age (year)	7.0 ± 2.10	6.60 ± 0.96
Height (cm)	118.10 ± 22.77	103.60 ± 6.61
Weight (kg)	24.90 ± 12.62	18.90 ± 2.02
BMI (kg/m ²)	14.99 ± 5.78	17.62 ± 1.36

AFG: Aqua Fitness Exercise Group, BMTG: Basic Movement Training Group, BMI: Body Mass Index

When analyzing Table 2: medicine ball throw before and after AF exercises (pre-study=129.20 ± 40.85 cm, post-study=132.75 ± 41.26 cm, ES =2.82, p=.005), sit and reach test (pre-study=16.70 ± 4.34 cm, post-study=18.57 ± 4.60 cm, ES =2.80, p=.005), standing long jump test (pre-study=54.70 ± 21.57 cm, post-study=59.17 ± 21.68 cm, ES =2.81, p =.005), vertical jump (pre-study=6.23 ± 1.53 cm, post-

study=7.56 ± 1.33 cm, ES =2.81, p=.005), body fat percentage (pre-study=17.73 ± 3.04 cm, post-study=16.26 ± 2.72 cm, ES =2.80, p=.005) changed significantly. For BMTG, a significant difference was found between the sit and reach test (pre-study=25.19 ± 1.95 cm, post-study=24.84 ± 2.04 cm, ES =2.06, p=.039) and body fat percentage (pre-study=20.31 ± 3.98 cm, post-study=20.09 ± 4.06 cm, ES =2.14, p=.032).

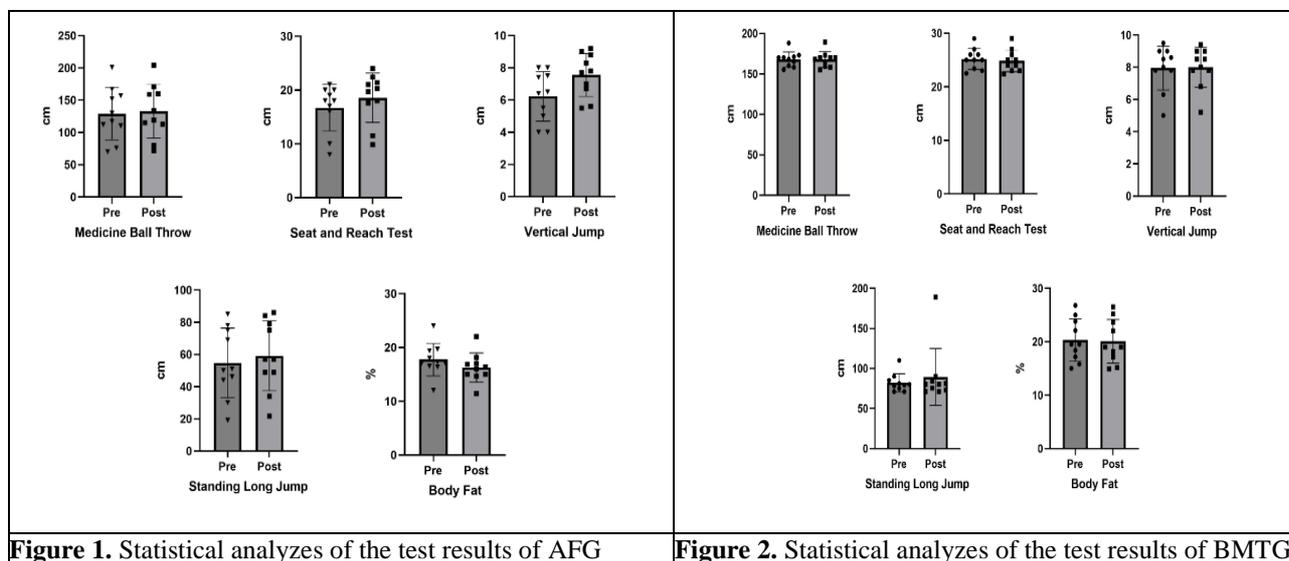
Table 2. Comparison of test results of AFG and BMTG groups before and after AF exercise

Parameters	Group	Pre-Study x̄ ± SS	Post-Study x̄ ± SS	ES	p
Throwing a Medicine Ball (cm)	AFG	129.20 ± 40.85	132.75 ± 41.26	2.82	.005*
	BMTG	167.80 ± 9.33	167.70 ± 9.63	0.57	.564
Sit and Reach (cm)	AFG	16.70 ± 4.34	18.57 ± 4.60	2.80	.005*
	BMTG	25.19 ± 1.95	24.84 ± 2.04	2.06	.039*
Standing Long Jump (cm)	AFG	54.70 ± 21.57	59.17 ± 21.68	2.81	.005*
	BMTG	82.00 ± 11.44	89.46 ± 35.48	0.73	.461
Vertical Jump (cm)	AFG	6.23 ± 1.53	7.56 ± 1.33	2.81	.005*
	BMTG	7.95 ± 1.36	8.00 ± 1.23	0.42	.674
Body Fat Percent (%)	AFG	17.73 ± 3.04	16.26 ± 2.72	2.80	.005*
	BMTG	20.31 ± 3.98	20.09 ± 4.06	2.14	.032*

Statistical analyzes of the test results of AFG are given in Figure 1. Accordingly, the ratio of medicine ball throw (p=.005), seat and reach test (p=.005), vertical jump (p=.005), standing long jump (p=.005) and body fat before and after AF

exercise (p=.005) there was a significant change. Statistical analyzes of the test results of BMTG are given in Figure 2. Accordingly, there was a significant change in sit and reach (p=.039) and

body fat ratio ($p=.032$) before and after AF exercise.



DISCUSSION

In our study, AF and BMT exercises were performed for eight weeks in individuals with ASD. After eight weeks AF, medicine ball throw, flexibility, standing long jump, vertical jump, and body fat percentage changed significantly in AFG. In contrast, flexibility and body fat percentage changed significantly in BMTG, but the significance value was higher in AFG. To our knowledge, this is the first study comparing AF and BMT exercise in individuals with ASD. Thus, our hypothesis that AF exercises have an impact on some strength parameters and body composition in individuals with ASD was confirmed.

The medicine ball throwing test is a method for evaluating trunk strength using a general movement pattern used in many sports (Davis et al., 2008). Although this test provides some information about the subject's general strength, its use to determine anaerobic power is limited (Ikeda et al., 2006). In a study by Costa et al. it was found that performance in throwing medicine balls improved after three days of strength training in wheelchair basketball players (Gomes et al., 2021). In the study by Jorgic et al. it was found that there was a significant relationship between the medicine ball throwing test and the standing long jump test in goalball players, and the medicine ball forging test provided information about overall explosive strength (Jorgić et al., 2019). In a study by Sammoud et al. it was found that jumping performance positively influenced swimming performance (Sammoud et al., 2021). In this

context, considering that the medicine ball throw test and the standing long jump test in our study showed a higher significant difference in AFG, it can be concluded that the reaction force formed by the participants against the force applied to the water improved the general strength parameters of the individuals and indirectly positively influenced the explosive power.

While flexibility is not an obvious indicator of performance, it is an important motoric feature that allows for high-level performance. Kirkin et al. concluded that high sit-to-reach flexibility would contribute to improving neuromuscular explosive performance in young elite football players (Kirkin et al., 2019). Jones, on the other hand, argued in his research that a high level of flexibility requires more performance (Jones, 2002). When considered in this context, we think that increasing flexibility in AFG indirectly means an increase in performance level and an increase in explosive force.

High anaerobic endurance means that athletes recover earlier and fatigue occurs in a longer time (Garcia-Depraect et al., 2022). The vertical jump test is also a commonly used test to determine anaerobic capacity (Ostojic et al., 2010). Savoie et al. concluded that muscle endurance and anaerobic power and capacity may decrease as a function of water loss in the body. At the same time, it was argued that vertical jumping ability may increase as a function of body weight loss when water loss is less than 3% (Savoie et al., 2015).

In our study, body fat percentage decreased and vertical jumping performance increased in AFG. At the same time, agility, vertical jump and throwing with medicine ball changed positively at the end of AF exercises. This shows that the decrease in body fat percentage after AF exercises is not due to dehydration, but probably causes an increase in general muscle mass in the body.

As a result, our study found that AF exercises decreased total body fat percentage in individuals with ASD and improved vertical jump, standing long jump, flexibility, and medicine ball throw test scores more than BMT exercises. In this context, the exercises of AF may have positive effects on improving the overall strength endurance, flexibility, and anaerobic performance of individuals with ASD. They may also be recommended for the rehabilitation of chronic diseases such as obesity, cardiovascular disease, and cholesterol that are common in individuals with ASD. AF Exercises can also be used for various disability groups. It is known that water has a rehabilitative effect. The effects of the exercises of AF on the affective characteristics of individuals with ASD can also be studied by conducting some psychological tests after AF exercises in these individuals. By performing long-term follow-up studies after these exercises, the general health status of individuals with ASD, the duration of admission to the hospital and the frequency of getting sick can also be examined.

Conflict of Interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

The study protocol was approved by the Ethics Committee of the Institute of Health Sciences of Bandırma Onyedi Eylül University (Ethics Committee Approval: 2022/170).

Author Contributions

Study Design, AK, BÇ; Data Collection, AK, OB; Statistical Analysis, AK, NK; Data Interpretation, AK; Manuscript Preparation, AK, BÇ, NK; Literature Search, AK, KU, OB. All authors have read and agreed to the published version of the manuscript.

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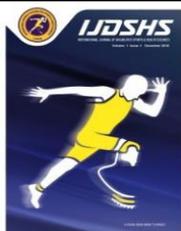
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RESEARCH ARTICLE

Understanding the Perspectives of Women on Pilates Through the Use of Metaphors

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Abstract

This study aimed to gain insight into the perspectives of women who practice Pilates by analyzing the metaphors they use to describe the exercise. The study involved 218 women who attended Pilates classes at the Istanbul Gaziosmanpaşa Municipality facilities thrice a week for sixty minutes each time. The research utilized a qualitative model involving a systematic content analysis and descriptive analysis of the qualitative data to understand the participants' viewpoints through metaphors. The participants, mainly comprised of females, provided 218 codes through their use of metaphors, with some codes overlapping. The codes were then organized into eight categories: Mood, Consciousness, Relaxation, Body awareness, Self-confidence, Energy, Happiness, and Therapy, which ultimately led to the formation of two themes, Psychological and Physical. After analyzing the metaphors, it was evident that the participants had a generally positive view of Pilates and that they believed it contributed positively to their health and well-being, both physically and psychologically. In conclusion, the study revealed that the participants perceived Pilates as a beneficial contributor to their overall wellness.

Keywords

Physical Activity, Quality of Life, Psychological Health

INTRODUCTION

In order to decrease the primary reasons for sickness and fatalities using health promotion techniques, it is suggested that one participates in physical activity that is appropriate for their age, physical fitness level, and current health status (Tremblay et al., 2010). It is assumed that progressive physical exercise contributes to developing a healthy attitude, promotes positive psychological dimensions, and improves the quality of life (Faria & Silva, 2000; Valois et al., 2004). However, due to the advancement of

technology, a sedentary lifestyle is leading to an increase in obesity and cardiovascular diseases. In addition, mental disorders caused by stress and daily life problems, such as anxiety disorders or depression, are also on the rise. Pilates is a physical activity that has recently gained popularity, especially among women, due to its quick recovery and resulting well-being (Gallagher & Kryzanowska, 2000; Latey, 2002; Stanko, 2002). Although Pilates is primarily a physical conditioning method that helps develop a practitioner's body and mind, it has adapted to the

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demand for physical activity and health (Anderson & Spector, 2000).

Joseph Hubertus created Pilates at the beginning of the 20th century as a system of physical and mental training (Pilates, 1945). Many studies have confirmed that Pilates can benefit muscle strength, endurance, flexibility, balance, injury prevention, performance improvement, and uniting the mind and body (Gallagher & Kryzanowska, 2000; Patti et al., 2021). Therefore, it has been recommended as an adult exercise method (Reyneke, 1993; LaBrusciano & Lonergan, 1996; Latey, 2002; Stanko, 2002; Smith & Smith, 2004). However, further research studies are needed to establish a scientific framework for Pilates. Some studies have reported that the Pilates program can improve physical and psychological health (Akbaş & Erdem, 2016; Karaman et al., 2017), while others have emphasized its benefits in quality of life, mental health, fatigue, physical condition, and body types (Soysal et al., 2016). In addition, non-traditional exercises like Pilates can also improve sleep quality, quality of life, depressive symptoms, and mood in older adults and adolescents (Siqueira et al., 2010).

Metaphor studies offer individuals the opportunity to express themselves. A metaphor represents more than its original meaning, creating new meanings that did not previously exist (Thornborrow & Wareing, 1998). Metaphors establish mental connections between unrelated things, while the underlying meanings of the concepts remain the same (Kovecses, 2002). Conceptual metaphors structure our thinking, according to Lakoff and Johnson. In metaphor research, the concept of "like" typically provides information about the connection between the subject of the metaphor and its source, as per Şaban (2008). The concept of "because," which is later posed, aims to explain why the metaphor is expressed in such a way. The use of metaphor refers to a way of thinking and seeing that pervades our comprehension of the world at large, as stated by Morgan (1998).

In this context, a metaphor is a powerful mental tool that individuals can use to comprehend and describe a highly abstract, complex, or theoretical situation. This study aims to uncover the perspectives of women who participate in Pilates exercises on exercises by using metaphors.

MATERIALS AND METHODS

Research Model

The research uses a qualitative research model with a systematic content analysis approach. Content analysis is a technique used to identify and classify communication content based on its graphic elements or message into categories. Bernard Berelson (1952) defines content analysis as an objective and quantitative method used to describe the explicit content of communication. Ole Holsti (1969) defines it as any research technique used to conclude by objectively describing certain features in a text. Finally, Klaus in Krippendorff (1980) defines content analysis as a research technique that links data to data to produce reproducible and valid inferences from a text, similar to the other definitions mentioned.

Working group

The research group comprises 218 women who participated in Pilates exercises. These participants also exercised at Istanbul Gaziosmanpaşa Municipality facilities for 60 minutes three days a week. The demographic information of the participants is provided in the tables below.

Table 1. Age distribution of participants

	N	min.	Max.	\bar{X}	Sd.
Age	218	18.00	59,00	35.48	8.6

When examining Table 1, we can see that the minimum age is 18, the maximum is 59, and the average age among the participating women is 35.48.

Table 2. Education level

Education Level	N	%
Primary Education	61	28.0
High School	85	39.0
Associate's Degree	27	12.4
Bachelor's Degree	43	19.7
Master's Degree	2	0.9
Total	218	100.0

When examining Table 2, it can be seen that the majority of the women who participated have a high school degree 39%, followed by

primary school graduates at 28%, undergraduate women at 19.7%, and associate degree holders at 12.4%. It is noteworthy that only two female participants are graduates.

Table 3. Period of participation in Pilates

	N	min.	Max.	\bar{X}	Sd.
Month	218	3.00	72.00	24.34	22.80

Perform Pilates exercises for a minimum of 3 months and a maximum of 72 months within five years.

Data collecting

In collecting research data, women who participated in Pilates exercises were asked to create reasoned metaphors about Pilates. In this direction, among the participants, " Pilates is like ...; because..." is located. The last part of the form contains information on demographic characteristics.

In the data collection phase, the female participants were informed and completed the required forms independently. Before The study was conducted by the Declaration of Helsinki and the protocol was approved by the Ethics Committee of Istanbul Aydin University no. 2022/20 from 24.11.2022

Data analysis

The present study utilized a descriptive analysis to examine the metaphors employed by women who participated in Pilates exercises. The data collected was presented in its original form as much as possible, and participants were directly quoted when necessary, following the approach outlined by Wolcott (1994). Descriptive analysis is often used in research where the conceptual structure is determined beforehand, as explained by Strauss and Corbin (1990). Its purpose is to present findings in an organized and interpreted form. The data is explained systematically; further descriptions are interpreted while incorporating participant quotes to reflect their views, per the basic understanding. For this research, the descriptive analysis approach was adopted to determine the conceptual structure, with quotes supporting the metaphors obtained from participants' thoughts as specified by Yıldırım and Şimşek (2016).

Study on Validity and Reliability

In qualitative studies, it is essential to report the collected data in detail and explain how the

researcher arrived at their results for validity (Yıldırım, 2010). Two basic procedures were carried out to ensure validity and reliability in this study. Firstly, the data analysis process was explained in detail to ensure validity, and all the obtained data were presented together in the quantitative and qualitative findings. Secondly, the themes and categories were presented to three experts and compared with the metaphor table created to ensure reliability. The research's reliability was calculated using the formula of Miles and Huberman (1994) (Trust = consensus/consensus + disagreement) by determining the number of consensus and disagreement in comparisons. The research's reliability calculation resulted in 94%. According to Miles and Huberman (1994), a study qualifies as reliable if there is 90% or more consensus among researchers and experts in qualitative research. Therefore, it can be stated that this study is reliable.

Encoding the data

The data that was collected was analyzed and separated into significant sections. It was determined which concept corresponded with each section, and a name was given to each section, creating a meaningful structure. The data set was read multiple times during the coding process. The coding process was carried out by repeatedly referring to the data set to dynamically process the code (Kvale, 1994; Morse, 2016; Silverman, 2016).

Identification of Categories and Themes

Based on the codes uncovered during the initial stage of qualitative data analysis, it is imperative to identify the overarching themes that can account for the data set and gather the codes under specific categories. In this context, more abstract coding is utilized in thematic coding. Initially, the codes discovered in the first stage are compiled, and common characteristics between them are determined. Thematic coding involves identifying similarities and differences between codes that possess distinct characteristics. To achieve this, codes related to each other are grouped, leading to their categorization. Categories of the exact nature make up the overarching themes. It is crucial to consider internal consistency while conducting thematic coding (Strauss & Corbin, 1990; Baltacı, 2017).

Therefore, when conducting thematic coding, connection with the data set upon which the themes are based. Furthermore, external consistency, which is the ability of all themes to explain the obtained research data coherently, is also crucial. As a result, themes are developed independently. Once categories and themes are determined, the coding process and data are organized according to the codes coherently to create a merged, meaningful collection (Patton, 1990; Silverman, 2016; Merriam & Grenier, 2019).

Organizing the Data by Codes, Categories, and Themes

A systematic structure was established to organize the data meaningfully using detailed and

a significant factor is establishing a meaningful thematic coding. The collected data was then reorganized according to this structure, with some data requiring additional coding. While editing the data, essential insights were uncovered, and the findings were redefined and interpreted accordingly. It is crucial to describe, explain, and present the data in a way that is easily understandable for the reader. Thus, in the findings section, the researcher refrained from providing personal views and comments and instead presented the information in a processed format (Miles & Huberman, 1994; Denzin & Lincoln, 2008; Şimşek & Yıldırım, 2011; Baltacı, 2017).

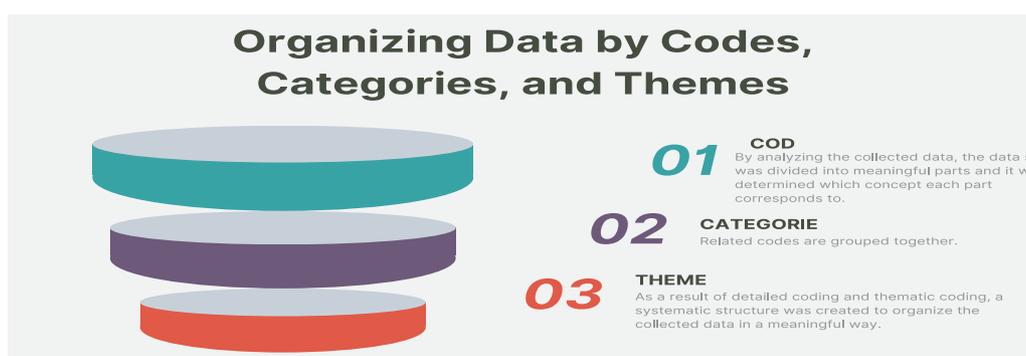


Figure 1. The process of organizing data into codes, categories, and themes.

As shown in Figure 1, analyzing the data involved identifying codes, categories, and themes based on the obtained categories.

Analysis of Results

In the final stage, he failed to provide explanations regarding the process of attributing meaning to the collected data, elucidating the connections between the findings, establishing cause-and-effect relationships, deriving conclusions from the findings, and emphasizing the significance of the obtained results (C. Marshall & Rossman, 2014; Connelly, 2016).

Research Ethics

In order to conduct this research, necessary permissions and consents were obtained from the Social Sciences Ethics Committee of Istanbul Aydın University. This decision was dated 24.11.2022 and numbered 2022/20. Furthermore,

detailed information about the research content was provided to all participating volunteers.

RESULTS

Upon examining the metaphors generated by participants, it is apparent that they possess a generally positive outlook on Pilates exercises, with no negative opinions expressed. The participants, mainly composed of 218 females, created 218 codes through their metaphors, overlapping some codes. From these codes, eight categories were derived: Mood, Consciousness, Relaxation, Body awareness, Self-confidence, Energy, Happiness, and Therapy. Ultimately, these categories gave rise to 2 themes, namely Psychological and Physical.

Table 4 displays the codes from the metaphors formulated by 218 female participants who participated in the study.

Table 4. Codes

Code	Frequency	Code	Frequency	Code	Frequency
Breath	24	Energy	8	Life	3
Water	13	Freedom	7	Peace	7
Happiness	8	Lifestyle	10	Relaxation	6
Life	8	Information	2	Flower	5
Freedom	7	Health	2	Quality of life	4
Peace	7	Sedative	2	Habit	3
Excitement	5	Need	2	Nature	3
Health	5	Green	2	Beauty	2
Love	3	Body	2	Tire	2
Therapy	2	Air	2	Development	2
Awareness	2	Struggle	2	Gift	2
Entertainment	2	Control	1	Book	1
Joy	1	Wise	1	Spring	1
Perfect	1	Respect	1	Visual show	1
Vigor	1	Smile	1	Passion	1
Sea	1	To be strong	1	Discovery	1
Music	1	Tasty	1	Sky	1
Weather	1	Game	1	Beginning of the end	1
Vitamin	1	Bond	1	Regeneration	1
Unwind	1	Break	1	Morale	1
Cleaning	1	Iron	1	Tree	1
Myself	1	Arrow	1	Precious time	1
Gymnastics	1	Taking time for oneself	1	Ball	1
Confidence	1	Rainbow	1	Sport	1
Food	1	Pleasure	1	Turning point	1
Ocean	1	Investing in the body	1	Playdough	1
Fitness	1	Machine	1	Heeled shoes	1
Sleep	1	Victory	1	Flexibility	1

Table 5. Categories

Categories	N	%
Mood	20	9.2
Consciousness	67	30.7
Relaxation	17	7.8
Body Awareness	34	15.6
Self-confidence	22	10.1
Energy	21	9.6
Happiness	8	3.7
Therapy	29	13.3
Total	218	100.0

Upon examination of Table 5, eight categories were revealed using codes created by the kadis who participated in the research. Upon further examination of these categories, it was observed that most responses, totalling 30.7%, fell under "Consciousness". Following this, 15.6% were classified as "Body Awareness", 13.3% as "Therapy", 10.1% as "Self-confidence", 9.6% as "Energy", 9.2% as "Mood", 7.8% as "Relaxation", and concluding with "Happiness" with 3.7%.

Upon examination of Table 6, it becomes clear that the categories' themes emerged from the metaphors used by the women who participated. As a result of the participants' words, two themes

were identified: "Psychology" and "Physical." Further examination of the themes shows that 162 participants discussed the psychological benefits of Pilates exercises, while 56 participants focused on the theme of "Physical."

Table 6. Themes

Themes	N	%
Psychological	162	74.3
Physically	56	25.7
Total	218	100.0

Table 7. The participants provided some examples of metaphors.

Participant Number	Example Sentences	Code	Category	Theme
38	"Pilates is like life because the working iron does not rust; we live healthily."	Life	Body Awareness	Physically
49	"Pilates is like freedom because many of the movements that we restricted at the beginning, we do as if we were on a feather after learning."	Freedom	Self-confidence	Psychological
100	"Pilates is like a rainbow because every colour and every dance gives happiness and excitement."	Rainbow	Mood	Psychological
102	"Pilates is like water because it is indispensable for human beings."	Water	Consciousness	Psychological
109	"Pilates is like looking at a blue sky because it gives peace, relaxation, relaxation."	Sky	Relaxation	Psychological
120	"Pilates is like play dough because it reshapes your body."	Playdough	Energy	Physically
160	"Pilates is like high heels because it makes you stand upright and stand out."	Heeled shoes	Body Awareness	Physically
168	"Pilates is like music because the more you listen to it, the more happiness it takes away from all troubles."	Music	Therapy	Psychological
190	"Pilates is like life because the more we move, the better our quality of life."	Life Quality	Energy	Physically
210	"Pilates is like a breath because when we breathe in, our whole being comes to life, and our soul is reborn."	Breath	Consciousness	Psychological
218	"Pilates is like medicine for the soul because when I do pilates, I feel perfect."	Medicine	Energy	Physically

When examining Table 7, several metaphors were formed by the women who participated in Pilates exercises

DISCUSSION

This study aims to uncover the favourable or unfavourable attitudes of women who engage in Pilates workouts, as indicated by the metaphors they generate to describe their experiences. The research for this objective indicated no bad attitudes among the participants and that Pilates workouts were generally well-regarded.

Pilates-based training offers numerous public health benefits, including improved physiological, psychological, and functional development of postural and motor skills (Lange et al., 2000). However, although Pilates exercises have been shown to provide physical and psychological benefits, research on Pilates has mainly focused on its physical benefits, and there need to be more

studies on its psychological benefits. Furthermore, while existing data suggests that Pilates can enhance body awareness, its psychological effects have not been directly evaluated (Araújo et al., 2012). Therefore, this study, which uses metaphors to gather individuals' perspectives is of particular significance.

In 2002, Ungaro stated that Pilates offers complete coordination of the body, mind, and spirit while reducing stress on the body. It also enhances attention, motivation, and cognitive functions. Adams et al. conducted a study to explore the experiences of their students in a Pilates class over a semester. Their findings supported the results of our study, as 78% of students reported an increase in body awareness and improved mental and physical health through Pilates.

In 2009, Teresa Garcia Pastor concluded that Pilates benefits health, physical and behavioural aspects, and can improve body composition. However, a study by Santana Pérez in 2010 argued that there was no significant change in body composition and flexibility. In contrast, Mokhtari et al. (2012) reported that Pilates exercises can have positive psychological effects by reducing depression and increasing blood serotonin levels. While there are differing opinions about the benefits of Pilates, most women in the study emphasized the psychological benefits. Caldwell et al. (2009) also found that Pilates-based exercise can improve psychological parameters. Some participants also mentioned physical benefits through metaphors. Rodrigues et al. (2010) discovered similar positive effects on the quality of life index of healthy older women following Pilates-based exercise twice a week for eight weeks. These results support other published explanations that the Pilates-based method positively impacts psychological functioning (Pilates & Miller, 1945; Lange et al., 2000).

Furthermore, Garcia and colleagues (2020) discovered an enhancement in flexibility and lower body strength due to Pilates exercises. Meanwhile, Duyan, İlkim, and Çelik (2022) concluded in their research that Pilates exercises decrease social appearance anxiety and improve psychological well-being. In another study, Silva and co-authors (2022) found that engaging in Pilates exercises helps develop posture and balance among women. The present study corroborated with the previous investigations as it was determined that the

participants had favourable perceptions, particularly regarding their physical and mental health. Moreover, their use of metaphors reinforced these findings.

Upon analyzing the metaphors constructed by the participants in the current study, it is apparent that they viewed Pilates exercises as highly beneficial. This perception was shaped mainly by the positive psychological impact they experienced and their hopes for the physical improvements resulting from the exercises. The study highlights the potential of Pilates exercises in enhancing women's perception of their physical and mental health.

Pilates exercises can positively impact life satisfaction, physical self-concept, and perception of health status. Future research could focus on identifying which aspects of the exercise program contribute to physical and psychological health. These findings highlight the significance of Pilates exercises in supporting individuals' psychological and physical development. Therefore, it is recommended that future studies use multiple evaluation methods to emphasize the importance of Pilates exercises.

Conflict of Interest:

There is no personal or financial conflict of interest within the scope of the study.

Information on Ethics Committee Permission

Board Name: Istanbul Aydın University
Social Sciences Ethics Committee Commission

Date: 24.03.2022

Issue/Decision Number: 2022/20

Researchers' Contribution Statement:

Research Design- BEO, DU, AK; Statistical analysis- BEO, DU, AK; Preparation of the article, BEO, DU, AK; Data Collection- Performed by BEO, DU, AK.

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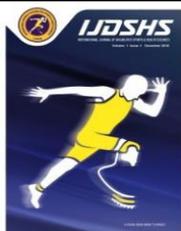
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RESEARCH ARTICLE

Examining the Relative Age Effect of Elite Paralympic Athletes

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Abstract

Although there are many studies on the Paralympic Games and athletes, which are an international organization, there are not enough studies in the literature on the "relative age effect" in Paralympic athletes. The research is the first study to examine the successful Paralympic athletes in terms of "relative age effect", especially in this respect. The aim of this research is to examine the effects of the relative age effect of the successful paralympic athletes. The model of the research was determined as "Basic Qualitative Research" and the data collection technique in the research was determined as "Document Analysis". The analysis of the data in the research was made according to the Miles and Huberman model. The universe of the research consisted of athletes who participated in the Paralympic Games between 1960 and 2022. The sample of the study consisted of 30 elite athletes, including the athletes who won the most gold medals in the Paralympic Games. The sampling method of the research is density sampling based on heuristic approach. As a result, it was understood that for the successful Paralympic athletes, the number of athletes born in the first six months of the election year is higher than those born in the last six months. Thus, it has been concluded that the elite Paralympic athletes with medals in the Paralympic Games are affected by the relative age effect.

Keywords

Paralympic, Olympic, National, Athlete, Relative Age Effect

INTRODUCTION

Sport; It is the whole of the activities that individuals carry out so that they can continue their lives more comfortably by feeling good physically, mentally and spiritually. At the same time, sports are also important for people who face many obstacles in their lives. Because, thanks to sports, although the obstacles are removed, it can provide more pleasure and satisfaction in life (Özkan et al., 2013). Sports have a special place especially for disabled individuals who have lost their physical, mental and spiritual abilities from birth or later to various degrees (Akinoğlu et al.,

2016). Disabled individuals tend to participate in sports activities or different sports branches specially organized for them in order to eliminate the negative situations they experience in life and to turn negative issues into a positive direction (Yıldız et al., 2016). In this way, disabled individuals can participate in various competitions by completing the training processes of the sports branches specially arranged for them, and can experience the feelings of success and failure in these competitions. With this process, disabled individuals can define themselves as athletes (Sarigöz et al., 2017; Youngson et al., 2023). Paralympic Games are one of the most important

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organizations that enable people with disabilities to compete fairly and equally. The Paralympic Games is an event that takes place two weeks after the Olympic games. It was first held in 1960 after the Rome Olympics. Since then, it has been held once every four years (Tow et al., 2020; Yardimci & Kulunkoglu, 2022). When the literature in the field of Paralympics is examined, there are many studies especially on paralympic athletes. Some of these studies are: Swartz et al. (2019) conducted a study on the mental health symptoms and disorders of paralympic athletes. In another research; Fagher et al. (2016) examined paralympic athletes' perceptions of their sports-related injury experiences, risk factors, and protection opportunities. In another study; Banack et al. (2011) aimed to reveal the coach autonomy support, basic needs satisfaction and intrinsic motivation of paralympic athletes. In another research; Alexander et al. (2020) tried to determine the views of female paralympic athletes on effective and ineffective coaching practices. In another study, Madden et al. (2017) investigated the evaluation of dietary intake and supplement use in paralympic athletes. Despite these studies, no research has been found that examines the relative age effect of paralympic athletes. The relative age effect refers to the asymmetry in the distribution of birth dates, which favors players born prematurely in the election year and discriminates against those born later in the year (Helsen et al., 1998). Grouping of athletes according to age groups is very common in sports. January is globally considered the start of the election year. In particular, categories in team sports correspond to annual or biennial competition cycles in which the athlete is included in competition groups according to his chronological age and a predetermined end date. (Gil et al., 2020). Therefore, it is seen that older athletes have more opportunities to reach a higher sports level in terms of selection and competition performance than their other younger peers (Till et al., 2010). When the literature on the relative age effect is examined, there are many studies. Some of these studies are: Barnsley and Thompson (1988) examined the relative age effect of hockey players in their study. They concluded that the players born in the first months of the year are stronger, faster and have better coordination skills than the players born at the end of the year, but they are more successful. In another study,

Simmons and Paull (2001) found that none of the 59 players selected for Sweden's under-17 football team were born in the last two months of the year. They also revealed that 25 players out of 59 players were born in the first 2 months of the year. In another study, Salinero et al. (2013) investigated the relative age effect of the player group consisting of 2763 players from the UK, Germany, Italy, France and Spain leagues. At the end of the study; They stated that the relative age effect is effective in these leagues. In line with this information, the aim of our study is to compare the relative age effect of 30 elite athletes who have won the most medals in the Paralympic games and who have won medals as competitors in both the Olympic and Paralympic games.

MATERIALS AND METHODS

This study was performed by adhering to the Helsinki Declaration. Ethical approval of the study was obtained from İstanbul Topkapi University Ethics Committee at the board meeting dated 20.03.2023 and numbered 2023/03 E-49846378-302.14.1-2300002932.

Model of the Research

The method of the research was determined as "Basic Qualitative Research" and the data collection technique in the research was determined as "Document Analysis". In the analysis of the data in the research, the Miles and Huberman model, which is a descriptive analysis form, was used.

Research Design

Qualitative data analysis; It is a collection of activities in which the data that can be obtained by different data collection methods and techniques such as document review, observation and interview are organized, categorized, themes are discovered, and ultimately this whole process is transferred to the report. In this study, document analysis technique was used in qualitative data analysis. Qualitative data analysis based on an interpretative philosophy is usually the data set studied; It is a combination of rough analysis (review, concentration, summarizing) with detailed analysis (detailing categories, hermenutic interpretation, describing data). The aim here is to produce common explanations by describing various data, describing in detail or comparing different data (Creswell, 2003; Flick, 2013). In qualitative studies, the analysis process mainly

involves understanding the essence of large amounts of data by reducing the volume of raw data, identifying important patterns, and creating a logical chain of evidence for the researched phenomenon by extracting meaning from the data (Patton, 2014). In this context, the Miles and Huberman model qualitative data analysis is essentially carried out in three steps: The first step is data reduction. Data reduction; It is the selection, examination, simplification, summary and transformation of the data obtained at the end of the research. In the second stage, data is displayed. Data representation; is to create an organized version of the collected data to reveal the results. The third stage is inference/validation. deduction/validation; It is testing the results in terms of validity, along with revealing causal relationships, patterns and possible structures between events and objects (Miles & Huberman, 2016). The reality, which is uncertain at the beginning of the research process and remains hidden in the data, is discovered and brought to light in the final stage.

Universe and Sample

The universe of the research consisted of athletes who participated in the Paralympic Games between 1960 and 2022. The sample of the research consisted of the athletes who won the most gold medals in the Paralympic games and the athletes who showed outstanding success in both the Olympic and Paralympic games. Density sampling was used in the sampling method of the study. Density sampling used in a qualitative research includes the best or most informative examples of the investigated phenomenon rather than extreme or unusual situations (Morgan & Morgan, 2008). Among the qualitative research methods, heuristic-based research generally uses density sampling (Mays & Pope, 2000). The phenomena studied in heuristic studies need not be extraordinary, pathological, or contradictory. Instead, it is essential that they contain intense information and have samples that can reach different and new information over time (Strauss & Corbin, 2015). The heuristic approach aims to discover and make sense of the nature of the studied event or phenomenon through self-experiences and the researcher's subjective explanations (Denzin & Lincoln, 2008). It enables the researcher to clearly express and make sense of the creative thought that exists within him. The heuristic approach is the only research approach

that enables human experiences to establish subjective and creative connections between the researcher and the researched phenomenon (taking into account the researcher's tacit knowledge) (West, 2001).

Data Collection Tools

For the research, websites such as the official website of the International Paralympic Committee "www.paralympic.org" and the official website of the International Olympic Committee "www.olympics.com", where detailed information about Paralympic and Olympic athletes are available. It is aimed to reach the necessary documents by examining e-content documents containing athlete data. In addition, validity-reliability in qualitative studies is handled differently from quantitative studies (Yıldırım & Şimşek, 2013). In terms of the reliability of the study, the "triangulation" technique, perhaps the most well-known and applied strategy, was used to increase its internal validity. Triangulation is the comparison of results from two or more data sources. In this way, the weaknesses of one of the methods can be compensated with the strengths of the other method (Streubert & Carpenter, 2011). In this study, documents from two different databases were compared and examined.

The Analyses of the Data

In this research, it is aimed to form a basis for data analysis with the theory known as 'Embedded Theory'. This type of analysis was developed by Glaser and Strauss (2006). Embedded theory is used both as a research strategy and as a data analysis method. Today, it is called the most impressive paradigm for qualitative research method (İlgar & İlgar, 2013). In embedded theory, data collection and data analysis are directly related to each other. Each collected data is directly compared with the next data, and in this way the comparison is continued until the most accurate data is reached. The embedded theory method consists of systematic but flexible guidelines developed for collecting and analyzing qualitative data with the aim of constructing theories embedded in and sourced from data (Charmaz, 2006). Data analysis in embedded theory is a well-defined process that begins with basic descriptions, continues with conceptual arrangement, and leads to theorization (Patton, 2002). Embedded theory has turned into an excuse presented to the scientific world for the qualitative approach by ensuring that qualitative

research is evaluated according to quantitative standards (Atkinson, 1997).

RESULTS

The aim of many athletes participating in sports competitions is to win. However, participating in the Paralympic Games or being able to compete in sports is a great source of pride for Paralympic athletes. It is clear that athletes from certain branches have an advantage. In Paralympic Games, there may be a chance to achieve more success, especially in individual competitions rather than team sports. For example,

there are more swimming medals than a team sport such as wheelchair basketball. In addition, as the number of competitions awarded with medals in the Paralympic Games increases over time, there will be differences in participation and success in the games from different branches. In this research, a list was created among the most successful and most medal-winning athletes in the history of the Paralympic Games and ranked according to their medal winning status. In addition, competition in both the Olympic Games and the Paralympic Games. In this way, the effect of the "relative age effect" phenomenon of the elite Paralympic athletes was examined.

Table 1. Top Paralympic gold medal winner athletes

Athlete	Country	Gender	Sport	Born Date
Trischa Zorn	USA	F	Swimming	June 1, 1964
Béatrice Hess	France	F	Swimming	November 10, 1961
Michael Edgson	Canada	M	Swimming	May 6, 1969
Sarah Storey	Great Britain	F	Swimming, Cycling	October 26, 1977
Jonas Jacobsson	Sweden	M	Shooting	June 22, 1965
Jessica Long	USA	F	Swimming	February 29, 1992
Roberto Marson	Italy	M	Athletics, Fencing	June 29, 1944
Mike Kenny	Great Britain	M	Swimming	January 30, 1945
Mayumi Narita	Japan	F	Swimming	August 27, 1970
Heinz Frei	Switzerland	M	Athletics, Cycling	January 28, 1958
Daniel Dias	Brazil	M	Swimming	May 24, 1988
Franz Nietlispach	Switzerland	M	Athletics	April 2, 1958
Chantal Petitclerc	Canada	F	Athletics	December 15, 1969
Erin Popovich	USA	F	Swimming	June 29, 1985
Claudia Hengst	Germany	F	Swimming	September 3, 1969

*Source: Retrieved from <https://www.paralympic.org> and <https://www.topendsports.com/>, March 23, 2023.

Table 1 shows the list of athletes who have won the most gold medals in total in the Paralympic Games. The swimmers and track and field athletes in the table have numerical superiority as they have more medals compared to team game athletes. It is seen that there are athletes with medals in different branches of athletics, as well as in cycling, shooting and fencing sports, in the list where the athletes who have excelled in swimming are predominant.

According to the table,

- Of the 15 athletes from different continents and countries, 8 are women and 7 are men,

- 7 out of 8 female athletes are swimming athletes,
- Only 3 of the 7 male athletes are in swimming,
- 5 out of 7 male athletes represent European continent countries,
- All of the medalists in more than one sport are from European Continental countries,
- 3 out of 4 athletes who have won medals in more than 1 sport are men.

The main focus of this stage is the evaluation of the most successful Paralympic athletes according to their date of birth in terms of "Relative age effect".

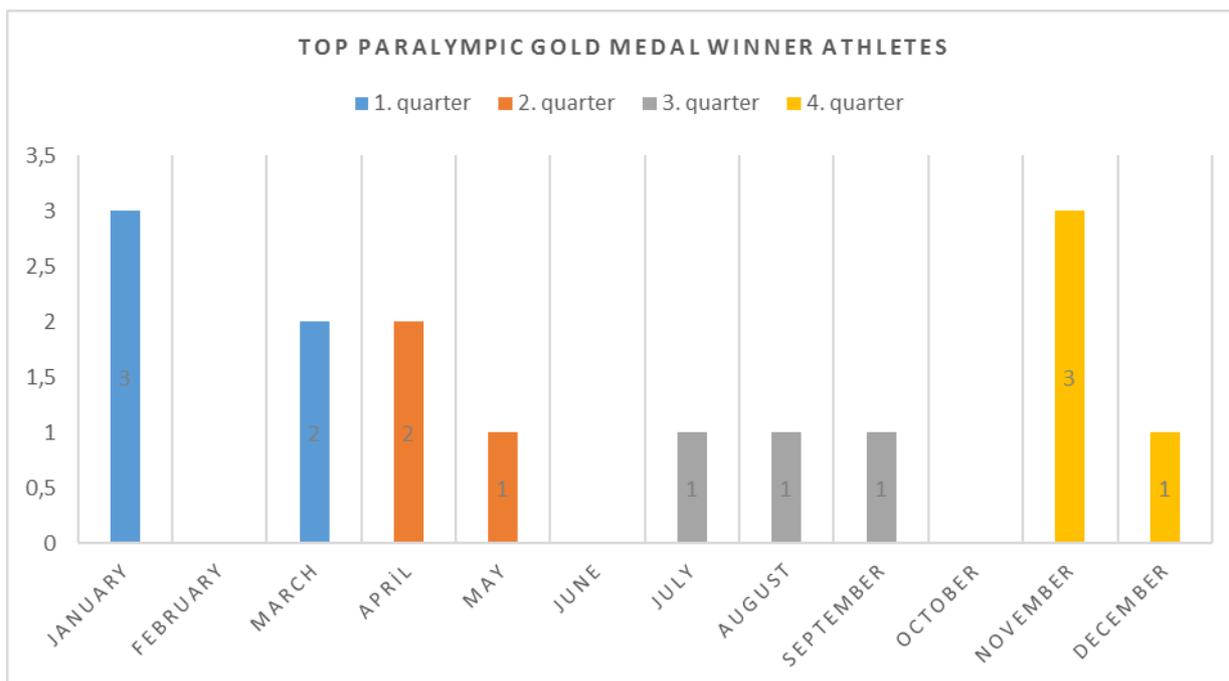


Figure 1. Top Paralympic medal winner athletes date of born list with quarter slice

In the Fig. 1, it is seen that the 15 elite athletes who won the most gold medals in the Paralympic Games are grouped according to their birth months, with the election year divided into quarters. In the chart where there are at least 3 athletes in each quarter, the athletes born in the 1st quarter have the highest number. The number of

athletes born in the 1st and 2nd quarters is higher than those born in the 3rd and 4th quarters. Therefore, it is seen that the athletes born in the first half of the election year are more than the athletes born in the last part of the year, in direct proportion to the "relative age effect".

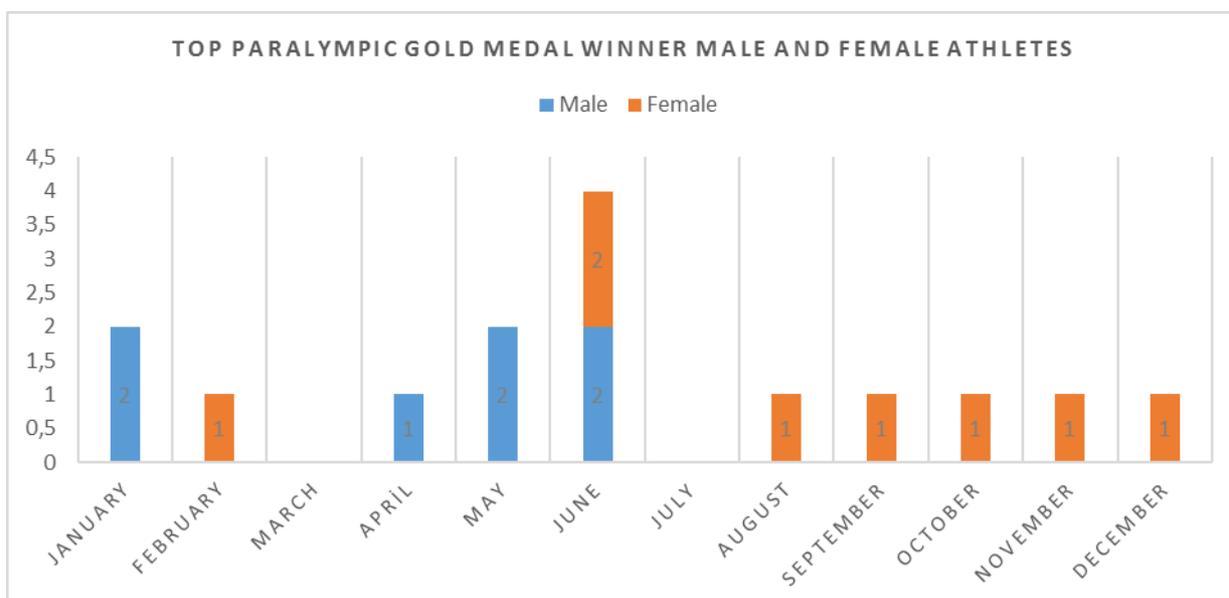


Figure 2. Male and female top Paralympic medal winner athletes date of born list with months

In the Fig. 2, all 7 male athletes who won the most gold medals in the Paralympics were born in the first months of the year. Although 3 of 8 female athletes were born in the first half of the election year, 5 female athletes are seen as born in

the last months of the year. For the elite athletes with the highest number of gold medals in the Paralympic Games, those born in the first period of the year for men and those born towards the end of the election year for women dominate.

Competed and Medal Winner Athletes in the Both of Olympic and Paralympic Games

It is known that even before the Paralympic Games started in 1960, there were athletes with disabilities competing in the Olympics. Although some of the Olympic athletes became disabled as a result of an accident or illness in different parts of their lives, they returned to elite sports with the Paralympic Games. Paralympic Games are very important for disabled athletes in terms of being able to compete with each other and highlight their sportive aspects.

It is planned to look at the "relative age effect" according to the birth dates of the athletes by choosing 15 athletes who have succeeded in competing and winning medals in the Olympic and Paralympic Games. It is important to examine the relative age effect, especially when it is considered that athletes with Olympic Games experience have started to compete in sports from very young age groups, have reached national sportsmanship, and outstripped many of their peers in their own category.

Table 2. Competed and successful athletes in both olympic and paralympic games

Athlete	Country	Gender	Sport	Born Date
Neroli Fairhall	New Zealand	F	Archery	26 August 1944
Marla Runyan	United States	F	Track and Field	January 4, 1969
Natalie Du Toit	South Africa	F	Swimming	January 29, 1984
Paola Fantato	Italy	F	Archery	September 14, 1959
Sonia Vettenburg	Belgium	F	Shooting	November 12, 1954
Assunta Legnante	Italy	F	Shot Put, Discus Throw	May 14, 1978
Natalia Partyka	Poland	F	Table Tennis	July 27, 1989
Oscar Pistorius	South Africa	M	Running	November 22, 1986
Pepo Puch	Austria	M	Equestrian	January 10, 1966
Zahra Nemati	Iran	F	Archery	April 30, 1985
Melissa Tapper	Australia	F	Table Tennis	March 1, 1990
Sandra Paovic	Croatia	F	Table Tennis	April 15, 1983
Pal Szekeres	Hungary	M	Fencing	September 22, 1964
Ilke Wyludda	Germany	F	Discus Throw	March 28, 1969
Orazio Fagone	Italy	M	Short Track Speed Skating	November 13, 1968

*Source: Retrieved from <https://www.olympics.com> and <https://www.paralympics.org>, March 23, 2023.

Table 2 shows the elite athletes who have competed in both the Olympic and Paralympic Games and have been successful. It is seen that the Olympic athletes in the table compete in more diverse sports branches than the athletes who compete only in the Paralympic Games. In the table, 11 of the 15 elite athletes from different continents and countries are men and 4 are women.

In the Fig. 3, it is seen that the 15 elite athletes who competed in the Olympic Games and won medals in the Paralympic Games are grouped according to their birth months, with the election year divided into quarters. In the chart where there are at least 3 athletes in each quarter, the athletes born in the 1st quarter have the highest number. The number of athletes born in the 1st and 2nd quarters is higher than those born in the 3rd and

4th quarters. Therefore, athletes born in the first half of the election year are seen to be more than athletes born in the last part of the year, in direct proportion to the "relative age effect".

The Fig. 4 shows in which successful athletes who competed in the Olympic and Paralympic Games are evaluated in terms of gender according to the relative age effect. 8 out of 11 female athletes were born in the first months of the election year. 3 of 4 male athletes are seen as born in the last months of the year. It is understood that successful male athletes competing in both the Olympic Games and the Paralympic Games were born mainly in the last part of the year, while female athletes were born in the first half of the election year.

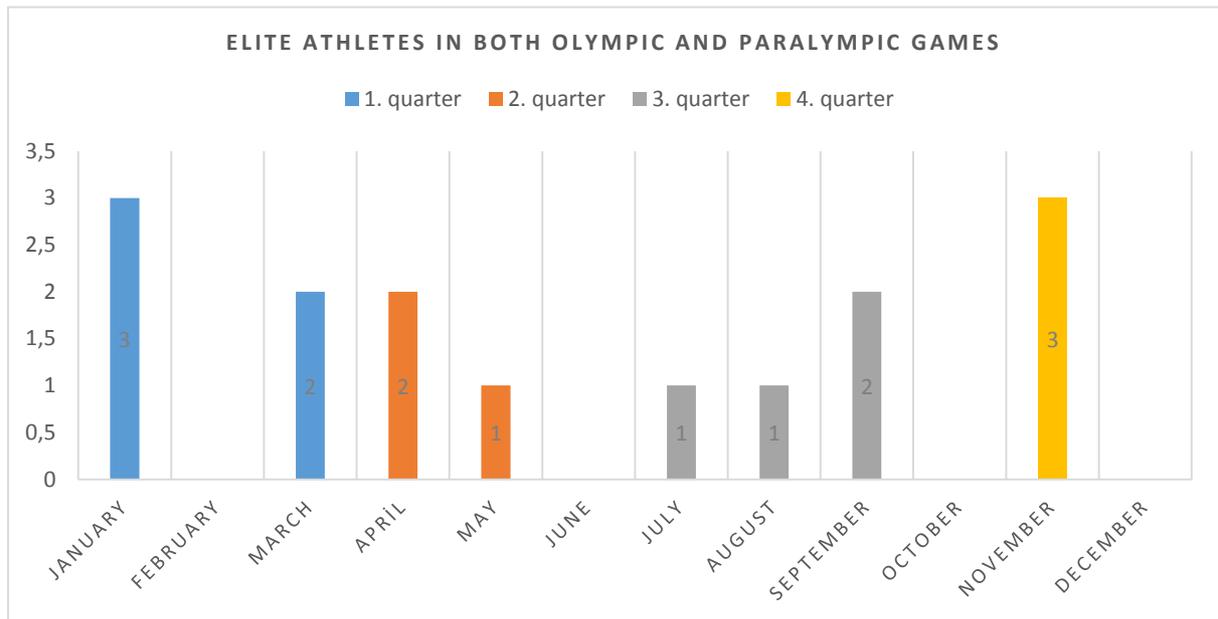


Figure 3. Competed elite athletes in both olympic and paralympic games date of born with quarter slice

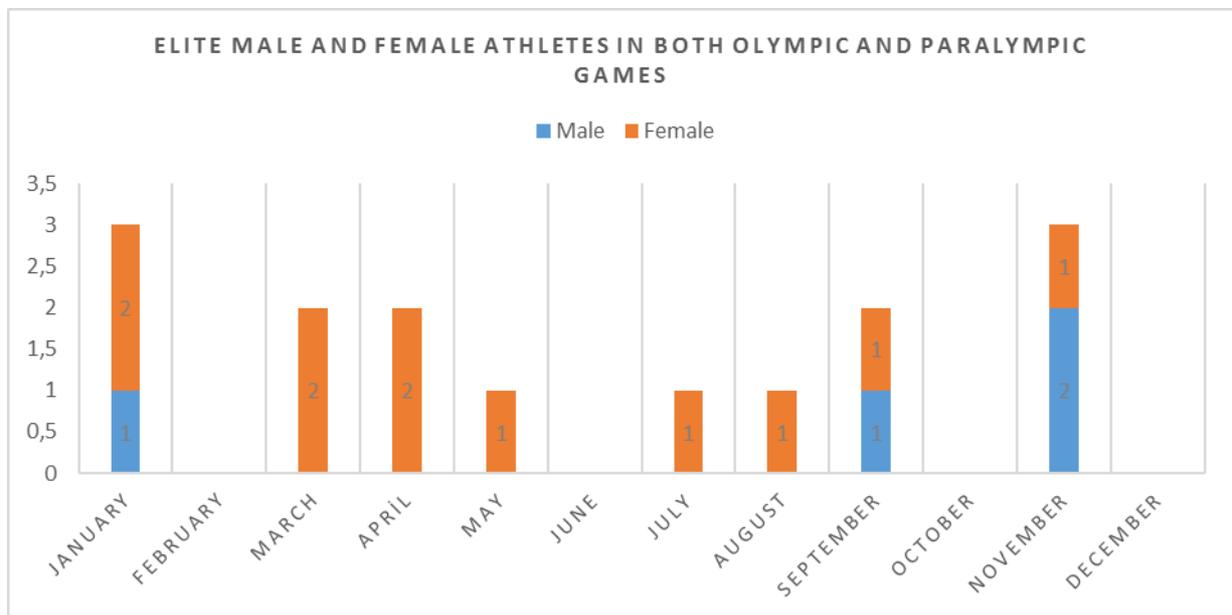


Figure 4. Competed male and female elite athletes in both olympic and paralympic games date of born list with months

As can be seen in the Fig. 5, when the 30 elite athletes who have excelled in the Paralympics are examined without gender discrimination, it is understood that there are more athletes born in the

first months of the election year than those born in the last months of the election year. Thus, successful paralympic athletes are affected by the relative age effect.

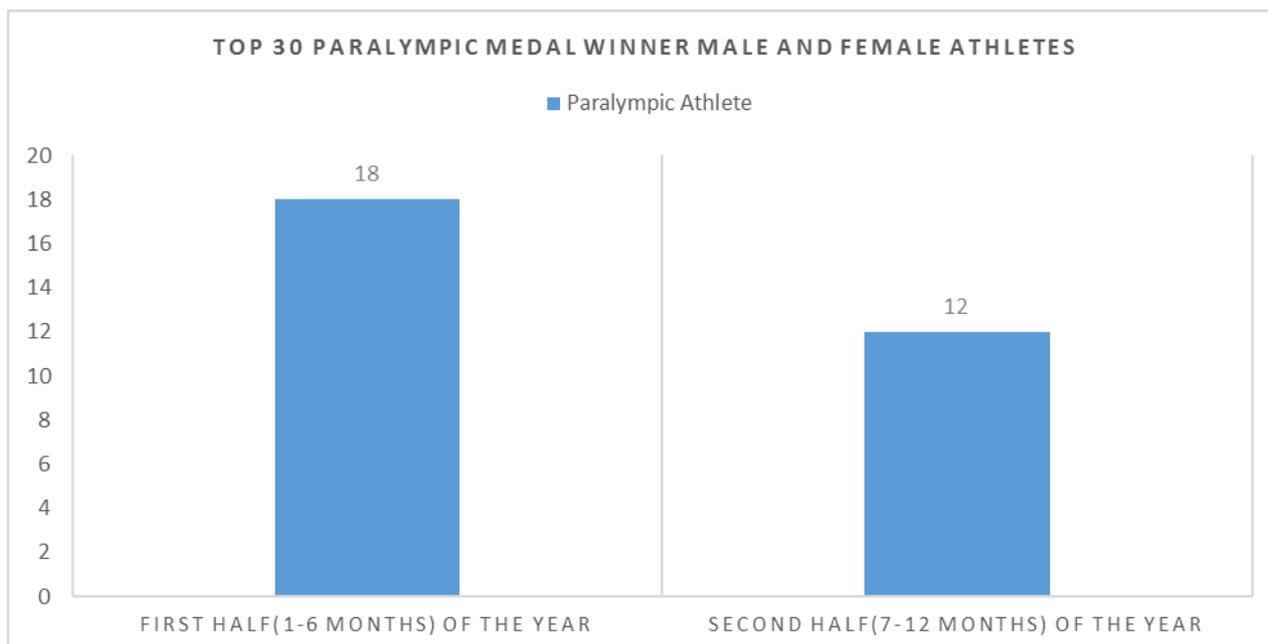


Figure 5. Top 30 medal winner paralympic athletes “relative age effect” graph

DISCUSSION

For nearly 50 years, many studies have investigated the relative age effect in the sports setting. Comparing the birth dates between junior and senior athletes in sports such as baseball, ice hockey, netball, rugby, football and tennis revealed skewed birth date distributions that favor individuals born prematurely in the election year (Musch and Grondin, 2001). In a study conducted for ice hockey, one of the aforementioned team sports; Bezuglov et al. (2020) examined the relative age effect of players playing in the Russian elite hockey league. In conclusion; They found that the teams in the Russian elite hockey league mostly included the athletes born in the first half of the year in their squads. Therefore, it can be said that teams and coaches shape their squads according to the relative age effects of the players. In another study; Rubia et al. (2020) investigated the relationship between the relative age effect and performance of the athletes participating in the World Handball Championships. As a result of the study; They found that there is a relative age effect between both male and female athletes in the U-19 and U-21 categories. However, they found that the athletes born in the first six months of the year took more time in the game and these players performed better than the athletes born in the other six months of the year. Similarly, in our study, it was seen in Table 1 that the majority of the paralympic athletes who won the most medals were born in the first six months of the year. In

addition, Rubia et al. (2020) stated that the relative age effect of both male and female players is a criterion to be considered in order to select players for international competitions or competitions.

In another study; Lorenzo-Calvo et al. (2021) examined the effect of relative age on people involved in swimming. As a result of the study; It has been revealed that male swimmers are more affected by the relative age effect than female swimmers. In this study, it was observed that all male swimmers who won medals in the Paralympic Games were affected by the relative age effect. Among female swimmers, the number of athletes born in both halves of the election year remained the same.

In another study; De Laroche Lambert et al. (2022) investigated the relative age effect of athletes interested in the French mountain skiing discipline. As a result of this study; They found that both female and male athletes were born in the first six months of the year more and they performed better than the athletes born in the other six months of the year. Similarly, in our study, successful Paralympic athletes, for both female and male athletes, were more likely to be born in the first six months of the year and were more numerous than those born in the other six months of the year.

Zháněl et al. (2022) conducted a study examining the relative age effect of the top 100 elite female tennis players between 2007 and 2016. In the study; They found that more than half of 100

tennis players were born in the first six months of the year. In particular, they stated that there was a moderate relative age effect among the top 10 players. In our study, it was seen that more than half of the best Paralympic female athletes were born in the first six months of the year.

As a result, it was seen that the athletes who won the most medals in the Paralympic games and were born in the first half of the election year were more than the athletes born in the last part of the year, in direct proportion to the "relative age effect". For the elite athletes with the highest number of medals in the Paralympic Games, those born in the first period of the year for men and those born towards the end of the election year for women dominate.

It has been observed that the athletes competing in both the Olympic Games and the Paralympic Games and winning medals are also affected by the "relative age effect". It is understood that successful male athletes competing in both the Olympic Games and the Paralympic Games were born mainly in the last part of the year, while female athletes were born in the first half of the election year.

When the two groups of paralympic athletes observed in the study are examined together, it is understood that the athletes born in the first months of the election year are more than the athletes born in the last months of the year. Thus, it is understood that elite Paralympic athletes are affected by the relative age effect.

Author Contributions

Study Design: BB; Data Collection: BB, AC; Analysis: BB; Manuscript Preparation: BB, AC.

Ethical Approval

Ethics committee approval of the study was obtained by the decision of the ethics committee of Istanbul Topkapi University, dated 20.03.2023 and numbered 2023/03 E-49846378-302.14.1-2300002932 and our study was performed by adhering to the Helsinki Declaration.

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Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this research.

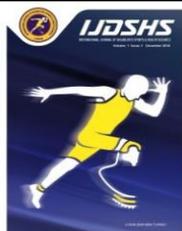
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RESEARCH ARTICLE

Different Biomechanics in Football Shooting Using Inside and Instep Kick

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Abstract

This research purposes were examined the differences in shooting accuracy using inside and instep kicks and observe differences in kick movements based on biomechanical variables. Twelve professional football players shot using inside and instep kicks on circular hops targets, shooting motions were recorded using a camera at 1000 frames per second. The kinematics during the swing phase and the impact phase with the ball producing the ball's trajectory were analyzed. Independent t-test used to compare shooting using inside and instep kick. The results showed that there was a significant difference in shooting accuracy using inside and instep kick ($t_{count} = 3.317$, $p = 0.003$) with a effect size large (Cohen's $d = 1.35$). When observing the movements, there were significant differences in backswing knee angle ($p=0.024$), frontswing knee angle ($p=0.034$), shoulder tilt angle ($p=0.045$), ball bearing foot placement ($p=0.019$), and inclination angle of pedestal foot ($p = 0.000$), while other biomechanical variables showed no significant difference ($p > 0.05$). This research concludes that accurate shooting movement is achieved using inside kicks, caused by the backswing and frontswing knee angles, body tilt, and the placement and angle of the pedestal foot.

Keywords

Accuracy, Shooting, Inside Kick, Instep Kick

INTRODUCTION

Football is a sport that requires tactical, technical, and physical performance skills (Modric et al., 2021). Football is essentially a movement performance consisting of elements of well-coordinated motion, in this case it is very dependent on the ability of a player to take into account and foster physical condition through the basic movements of the movement process of a football player. Football is a type of game that has complex movements. This means that the movement consists of movement elements that are well coordinated, so that they can be played well. To be able to achieve mastery of the basic techniques of playing football, players must perform with the principles of correct, careful,

systematic technical movements that are carried out repeatedly and continuously, so as to produce good cooperation between a set of muscle nerves for the formation of a harmonious movement, thereby resulting in movement automation.

Good mastery of movement skills can be obtained through research efforts in the field of sports biomechanics as a learning capital for movement as well as supporting factors in the sport in question. Sports biomechanics is a method by which the very fast actions occurring in sport can be recorded and analyzed in detail. Sports biomechanics represents a science that provides quantitative and qualitative assessments of sports performance, especially kinematics and sports movement kinetics (Taborri, 2020). In the game of football, kicking technique is an important

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technique for skilled ball manipulation during passes and shots.

Players must position themselves to support maximum acceleration during the kicking action, ensuring a strong shot and body balance. Kinematic studies of kicking motion describe variations in the angle and speed of the 3 most involved limb joints, namely the hip, knee, and ankle. Thus it has been observed that in kicking, the limbs are involved during the back swing, hip hyperextension, knee flexion, and ankle flexion. During the wind up phase, the hips are bent while the knees reduce flexion. So at the time of collision with the ball there is hip flexion, knee flexion, and ankle flexion. In this phase, the ankle is in a fixed position so that the foot forms a single unit to allow for effective contact and ensure fast ball release.

Shooting is the most common way to score. Accuracy are the most important variables related to football shooting (Martinez et al., 2020). Inside kick results better accuracy. In shooting, kick accuracy is most important and players usually use inside kicks (Rodenas, et al., 2020). However, instep kick can also produce good accuracy. Izovska, Maly, & Zahalka (2016) reported that regarding instep kick accuracy, we noted high variability in accuracy when the mean difference between the best and worst trials was $56.8 \pm 19.6\%$. Research shown that the most accurate instep kick is found at speeds between 90-102 km.h⁻¹, which is about 80-90% of the maximum kick speed. This shown that both kicks types can produce good accuracy.

Viewed from the accurate kick mechanism, activation of the kicking leg muscles is a significant mechanism that contributes greatly to the accuracy of kicks in football (Katis et al., 2012). Katis et al (2012) analyzed the activation of the tibialis anterior (TA), rectus femoris (RF), biceps femoris (BF) and gastrocnemius muscles (GAS) of the swinging leg and ground reaction forces (GRFs) of the support leg. GRFs did not differ between kick conditions ($P > 0.05$). Significantly higher TA and BF activity and lower GAS EMG activity during accurate kicks to the upper target ($P < 0.05$) compared to inaccurate kicks. In addition, there was significantly lower TA and RF activation during accurate kicks against the bottom target ($P < 0.05$) compared to inaccurate kicks. Increasing TA and BF muscle activation and reducing GAS activation can help

players to kick accurately against high targets. Conversely, players displaying higher TA and RF activation may be less accurate against bottom targets. While comparing the two types of kicks, previous studies reported comparisons in terms of muscle activation, the results showed that a significant interaction effect was identified for the hamstrings ($P = 0.02$) and tibialis anterior ($P < .01$). Greater activation of the kicking limb iliacus ($P, .01$), gastrocnemius ($P = 0.01$), vastus medialis ($P = 0.016$), and hip adductors ($P, .01$) occurred during the instep kick (Brophy et al. , 2007).

The explanation above explained the accuracy of kicks and differences in kick accuracy based on muscle activation. However, the lack of related studies comparing the accuracy of the two types of kicks based on their biomechanical variables still needs to be done. So that it shown the kinematics of the two kickstypes. Through biomechanical analysis of the inside and instep kick movements, it can assist coaches in preparing training programs for football athletes, as well as evaluating the movements made by athletes, so that athletes can improve their abilities and identify the weak points. Therefore, this research was conducted to examines differences in shooting accuracy using inside and instep kicks and observes differences in kick movements based on biomechanical variables. The research hypothesis that there are differences in shooting accuracy using inside and instep football kicks and there are differences in biomechanical variables in the movements of the two types of kicks.

MATERIALS AND METHODS

Research methods

The researcher used a quantitative approach with an analytical observational research design. The cohort research design is classified as an observational analytic research design (Rezigalla, 2020). The design of the observational analytic research compared the two groups, with exposure and outcome. This research design is used to find out how and why a phenomenon occurs through statistical analysis of causal factors. The type of observational analytic used is a cross sectional research. Cross-sectional research design is the kind of observational research design. In a cross-sectional research, researchers measure outcomes and exposures to research participants at the same time (Setia, 2016). Cross sectional research studies

the relationship of causal factors and effects simultaneously or at a time in a population. Simultaneous means that all variables are observed/measured at the same time. This research measures the different biomechanics of football shooting using inside and instep kicks. Shooting accuracy is an important factor (Arafat et al., 2020). The variables examined for each type of kick consisted of the swing phase and the impact phase with the ball producing the ball's trajectory. Variables include the angle of knee flexion of the backswing kick, the angle of extension of the knee of the pedestal leg, the angle of the frontswing pelvis, the angle of extension of the knee of the frontswing kick, the angular speed of the frontswing, the angular acceleration of the frontswing, the speed of the ball after the collision, the angle of inclination of the kicking leg, the distance of the pedestal feet with the ball, pedestal feet angle, hip tilt angle, shoulder tilt angle, ball momentum, touch force, impulse, power, effort, hip angle follow through, angular velocity follow through, slowdown follow through, kinetic energy of ball moving, ball height, potential energy of ball moving, and mechanical energy of ball moving.

Research subjects

In total, 12 healthy, male, outfield professional football players, with at least 4 years of experience. They are players who play for league 1 or league 2 of Indonesian football. Average age of 20.6±1.41 years, 69.09±6.98 kg, 173.4±6.1cm, 8.1±2.6 years of training experience, 5.6±1.3 number of training sessions per week. All of them are experienced football players with their right foot as their dominant foot. The participants were fully informed about the protocol before participating in this study. Informed consent was obtained prior to testing from all participants. This study was approved by the ethics committee of Sebelas Maret University of Surakarta.

Data collection

Before the test, all players warmed up for about 10 minutes including jogging and kicking practice and all participants were previously familiarized with the shooting test procedure before the test session (Li, et al., 2015). After installation, participants were instructed to do a shooting test. The subject stands 16 yards from the goal. Subjects were instructed to shoot a stationary ball into the goal at four circular targets with a diameter of one meter mounted on the goal posts using inside and instep kicks. Shot starts

bottom-left, bottom-right, top-left, and top-right. So that a total of 8 shots for each subject were used for analysis whether they succeeded or failed to enter the circular target (4 shots using inside kicks and 4 shots using instep kicks) (Khalifa, et al., 2021). Successful and failed shots are used to determine the percentage of accuracy of the inside and outside kick. Then from a successful shot, proceed to analysis of body kinematics. Full body kinematics recorded using a camera at a high speed of 1000 frames per second.

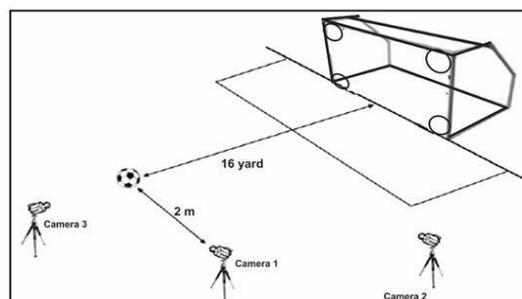


Figure 1. Camera Position for Recording

Camera 1 is mounted two meters on the right side of the ball and perpendicular to capturing the movement of the foot from side when shooting using inside and instep kicks. Camera 2 is installed in the middle aiming to capture the path of the ball to a circular target to determine the ball that goes to a circular target. Camera 3 is behind the participant to capture the body tilt position when shooting using inside and instep kicks (Figure 1).

Data analysis

Kinematics analysis was used Dartfish software. The kinematic analysis is divided into two phases, namely the swing phase and the impact phase with the ball producing the ball's trajectory. Kinematics analysis used Dartfish software only can determine angle, time, and distance, while to find out angular velocity, angular acceleration, ball velocity, momentum, touch force, impulse, power, work, and energy, researchers use following formula:

The angular velocity along the cycle step wave (rad/s) is shown to increase linearly with the highest speed (Clark, 2022), where is the angular velocity ω (rad/s), is the change in angle (rad), and is the change in time (s), so it can be determined by:

$$\omega = \Delta\theta.\Delta t^{-1} \tag{Equation 1}$$

During the kick, the thigh rotates in a sagittal plane in the swing phase. The model equations for

angular velocity ω (rad/s), time (s) and angular acceleration (rad/s²) is (Clark et al., 2021):

$$\alpha = \Delta\omega.\Delta t^{-1} \quad (\text{Equation 2})$$

The ball speed is calculated based on the equation with the distance traveled by the ball and the elevation angle of the ball (Chudinov, 2021), where L is the balls reach distance, θ is the balls elevation angle, v is the balls velocity, and gravity (9.8 m/s²), so it can be determined by:

$$L = (v^2 \sin 2\theta).g^{-1} \quad (\text{Equation 3a})$$

so to determine v with the formula:

$$v^2 = L.g.(\sin 2\theta)^{-1} \quad (\text{Equation 3b})$$

When an impact occurs between foot and ball, momentum (p) is generated from mass (m) and velocity (v) (Noé, 2006), formulated by:

$$p = m.v \quad (\text{Equation 4})$$

Then, the resulting force exerted by the body will be equal to the change in momentum (Δp) per unit time (Δt), where is the force (N), is the change in momentum (N.s), and Δt is the change in time (s), so it can be determined by (Grassmann et al., 2004):

$$F = \Delta p. \Delta t^{-1} \quad (\text{Equation 5})$$

The supporting limb displacement requires to produce an initial impulse (net effect of the force acting for a certain period of time (Noé, 2006), where I is the impulse (N.s) F is the force (N), and Δt is the change in time (s):

$$I = F. \Delta t \quad (\text{Equation 6})$$

When kicking a ball, power is also needed which is related to speed (v), P where is power (watts), F is force (N), and v is velocity (m/s), so it can be determined by (Toussaint & Beek, 1992):

$$P = F.v \quad (\text{Equation 7})$$

When analyzing the energy to kick the ball, it takes an effort (Joule) which is done with a force (F) at the distance the ball has traveled (d), so that it can be determined by (Toussaint & Beek, 1992):

$$W = F.d \quad (\text{Equation 8})$$

Then, the size of the kinetic energy of the ball is depends on the mass and speed of the ball, where EK is the kinetic energy (Joule), m is the mass of the ball (0.45 kg), and v is the velocity (m/s), so it can be determined by (Grassmann et al. al., 2004):

$$EK = \frac{1}{2} mv^2 \quad (\text{Equation 9})$$

In addition to kinetic energy, potential energy is also generated when there is a change in the vertical position or height of an object or ball. If want to change the vertical position of an object or ball to a height h, work must be done to overcome the weight force of W or the gravitational force of F_g . Where EP is potential energy (Joule), m is the mass of the ball (0.45 kg), g is gravity (9.8 m/s²), and h is the height of the ball (m). This equation applies to objects near the Earth surface, where gravity is assumed to be nearly constant. Thus, it is necessary to apply an external force $F = W$ (weight) and the equation (Alcocer, 2021) is obtained:

$$EP = m.g.h \quad (\text{Equation 10})$$

The rate of segmental energy change is defined as the rate of mechanical energy change of a segment. Mechanical energy (EM) refers to the sum of potential energy (EP) and kinetic energy (EK) (Chen, Chang, & Cheng, 2019), where EM is mechanical energy, EP is potential energy (Joule), and EK is kinetic energy (Joule), so it can be determined with:

$$EM = EP + EK \quad (\text{Equation 11})$$

The Kolmogorov-Smirnov test shows that the data is normally distributed, to compare the accuracy of shooting types on targets and to compare shooting biomechanics variables using inside and instep kicks, the researcher used *independent t-test*. The significance level is set at 0.05 (Devi & Sing, 2021). To show the magnitude of the difference, the effect size is calculated. The magnitude of the effect size is interpreted with the criteria $<0.02 = \text{trivial}$, $0.2-0.6 = \text{small}$, $>0.6-1.2 = \text{moderate}$, $>1.2-2.0 = \text{large}$, and $>2.0 \text{ very large}$ Differences (Sekulic et al., 2021). Independent t-test analysis was performed using SPSS 16.

RESULTS

Data Description

Table 1. Description of Shooting Accuracy Data Using Inside and Instep Kick

Shooting Type	N	Shooting Accuracy	Target Position				Total
			Bottom left	Bottom right	Top Left	Top right	
Inside Kick	48	Accurate	2	4	2	6	14
		No Accurate	10	8	10	6	34
Instep Kick	48	Accurate	2	1	0	1	4
		No Accurate	10	11	12	11	44

The description of the shooting accuracy data using inside and instep kicks is presented in table 1. Based on the table, it can be seen that in 48 shooting attempts, each type of shooting showed a higher shooting accuracy in number shooting using inside kick with a total accuracy of 14 balls enter the target, while in shooting using instep kick only 4 balls that enter the target. Of the 14 balls that entered the target when shooting using an inside kick, 2 balls entered the lower left target, 4 balls entered the lower right target, 2 balls entered the upper left target, and 6 balls entered the upper right target. Meanwhile, of the 4 balls that entered the target when shooting using an instep kick, 2 balls entered the lower left target, 1 ball entered the lower right target, and 1 ball entered the upper right target.

Percentage of accurate shooting using inside and instep kick served in the table 2. According to the table, it can be seen that the percentage of the ball enter the target of shooting using the inside kick is 14.583% and that did not enter the target is 35.417%, while the percentage of ball enter the target of shooting using Instep kick is 4.167% and those who did not enter the target is 45.833%. Based on table 2, most of the shooting that entered the target is shooting using inside kick where the percentage of accuracy on the lower left target is 4.167%, the lower right is 8.333%, the upper left is 4.167%, and the upper right is 12,500%. While shooting using instep kick, the percentage of target accuracy on the lower left is 4.167%, lower right is 2.083%, upper left is 0.000%, and upper right is 2.083%.

Table 2. Percentage of Shooting Accuracy Using Inside and Instep Kick

Shooting Type	Shooting Accuracy	Target Position				Total
		Bottom left	Bottom right	Top Left	Top right	
Inside Kick	Accurate	4.167%	8.333%	4.167%	12.500%	14.583%
	No Accurate	20.833%	16.667%	20.833%	12.500%	35.417%
Instep Kick	Accurate	4.167%	2.083%	0.000%	2.083%	4.167%
	No Accurate	20.833%	22.917%	25.000%	22.917%	45.833%

Independent t-test

Table 3. Testing differences in football shooting accuracy using inside and instep kick

Shooting type	Mean	t _{count}	sig (p)	Effect size
InsideKick	1.17	3.317	0.003*	1.35
Instep Kick	0.33			

*Significant difference in shooting biomechanics using inside and instep kick (p < 0.05)

The difference in the accuracy of shooting football using inside and instep kicks is presented in table 3. Based on the table, it wa shown that

there is a statistically significant difference in shooting football using inside and instep kicks (t_{count}= 3.317, p = 0.003)with the effect size

large(*cohen's d* =1.35), where the percentage of shooting accuracy on targets is higher for shooting using inside kicks than shooting using inside kicks. Furthermore, the biomechanical analysis to

determine the characteristics of each motion shooting is done, so it can be the difference biomechanics variables shooting using the inside and instep kick in producing precision.

Table 4. Test of biomechanics differences in football shooting using inside and instep kick

No	Biomechanics Variables	Inside Kick (mean)	Instep Kick (mean)	t _{count}	sig (p)
1	Knee flexion angle of the backswing kick (°)	85.35	102.17	3.213	0.024*
2	Knee extension angle of pedestal leg (°)	152.50	158.00	1.575	0.175
3	Frontswing hip angle (rad)	1.12	1.17	0.154	0.883
4	Frontswing kick knee extension angle (°)	146.46	137.67	2.883	0.034*
5	Frontswing angular speed (rad/s)	2.37	2.44	0.449	0.672
6	Frontswing angular acceleration (rad/s ²)	5.10	5.12	0.033	0.975
7	Velocity of ball after collision (m/s)	19.63	28.58	1.192	0.287
8	Kick foot tilt angle (°)	69.06	60.50	2.213	0.078
9	Distance from pedestal leg to ball (m)	0.27	0.22	3.427	0.019*
10	Pedestal leg tilt angle (°)	70.10	56.67	11.926	0.000*
11	Pelvic tilt angle (°)	11.04	11.50	0.167	0.874
12	Shoulder tilt angle (°)	23.38	12.83	2.662	0.045*
13	Momentum of the ball (Ns)	8.84	12.86	1.192	0.287
14	Touch force (N)	83.43	128.63	1.345	0.236
15	Impulse (Ns)	8.84	12.86	1.192	0.287
16	Power (Watts)	1707.93	4316.41	1.234	0.272
17	Effort (J)	181.53	431.64	1.180	0.291
18	Pelvic angle follow through (rad)	0.46	0.48	0.312	0.768
19	Angular follow through speed (rad/s)	0.79	0.89	0.556	0.602
20	Angular deceleration follow through (rad/s ²)	-1.41	-1.67	0.569	0.594
21	The kinetic energy of the moving ball (J)	90.77	215.82	1.180	0.291
22	Ball height (m)	1.35	1.05	0.413	0.697
23	Potential energy of the moving ball (J)	5.95	4.64	0.415	0.696
24	Mechanical energy of the moving ball (J)	96.72	220.46	1.189	0.288

*Significant difference in shooting biomechanics using inside and instep kick (p < 0.05)

The average comparison of shooting biomechanics variables using inside and instep kicks is presented in table 4. There is a statistically significant difference in biomechanics variables between shooting using inside and instep kicks for the knee flexion angle of the backswing kick (p = 0.024), the knee extension angle of the leg frontswing kick (p = 0.034), the distance of the pedestal leg with the ball (p = 0.019), Pedestal leg tilt angle (p = 0.000), and the Shoulder tilt angle (p = 0.045).

There was no statistically significant difference in biomechanical variables between shooting using inside and instep kicks for the extension angle of pedestal leg (p = 0.175), frontswing hip angle (p = 0.883), angular frontswing velocity (p = 0.672), angular frontswing acceleration (p = 0.975), ball speed (p = 0.287), kick foot tilt angle (p = 0.078),

Based on the results of the independent t-test, it was shown that there is a statistically

hip tilt angle (p = 0.874), ball momentum (p = 0.287), touch force (p = 0.236), impulse (p = 0.287), power (p = 0.272), effort (p = 0.291), hip angle follow through (p = 0.768), angular speed follow through (p = 0.602), angular deceleration follow through (p = 0.594), the kinetic energy of moving ball (p = 0.291), the ball height (p = 0.697), the potential energy of moving ball (p = 0.696), and the mechanical energy of moving ball (p = 0.288).

DISCUSSION

Shooting is the most common way to score. All parts of the legs can be used for shooting based on the situation and conditions of the game. Although all parts of the foot can be used in shooting, ball accuracy is an important variable related to football shooting (Martinez et al., 2020). significant difference in the accuracy of the ball between shooting using inside and instep kicks

with a p-value of 0.003 ($p < 0.05$), which in this research shown that the accuracy of shooting using inside kicks is more precise than shooting using instep kick with the accuracy percentage of shooting using inside kick is 14.583%, while accuracy of shooting using instep kick is 4.167%. In line with these results, Ródenas et al (2020) stated that inside kick generate better accuracy. The study of Bujanj et al (2010) reported that there was a certain range of values where inside kick accuracy was achieved, while the speed of the ball after being kicked found no difference. The instep kick reported no significant difference in kick accuracy at both target positions and at the approach angle, however there was a difference in ball speed (Majelan et al., 2011). This shown that the instep kick is a powerful kicking technique.

When comparing body kinematics when shooting using inside and instep kicks, it shows that there are statistically significant differences in the angle of knee flexion of the backswing kick, the angle of knee extension of frontswing kick, the distance between the pedestal leg and the ball, the pedestal leg tilt angle, and the shoulder angle. Kellis & Katis (2007) reported that the football kick is characterized by a movement proximal to the distal segment of the lower leg of the kicking leg. Arguz et al (2021) shown a relationship between penalty kick variables during the performance phase and accuracy where the knee angle during the swing (backswing and frontswing) is an important factor. In this study, the players shown shooting using the inside kick, the backswing knee angle is smaller than shooting using instep kick and the frontswing knee angle is larger than shooting using an instep kick, namely the backswing knee angle of 85.35° and the frontswing knee angle of 146.46° on shooting using an inside kick, and a backswing knee angle of 102.17° and a frontswing knee angle of 137.67° when shooting using an instep kick. Majelan et al (2011) reported that players kick with more knee extension and hip flexion efficacy. Matteo et al (2015) also report hip extension, abduction and rotation into the kicking leg. After ball contact, the move ends in the airborne phase.

Kellis & Katis (2007) explained that an accurate kick is achieved through a slower kicking motion and a lower ball speed value. Although there is no difference in terms of foot speed and ball speed between the two types of kicks in this study. But according to the type of accurate kick,

the inside kick displays lower frontswing angular acceleration and speed and lower ball speed than the instep kick. According to Kellis & Katis (2007), angular velocity is maximized first by the thigh, then the calf and finally the foot. During the backswing, the thighs slow down because the movement depends on the activation of the hip muscles. Forward acceleration is achieved through knee extension. The final velocity, path and spin of the ball largely depends on the quality of the foot-ball contact.

In relation to foot speed, according to Less (2003), the forward rotation stage and the moment of impact with the ball are the most important from a performance standpoint. A high angular velocity of the shank means a high foot velocity. It appears that to achieve a high foot velocity, energy must be built up in the early stages of the movement. Thigh energy is built in the swing phase. Therefore the range of movement in which the hips and legs move, and the muscle strength applied during this stage will determine the maximum speed of the foot at impact. Related to the energy that must be built during the initial stages of movement, effort is the energy that is channeled to successfully move the foot to kick the ball with a certain style. This means that it takes a lot of effort to generate a lot of energy and eventually achieve a high foot velocity.

The results of our study also report that, although the results of the study reported no statistically significant difference related to effort, the instep kick was carried out with an effort of 431.64 Joules greater than the inside kick which was 181.53 Joules. From this big effort, the instep kick produces a greater force, namely 128.63 N than the inside kick, which is equal to 83.43 N, to kick the ball so that the ball that is kicked produces a faster ball. Because of this, why is the instep kick said to be a powerful kick because it is done with high effort and style and results in high ball speed. Unlike the case with the dominant inside kick on accurate kicks.

Then related to kick accuracy, Arguz et al (2021) relate it with increasing the body tilt angle to increase the level of accuracy in penalty kicks on the side of the target, this is because the accuracy of the kick can be affected by the position of the body joints during performance. In this study, the players shown shooting using the inside kick is done with the shoulder tilt angle greater than shooting using instep kick which is

23.38⁰ of the shoulder tilt in shooting using inside kick and 12.83⁰ the shoulder tilt in shooting using instep kick. Regarding the research results, to produce an accurate kick, the placement of the pedestal leg is very important for kick performance, because the pedestal leg helps stabilize the body when swinging the kicking leg (Katis et al., 2013). In this study, the players shown shooting using the inside kick, the placement of the pedestal leg with the ball is slightly farther away than shooting using an instep kick, which is 0.27 meters for shooting using an inside kick and 0.22 meters for shooting using an instep kick. The angle of the pedestal leg for shooting using inside kick is greater than for shooting using instep kick, which is 70.10⁰ for the pedestal leg tilt for shooting using inside kick and 56.67⁰ for the pedestal leg tilt for shooting using instep kick.

Conclusion

This study concludes that accurate shooting movements are achieved using inside kicks and depend on the size of a certain angle. Based on accurate shooting kinematics studies, it was carried out with a backswing knee angle of 85.35⁰, a frontswing knee extension angle of 146.46⁰, the distance of the pedestal foot from the ball is 0.27 m, the inclination angle of the pedestal leg is 70.10⁰, and the shoulder tilt angle is 23.38⁰. The magnitude of the rotation angle, namely the backswing and frontswing knee angles, is important in kick performance. This is because it will affect the range of movement in the hips and legs moving and determines the maximum speed of the foot when impacted by the ball. Accurate kicks are generally slower, performed with a smaller backswing knee angle and a greater frontswing knee angle during rotation. Through the magnitude of the angle during this rotation, it then generates the amount of effort to channel energy to succeed in moving the foot to kick the ball with a certain style, which then determines the magnitude of the foot speed and momentum with the ball, and determines the speed of the ball after being kicked.

Conflict of interest

The author states that there is no conflict of interest. No financial support received.

Ethics Statement

Approval from the Scientific Research Ethics Committee of Sebelas Maret University Surakarta was obtained for this research (protocol number 254/UN27.22/PT.01.03/2022)

Author Contributions

The study design was carried out by RID; Data collection is done by RID; Statistical analysis was performed by RID; Data interpretation was performed by HN; The preparation of the manuscript was carried out by HN; Literature search was conducted by IS. All authors have read and approved the published version of the manuscript.

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RESEARCH ARTICLE

Intolerance of Uncertainty Levels in Families of Children with Special Needs During Covid-19 Process

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Abstract

The objective of this study was to investigate the levels of intolerance of uncertainty among families of children with special needs during the Covid-19 pandemic, with respect to various factors. The study utilized a relational survey model and included 250 families of children with special needs who participated in the research during the Fall academic year of 2020-2021. Due to the Covid-19 pandemic's unavoidable circumstances, data were collected electronically via Google Forms. To gather the data, a "Demographic Information Form" and an "Intolerance of Uncertainty Scale" were administered. The obtained data were analyzed using the SPSS 26.0 software. The results indicated that families of children with special needs had a higher level of intolerance of uncertainty, as indicated by the scale's overall scores and the prospective anxiety sub-dimension ($p > 0.05$). The study further revealed that the families' income level and whether one of their relatives had Covid-19 significantly impacted their intolerance of uncertainty levels ($p > 0.05$). However, there were no significant differences based on the families' age, gender, marital status, Covid-19 status, loss of a loved one due to Covid-19, chronic illness, or job loss during the pandemic ($p > 0.05$). Based on studies examining the intolerance of families of children with special needs to uncertainty, efforts can be made to provide psychological support to families of children with special needs. Seminars can be organized for families of children with special needs by institution managers or special education teachers.

Keywords

COVID-19, Families, Intolerance of Uncertainty, Children with Special Needs

INTRODUCTION

In December 2019, Covid-19 emerged in the city of Wuhan in China, quickly affecting the entire world and causing a global pandemic (Zheng et al., 2020; Wang et al., 2020; Altuntaş et al., 2022). Covid-19 is a highly contagious disease with symptoms such as fever, cough and difficulty breathing. The disease was first seen in Turkey on March 11th, 2020 (Ministry of Health of Turkey, 2020). After cases began to appear in different

countries, measures were taken to slow the spread of the disease, such as travel restrictions, remote work for some employees, partial or full lockdowns and schools switching to online education (Alper, 2020; Memikoglu, 2020).

The expectations of parents can change with the addition of each child to the family. Such changes in expectations can have positive or negative effects on communication and interaction within the family. Families who learn that they have a child who requires special education may

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have to delay or cancel many things they wanted to do and reevaluate their life goals. Preexisting communication and interaction deficiencies within the family may worsen with the diagnosis of the child (Ozsenol et al., 2003).

In the literature, it is widely accepted that families of children with special needs go through a stage model with its components in accepting this situation. There are many processes that families experience in this stage model. These processes are shock, disbelief and denial, anger and resentment, bargaining, depression and sadness and acceptance stages (Cavkaytar, 2010).

The inclusion of a child with special needs into a family can cause changes in the experiences of family members, create traumas and negatively affect the current structure of the family (Iscan and Malkoc, 2017). Studies on families of children with special needs show that these families experience more stress and anxiety than families with typically developing children (Metin, 2012). The reasons for families of children with special needs to experience more stress and anxiety than families with typically developing children are difficulties and problems in the child's care, education, health status, treatment and growing (Sivrikaya and Tekinarlan, 2013).

It is known that changes in the course of the Covid-19 pandemic, the emergence of new variants and similar situations can have negative effects on individuals' psychological conditions. It is considered that these situations can lead to uncertainty, concern, anxiety and stress. The concept of uncertainty is the situation where the future situations and events are unclear. Uncertainty can have negative consequences on human psychology (Saricam, Erguvan, Akın and Akca, 2014).

The intolerance of uncertainty is the negative reactions that individuals give to events and situations encountered in the flow of their lives (Bhur and Dugas, 2002). It is thought that the Covid-19 outbreak and the emotions associated with the perceived risk have further intensified anxiety (Tull et al., 2020). It is known that Covid-19 poses a risk for individuals with chronic illnesses and those aged 65 and above, who are defined as the high-risk group. In the initial period when the outbreak disease emerged, the fact that people did not know about this disease and the strict measures taken in countries where the

disease was seen caused negative situations to occur in human psychology (Karakas, 2020).

Families of children with special needs are believed to experience higher levels of anxiety and stress compared to families with typically developing children, and their current negative psychological states may be influenced by the levels of stress, anxiety, and intolerance of uncertainty caused by the psychological impacts of the Covid-19 outbreak. Therefore, the primary objective of this study was to investigate the levels of intolerance of uncertainty in families of children with special needs during the Covid-19 pandemic based on various factors. To achieve this overarching aim, the study aimed to address the following questions.

1. What are the intolerance of uncertainty levels of families of children with special needs during the Covid-19 outbreak?
2. Is there a significant difference in the intolerance of uncertainty levels of families of children with special needs during the Covid-19 outbreak based on age, gender, marital status, income level, status of having or not having Covid-19 disease, status of their close ones having or not having Covid-19 disease, having lost a close one because of Covid-19, having a chronic illness and experiencing job loss during Covid-19?

MATERIALS AND METHODS

Research Model

In this study, the relational survey model, which is one of the quantitative research methods, was used to examine the level of intolerance of uncertainty among families of children with special needs during the Covid-19 process. Quantitative research focuses on examining the relationships between mathematically measured variables and is concerned with quantities. It examines the direction of views on the researched subject in the universe. In quantitative research, it is necessary to select the sample to represent the universe and to ask the participants in the sample the correct questions (Saunders, Lewis and Thornhill, 2016). Relational survey is a research model used to determine the presence and/or degree of linked changes in two or more variables (Oral and Coban, 2020). In studies using the correlational survey model, the description of a situation or event as it is, determining the relationships, effects and degrees of the variables

that cause this situation or event is the goal (Kaya, Balay and Gocen, 2012).

Study Group

The study group consisted of 250 parents of children with special needs who volunteered to participate in this study. Study group of the study was determined using simple random sampling technique. In simple random sampling, all units have an equal chance of selection. In practice, units are listed and random selections are made from among them. When the population is not very large and complex, the selection process can be facilitated and, in this method, evaluation and

sampling errors can be easily calculated without statistical weighting (Dawson and Trapp, 2001; Kılıc, 2013). Within this scope, data collection tools of the research were applied to 250 parents who volunteered to participate using random sampling technique. Written informed agreement was acquired from the families for this study in following with the guidelines set out in the Declaration of Helsinki. The demographic characteristics of the families of children with special needs in the study group are given in detail in Table 1.

Table 1. Demographic characteristics of the families of children with special needs

Variable		Number (n)	Percentage (%)
Age	20-29 age	67	26,8
	30-39 age	111	44,4
	40 age and above	72	28,8
Gender	Female	165	66
	Male	85	34
Marital status	Single	68	27,2
	Married	182	72,8
Income level	Low	66	26,4
	Middle	107	42,8
	High	77	30,8
Status of having or not having Covid-19 disease	Yes	163	65,2
	No	87	34,8
Status of their close ones having or not having Covid-19 disease	Yes	158	63,2
	No	92	36,8
Having lost a close one because of COVID-19	Yes	96	38,4
	No	154	61,6
Having a chronic illness	Yes	77	30,8
	No	173	69,2
Experiencing job loss during Covid-19	Yes	77	30,8
	No	173	69,2

Table 1 shows the demographic characteristics of the participants included in the study.

Data Collection Tools

For data collection in this study, researchers used the “Demographic Information Form” which was prepared with expert opinions to gather information about families of children with special needs. The form included questions on age, gender, marital status, income level, Covid-19 status, whether their close ones had Covid-19, having lost a close one due to Covid-19, having a chronic illness, and experiencing job loss during the pandemic.

In addition, the “Intolerance of Uncertainty Scale” (IUS) was used, which was developed as a

short form by Carleton, Norton, and Asmundson (2007) and adapted into Turkish by Sarıcam, Erguvan, Akin, and Akca (2014) after undergoing validity and reliability analyses. The IUS-12 consists of 12 items and two subscales: the “prospective anxiety” dimension (the first seven questions) and the “inhibitory anxiety” dimension (the remaining five questions). The total score on the scale ranges from 12 to 60, with higher scores indicating a higher level of intolerance of uncertainty and lower scores indicating a lower level. The score obtained is linearly related to the level of intolerance of uncertainty. The Cronbach’s

alpha coefficient for the scale was found to be $\alpha = 0.84$, and for the inhibitory anxiety subscale, it was calculated as 0.77.

Data Collection and Analysis

Ethical permission was obtained from the Cyprus International University Scientific Research Ethics Committee before the data were collected for this study. The study collected data from 250 families of children with special needs between February 1, 2022 and April 15, 2022, using Google Forms sent via electronic mail and messaging applications. The collected data were analyzed using Statistical Package for Social Sciences (SPSS) 26.0 software. Before starting the data analysis, the Cronbach Alpha test was applied to assess the reliability of the participants' responses to the Intolerance of Uncertainty Scale, and the alpha value was found to be 0.966. Descriptive statistics were used to determine the distribution of participants according to their demographic characteristics, and the Intolerance of

Uncertainty Scale scores were analyzed for normality using the Kolmogorov-Smirnov test and Skewness-Kurtosis values. The analysis showed that the data set had a normal distribution.

RESULTS

The Intolerance of Uncertainty Scale scores of families of children with special needs are presented in Table 3.

According to the findings presented in Table 2, the families of children with special needs obtained an average score of 25.05 ± 6.96 on the prospective anxiety subscale of the Intolerance of Uncertainty Scale, ranging from a minimum of 7 to a maximum of 35. For the inhibitory anxiety subscale, the average score was 17.38 ± 5.54 , with a minimum of 5 and a maximum of 25. Finally, the families had an average score of 42.42 ± 12.17 on the overall Intolerance of Uncertainty Scale, with a range of 12 to 60.

Table 2. The Intolerance of uncertainty scale scores of families of children with special needs

	n	\bar{x}	SS	Min	Max
Prospective anxiety	250	25,05	6,96	7	35
Inhibitory anxiety	250	17,38	5,54	5	25
Intolerance of Uncertainty Scale	250	42,42	12,17	12	60

Table 3. Comparison of intolerance of uncertainty scale scores by age variable for families of children with special needs

	Age	n	\bar{x}	SS	Min	Max	F	p
Prospective anxiety	20-29 age	67	26,13	8,13	7	35	1,209	0,30
	30-39 age	111	24,83	6,50	10	35		
	40 age and above	72	24,38	6,44	9	35		
Inhibitory anxiety	20-29 age	67	18,58	6,22	5	25	2,211	0,11
	30-39 age	111	16,87	5,37	5	25		
	40 age and above	72	17,03	5,00	5	25		
Intolerance of Uncertainty Scale	20-29 age	67	44,72	14,18	12	60	1,647	0,19
	30-39 age	111	41,70	11,43	17	60		
	40 age and above	72	41,40	11,08	17	60		

* $p < 0,05$

The results in Table 3 indicate that no statistically significant difference was found ($p > 0.05$) in the overall scores of the Intolerance of Uncertainty Scale and its sub-dimensions based on the age variable among families of children with

special needs. The families had similar scores in terms of prospective anxiety, inhibitory anxiety, and the overall scores on the Intolerance of Uncertainty Scale, regardless of their age groups.

Table 4. Comparison of intolerance of uncertainty scale scores by gender variable for families of children with special needs

	Gender	n	\bar{x}	SS	t	p
Prospective anxiety	Female	165	24,81	7,24	-0,746	0,457
	Male	85	25,51	6,40		
Inhibitory anxiety	Female	165	17,15	5,67	-0,917	0,360
	Male	85	17,82	5,26		
Intolerance of Uncertainty Scale	Female	165	41,96	12,60	-0,844	0,399

Upon analysis of Table 4, it was observed that there was no statistically significant difference ($p>0.05$) in the scores obtained by families of children with special needs from the sub-dimensions of prospective anxiety and inhibitory

anxiety as well as the overall score on the Intolerance of Uncertainty Scale, based on the gender variable. The results indicated that female and male participants had similar scores in terms of prospective anxiety, inhibitory anxiety and overall scores on the Intolerance of Uncertainty Scale.

Table 5. Comparison of intolerance of uncertainty scale scores by marital status variable for families of children with special needs

	Marital Status	n	\bar{x}	SS	t	p
Prospective anxiety	Single	68	25,54	5,44	0,688	0,492
	Married	182	24,86	7,46		
Inhibitory anxiety	Single	68	17,34	4,69	-0,066	0,948
	Married	182	17,39	5,83		
Intolerance of Uncertainty Scale	Single	68	42,88	9,69	0,363	0,717
	Married	182	42,25	12,99		

Upon analysis of Table 5, it can be seen that there is no statistically significant difference ($p>0.05$) in the overall scores of the Intolerance of Uncertainty Scale and its sub-dimensions based on the marital status variable of the families of children with special needs.

Although single participants had higher prospective anxiety scores and overall scores on the Intolerance of Uncertainty Scale than married participants, and married participants had higher inhibitory anxiety scores than single participants, the differences were not statistically significant.

Table 6. Comparison of intolerance of uncertainty scale scores by income level variable for families of children with special needs

	Income level	n	\bar{x}	SS	F	p	Diff.
Prospective anxiety	Low	66	22,83	8,58	4,748	0,009*	1-2
	Middle	107	26,01	6,23			1-3
	High	77	25,61	5,99			
Inhibitory anxiety	Low	66	16,30	6,36	1,794	0,168	
	Middle	107	17,61	5,59			
	High	77	17,97	4,55			
Intolerance of Uncertainty Scale	Low	66	39,14	14,83	3,336	0,037*	1-2
	Middle	107	43,62	11,36			1-3
	High	77	43,58	10,20			

* $p<0,0$

The results showed that there was a statistically significant difference ($p < 0.05$) between the overall scores of the Intolerance of Uncertainty Scale and the average scores of the prospective anxiety subscale obtained by families of children with special needs within the scope of the research, according to the variable of income

level. The scores of the participants with low income were calculated to be significantly higher than the prospective anxiety scores and Intolerance of Uncertainty Scale general scores of the participants with moderate- and high-income status.

Table 7. Comparison of intolerance of uncertainty scale scores by status of having or not having covid-19 disease variable for families of children with special needs

	Status of having or not having Covid-19 disease	n	\bar{x}	SS	t	p
Prospective anxiety	Yes	163	24,83	6,99	-0,682	0,496
	No	87	25,46	6,93		
Inhibitory anxiety	Yes	163	17,28	5,47	-0,366	0,715
	No	87	17,55	5,68		
Intolerance of Uncertainty Scale	Yes	163	42,11	12,16	-0,557	0,578
	No	87	43,01	12,24		

Upon analysis of Table 7, it can be concluded that there is no significant difference ($p > 0.05$) in the overall scores of the Intolerance of Uncertainty Scale and the scores obtained from its sub-dimensions, i.e., prospective anxiety and inhibitory anxiety, based on the variable of having or not having Covid-19 disease among parents of

children with special needs. The scores of participants who had Covid-19 disease and those who did not have Covid-19 disease were found to be similar in terms of prospective anxiety, inhibitory anxiety, and overall scores of the Intolerance of Uncertainty Scale. Therefore, having Covid-19 disease did not have a significant impact on the scores of the participants.

Table 8. Comparison of intolerance of uncertainty scale scores by status of their close ones having or not having covid-19 disease variable for families of children with special needs

	Status of their close ones having or not having Covid-19 disease	n	\bar{x}	SS	t	p
Prospective anxiety	Yes	158	24,44	6,75	-1,828	0,069
	No	92	26,10	7,24		
Inhibitory anxiety	Yes	158	16,67	5,54	-2,672	0,08*
	No	92	18,59	5,33		
Intolerance of Uncertainty Scale	Yes	158	41,11	11,84	-2,260	0,025*
	No	92	44,68	12,44		

* $p < 0,05$

When Table 8 is examined, it is determined that there is a statistically significant difference ($p < 0.05$) between the Intolerance of Uncertainty Scale general scores and the inhibitory anxiety subscale scores according to the variable of status of their close ones having or not having Covid-19 disease. The inhibitory anxiety and Intolerance of Uncertainty Scale general scores of participants whose family members did not have Covid-19 were found to be statistically significantly lower than those whose family members had Covid-19.

Table 9 shows that there is no statistically significant difference ($p > 0.05$) between the scores of the families in terms of prospective anxiety and inhibitory anxiety sub-dimensions as well as their general scores on the Intolerance to Uncertainty Scale based on the variable of having lost a close one because of Covid-19. The scores on the Intolerance to Uncertainty Scale and the prospective anxiety and inhibitory anxiety sub-dimensions are found to be similar for participants who have lost a close one during the Covid-19 pandemic and those who have not.

Table 9. Comparison of intolerance of uncertainty scale scores by having lost a close one because of covid-19 variable for families of children with special needs

		Having lost a close onebecause of Covid-19	n	\bar{x}	SS	t	p
Prospective anxiety	Yes		96	24,60	7,51	-0,795	0,427
	No		154	25,32	6,61		
Inhibitory anxiety	Yes		96	17,69	5,50	0,702	0,483
	No		154	17,18	5,56		
Intolerance of Uncertainty Scale	Yes		96	42,29	12,87	-0,136	0,892

Table 10. Comparison of intolerance of uncertainty scale scores by having a chronic illnessvariable for families of children with special needs

		Having a chronic illness	n	\bar{x}	SS	t	p
Prospective anxiety	Yes		77	23,87	7,91	-1,792	0,074
	No		173	25,57	6,46		
Inhibitory anxiety	Yes		77	17,00	5,97	-0,716	0,475
	No		173	17,54	5,34		
Intolerance of Uncertainty Scale	Yes		77	40,87	13,68	-1,349	0,178
	No		173	43,12	11,40		

* $p < 0,05$

When Table 10 is examined, it is determined that there is no statistically significant difference between the scores of prospective anxiety, inhibitory anxiety subscales and general scores of Intolerance of Uncertainty Scale according to the variable of having a chronic illness ($p > 0.05$). Generally, the scores of participants with a chronic

illness on the general score of intolerance of uncertainty and the subscales of prospective anxiety and inhibitory anxiety were higher than those of participants without a chronic illness but this score difference was not statistically significant.

Table 11. Comparison of intolerance of uncertainty scale scores by experiencing job loss during covid-19 variable for families of children with special needs

		Experiencing Job Loss during Covid-19	n	\bar{x}	SS	t	p
Prospective anxiety	Yes		77	24,87	8,14	-0,269	0,788
	No		173	25,13	6,40		
Inhibitory anxiety	Yes		77	17,62	6,53	0,471	0,638
	No		173	17,27	5,05		
Intolerance of Uncertainty Scale	Yes		77	42,49	14,42	0,060	0,952
	No		173	42,39	11,06		

When Table 11 is examined, it is seen that there is no statistically significant difference ($p > 0.05$) between the overall scores and subscales of the Intolerance of Uncertainty Scale according to the variable of experiencing job loss during the Covid-19 process for families of children with

special needs. The prospective anxiety and inhibitory anxiety scores and the overall scores of the Intolerance of Uncertainty Scale were found to be similar for the participants who experienced job loss during the Covid-19 process and those who did not.

DISCUSSION

The present study aimed to investigate the level of intolerance to uncertainty among families of children with special needs during the Covid-19 pandemic. It is well-known that uncertain situations can lead to negative reactions and anxiety, especially during the pandemic (Kasapoglu, 2020). The study first examined the relationship between the level of intolerance to uncertainty and age, and no significant differences were found among different age groups of families. This is consistent with previous studies on university students which also found no significant relationship between age and intolerance to uncertainty (Kilit et al., 2020; Cetin, 2021). However, Akandere et al. (2009) reported that the age variable had an effect on the life satisfaction and hopelessness levels of families of children with intellectual and physical disability. It is possible that the intense anxiety and stress experienced by families of children with special needs due to their child's condition may explain why age did not significantly affect their level of intolerance to uncertainty in the present study.

The impact of gender on the level of intolerance to uncertainty among parents of children with special needs during the Covid-19 process was examined. The results showed no significant difference between the scores of the sub-dimensions of prospective anxiety and inhibitory anxiety and the general score of Intolerance of Uncertainty Scale based on the gender of parents. The scores were similar for both female and male participants. Similar findings were reported in studies conducted on university students by Tantan, Ulu and Yaka (2019) where the level of continuous anxiety, decision-making behavior and intolerance of uncertainty were not affected by gender. However, Kilit, Donmezler, Erensoy and Berkol (2020) found that the level of intolerance of uncertainty among university students varied significantly according to gender, with female students showing higher levels of intolerance to uncertainty than male students. In another study by Nuri, Direktor and Akcamete (2019) examining the quality of life and stress levels of parents of children with attention deficit hyperactivity disorder, female participants were found to have higher emotional well-being scores than male participants. Similarly, Derli and Okur (2008) found that regardless of gender, the

depression levels of parents with a child with special needs were high, and the source of stress and depression was being a parent of a child with special needs. Families of children with special needs, particularly mothers, experience psychological and economic problems due to their inability to meet their children's needs, and they need social services and support to address these challenges, as reported by Isikhan (2005).

It was found that there is no statistically significant difference between the general scores of the Intolerance of Uncertainty Scale and the scores obtained from the sub-dimensions of the scale according to the marital status variable of families of children with special needs. The inhibitory anxiety scores of families who are married were higher than those of single participants, while the prospective anxiety scores and general scores of Intolerance of Uncertainty Scale of single families were higher than those of married participants. However, it was found that these score differences identified due to the marital status of families were not statistically significant. Yıldız (2021) concluded that there was no significant difference related to the marital status variable in the levels of intolerance of uncertainty of teachers working in primary education level in private and public schools. In addition, Guduk, Guduk and Vural (2021) found no significant difference between the marital status variable of their participants and their levels of intolerance of uncertainty. In general, when the literature on marriage life and families of children with special needs is examined, it is seen that there is not much conceptual debate and psychological, social, economic and cultural problems are experienced in families of children with special needs and mothers are affected by these problems due to gender inequality. Therefore, it is thought that the disruption of marriage relationship, unequal distribution of responsibility between spouses and one of the spouses having more responsibility causing problems and leading to the breakdown of marriage (Danıs, 2006; Sarıhan, 2007).

It was observed that there is a statistically significant difference between the general scores of the Intolerance of Uncertainty Scale and the sub-dimension of prospective anxiety obtained by families according to their income level. The prospective anxiety scores of families of children with special needs who have a low income are significantly higher than the general scores of

Intolerance of Uncertainty Scale, compared to families of children with special needs with middle and high income level. Families of children with special needs have a need for financial resources for the care, needs, education and treatment of their children. Families with low financial status may experience problems in meeting the educational, care and treatment needs of their children which may lead to stress and anxiety. The reason for the higher intolerance for Intolerance of Uncertainty Scale scores of families with low financial status compared to those with middle and high income can be explained in this way. In contrast to these results, Kilit, Donmezler, Erensoy and Berkol (2020) concluded that the income levels of university students did not affect their levels of intolerance for uncertainty. In Konuk's (2021) study, a similar result was obtained showing that the cognitive flexibility, intolerance of uncertainty and psychological well-being scores of the participants differed according to their income levels. It is known that social services are also provided to families with special needs children in addition to educational services. The Ministry of National Education provides special education and inclusive education for individuals with special needs, as well as guidance and counseling services for their families. In addition, the Ministry of Family, Labor and Social Services provide home care support and institutional care services (Ministry of Family and Social Policies, 2017). The Social Security Institution provides some medical devices and orthopedic assistive devices in cooperation with non-governmental organizations (Social Security Institution, 2017).

There is no statistically significant difference between the scores of the sub-dimensions of prospective anxiety and inhibitory anxiety that parents of children with special needs receive based on their experience with Covid-19 and their scores on the Intolerance of Uncertainty Scale. The scores of parents of children with special needs who have experienced Covid-19 and those who have not were found to be similar in terms of prospective anxiety, inhibitory anxiety and general scores on intolerance of uncertainty. Based on these results, it can be interpreted that the situations experienced by families of children with special needs during the Covid-19 pandemic, the uncertainty of the course of the disease, lack of knowledge about the disease at the beginning of the outbreak, social restrictions that people are not

used to and uncertainty that affects each individual in different dimensions have affected all individuals. In the study conducted by Kasapoglu (2020) on individuals' anxiety levels, psychological resilience and intolerance of uncertainty during the Covid-19 pandemic, it was concluded that the restrictions and social isolation during the Covid-19 pandemic increased individuals' anxiety and intolerance of uncertainty levels. Having a child with special needs affects the entire life of the family. The inclusion of a person with special needs in the family means the end of the expectation of having a typically developing child. This situation is said to cause serious stress on parents of children with special needs (Raina et al., 2005; Kaya, 2010; Ozulkuand Baglama, 2022). Individuals with special needs and their families may face problems in many areas such as health, social, physical and economic. During the Covid-19 pandemic, problems may arise in accessing services provided to individuals with special needs. Due to the differences of individuals with special needs, their probability of complying with rules such as wearing masks, social distancing and other rules is lower than that of typically developing individuals. The Covid-19 pandemic causes more strain on individuals with special needs and their families in our society and exacerbates the negative conditions that already exist in this pandemic (Basaran et al., 2020). This situation can cause stress, anxiety, and other similar conditions in both individuals with special needs and their families. It was determined that there is a statistically significant difference between the general scores of the Intolerance of Uncertainty Scale and the inhibitory anxiety scores of the scale based on whether a close one had Covid-19. The inhibitory anxiety scores and the general scores of the Intolerance of Uncertainty Scale for families of children with special needs, where a close one did not have Covid-19, were found to be significantly lower than those of families where a close one had Covid-19. The fact that a close one of families of children with special needs not having had Covid-19 results in a higher intolerance of uncertainty score can be explained by the uncertainty about the consequences of the disease when it occurs in close proximity and fear of infecting individuals with chronic conditions in the family. The reason why the intolerance of uncertainty scores of families with children with special needs, where a close one had Covid-19, are

higher than those of families where a close one did not have Covid-19 is thought to be because witnessing and knowing the disease process and seeing a close relative having the disease alleviates the families' anxiety and uncertainty.

There was no statistically significant difference between the scores of families of children with special needs, based on their prospective anxiety and inhibitory anxiety sub-dimensions, and their Intolerance of Uncertainty Scale general scores, based on whether or not they had lost a close one due to the Covid-19 pandemic. The uncertainty intolerance levels of individuals with high anxiety are more affected by sudden losses. Studies have shown that intolerance to uncertainty is effective in the occurrence of emotional problems after traumatic events (Fetzner, Horswill, Boelen, Carleton, 2013; Çuhacı and Nuri, 2022). Living with individuals with special needs brings certain limitations to family members' lives and causes an adaptation process. The birth of a child with special needs affects the emotions, thoughts and behaviors of both the family and the individual with special needs. When the literature is examined, it is stated that families of children with special needs experience shock, denial, grief and depression processes (Kaya, 2010; Ozulku and Baglama, 2022). In their research, Ergun and Ertem (2012) found that the most common situations experienced by mothers of children with special needs were chronic sadness, anger and loneliness. It is thought that families of children with special needs face stressful situations such as economic difficulties, tension within the family, changes in the family's social life, the failure of spouses to meet the care burden of the special needs child, disappointment during the process of meeting with experts, mourning and depression.

It was determined that there is no statistically significant difference between the scores of families who have a chronic illness in terms of their prospective anxiety, inhibitory anxiety scores and Intolerance of Uncertainty Scale general scores. Generally, the intolerance of uncertainty scale general scores of participants with chronic illnesses and the prospective anxiety and inhibitory anxiety scores are higher than those of families without chronic illness. However, this score difference calculated is not statistically significant. Having a child with special needs causes many difficulties such as financial problems,

psychological problems, problems with family and social environment, education of the special needs child and monitoring of their health conditions (Ozsenol et al., 2003; Çuhacı and Nuri, (2022). During the Covid-19 pandemic, the difficulties that families with special needs children may experience have increased and they have had to cope with problems and challenges arising from the pandemic. Health problems of individuals with special needs and their families and their necessary treatment processes cannot be done at appropriate times due to the Covid-19 pandemic, causing them to experience more health problems (Kurt and Erden, 2020). The protective care needs of individuals with special needs have increased during the Covid-19 pandemic and there is a need for social service support in terms of providing protective care and supporting the care burden (Balci and Kocatakan, 2021).

It was observed that there is no statistically significant difference between the overall scores and sub-dimensions of Intolerance of Uncertainty Scale of families of children with special needs children who experience job loss during the Covid-19 process and those who do not. The prospective anxiety and inhibitory anxiety scores and the overall Intolerance of Uncertainty Scale scores of families of children with special needs children who experience job loss during the Covid-19 process and those who do not were found to be similar. It is known that families of children with special needs children incur high expenses for their education and healthcare needs, transportation costs for their education, special diet programs in case of health problems of special needs children and procurement of devices and equipment they need due to their special needs which can put families in financial difficulties. It is thought that the effect of stress intensity of families with special needs children on family functionality varies according to their economic income status. In families of children with special needs children, mothers and fathers can be affected at different levels. Often, mothers try to quit their jobs and fulfill their responsibilities towards their special needs children. It is considered that providing financial support to families for their children with special needs reduces their financial difficulties. Providing free education, healthcare, transportation and necessary equipment for children with special needs is believed to positively affect the stress and anxiety levels of families.

As a result of the present study, significant differences were found in the intolerance of uncertainty levels of families of children with special needs children depending on their income status and the variable of one of close ones having Covid-19. However, no significant differences were found in the intolerance of uncertainty levels of families based on their age, gender, marital status, Covid-19 infection, losing a close one in Covid-19 pandemic, having a chronic illness and experiencing job loss during the Covid-19 process. Based on these results, the following recommendations can be made for further research and practices:

Based on studies examining the intolerance of families of children with special needs to uncertainty, efforts can be made to provide psychological support to families of children with special needs. Seminars can be organized for families of children with special needs by institution managers or special education teachers. The number of psychologists working in schools can be increased and meetings can be scheduled with families at certain intervals. Providing free education, health, transportation and necessary equipment to families of children with special needs is thought to positively affect their financial stress and anxiety. Research can be conducted on families of children with special needs taking into account the variables of their special needs to investigate their level of intolerance of uncertainty. Studies can be conducted that explain the direct relationship between intolerance of uncertainty and happiness in families of children with special needs. Based on research findings, group or individual intervention programs aimed at increasing families' tolerance to uncertainty can be developed and implemented. In addition, intervention programs that have been previously proven to be effective in reducing intolerance to uncertainty can be applied.

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Conflict of interest

No disagreement of interest is said by the writers. In addition, no financial support was received.

Ethics Committee

(Date: 20.01.2022; Decision number:-020-727). Participants who volunteered for the study

were informed with a written informed consent form.

Author Contributions

All authors contributed equally in all of the processes. All authors have read and agreed to the published version of the manuscript.

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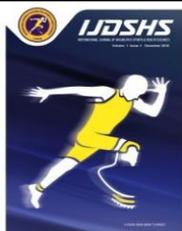
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RESEARCH ARTICLE

Does the First Goal Scorer Win in Football? U 19 League Example

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Abstract

This study was conducted to examine the effect of the first goals scored by the 18 football teams in the U-19 Elite Academy Football League. In this context, the distribution of the goals scored and conceded by the teams in home and away matches according to the time periods of 15 minutes each were analysed. The official web page of TFF (Turkish Football Federation) at <https://tff.org> was used to collect data. 34.21% of the first goals scored between 0-15th minutes, 39.29% of the first goals scored by the champion team were scored between 16-30th minutes. All teams in the league won 70.76% of the matches in which they scored the first goal, while only 14.91% of the matches in which they conceded the first goal were lost and 14.33% ended in a draw. It was concluded that the rate of leaving with a win the competitions in which the champion team scored the first goal was 82.14%, which is quite high. In the matches in which all teams in the league scored the first goal, the average points per match was 2.27, champion team was 2.57. As a result, it can be said that the first goal scored is mostly concentrated in the first half of the competitions and in the first 15 minutes, the first goal scored in football is important both in winning the matches and in achieving the desired point average per match, and coaches should develop tactical strategies on scoring the first goal.

Keywords

Football, Competition, Analysis, First Goal

INTRODUCTION

Football is one of the most popular sports compared to other sports. In modern football, it is possible to measure the performance of both the team and the players in a competition and to determine the positive and negative aspects. The positive and negative aspects identified can be done by interpreting the competition images and data. The interpretation of the analysed data and its use as part of the tactical plan is important for tactical preparation for the competition. It is important to make the most accurate use of the opportunities to score a goal in a football match, to increase the attacking options that affect the goal

formation and to develop the necessary strategies to win the match (Akgül, 2017).

One of the most important parts necessary to contribute to the success of the teams in football is the competition analyses. There are many studies in the literature on match analysis, goal analyses and performance parameters. While some of these studies were based on the number of passes before the goal was scored, some of them focused on the time of the goal, and some of them looked at the effect of the first goal on the result (Armatas and Yiannakos, 2010; Arslanoğlu et al. 2018; Arslanoğlu et al. 2013; Çobanoğlu O., 2019; Sever and Arslanoğlu, 2016). Competition analysis is a very important tool that can provide feedback to coaches and athletes in terms of technical and

tactical performance in matches. One of the important variables proposed in competition analysis is goals scored (Göral and Öz, 2021).

The first goal is considered to have had an impact on the outcome of the match. Therefore, analysing which team scored the first goals and in which minutes, and developing strategies based on the results, can be remarkable for winning a football match. It is seen that the first goals affect both high and limited budget teams. Considering the effect of the first goal scored on the result of the match, it is very important to determine the tactics to be developed for scoring and not conceding goals (Yolgörmez and Kayatekin, 2023).

There are advantages and disadvantages whether a football team plays home or away matches. Indeed, at this point, factors such as the spectator effect, the fact that the spectators do not go away and recognise the field better than the rival team because it is at home are some of the advantages of home matches. Some of the disadvantages are the pressure of rival spectators, fatigue from travelling away and unfamiliar pitches (Göral and Öz, 2021). Although there are advantages and disadvantages in home and away matches, it is seen in the literature that the team that scores the first goal is more advantageous. In addition, as a result of many studies in the literature on football, it has been stated that the advantage of being a host is also clearly revealed (Legaz et al. 2013).

The aim of this study is to examine the effect of the first goals scored on the match results of the teams in the U-19 Elite Academy Football League in all matches played at home and away, to determine the distribution of goals according to 15-minute time periods and the average points in the matches in which the first goal was scored. In addition, it is aimed that the results obtained will contribute to the development of match strategies of coaches and athletes.

MATERIALS AND METHODS

Study Model

Before the data collection phase of the study, ethics committee approval was obtained from Sinop University Human Research Ethics Committee on 10.04.2023 with decision number 2023/60.

In the study, the performances of the teams competing in the U-19 Elite Academy Football League in the 2021-2022 season were evaluated in terms of some parameters. The data of the matches played during the season were obtained and recorded by accessing the official "https://tff.org" website of the TFF (Turkish Football Federation). The data collection group of the study consists of a total of 380 matches played by 20 teams competing in the U-19 Elite Academy Football League for 38 weeks in the 2021-2022 season.

The effects of the first goals scored in a total of 380 matches of 20 teams in the league in 38 weeks during the 2021-2022 season on the match result, average points per match and goal minutes were analysed. Matches that ended in a goalless draw were not taken into consideration as they did not make any difference in the score. Competitions in which a match did not end in a goalless draw within 90 minutes and there was a winner as a result were included in the study. In the study, the following parameters were taken into consideration.

-The effect of the first goals scored by all teams overall, home and away on the result of the match (Win, draw, defeat)

-The distribution of the first goals scored by all teams overall, home and away in 15 minute time periods (1-15 min. / 16-30 min. / 31-45 min. / 46-60 min. / 61-75 min. / 76-90 min.) is as shown.

-The average points per match of the first goals scored by all teams overall, home and away were analysed.

-The effect of the first goals scored by the champion team in all matches and the first goals scored by the Teams finishing in the top four places in the league (Galatasaray, Fenerbahçe, Beşiktaş, Trabzon) in general, home and away matches on the result of the match.

-The distribution of the first goals scored by the champion team in general, home and away in time periods of 15 minutes each (1-15 min. / 16-30 min. / 31-45 min. / 46-60 min. / 61-75 min. / 76-90 min.) is as shown.

-The average points per match for the first goal scored by the champions overall, at home and away were analysed.

Data Analysis

The data obtained in the research were analysed with SPSS 22.0 V. programme. Descriptive statistics data with frequency

percentage were included in the study. The results obtained were interpreted by the researchers.

RESULTS

In this section, the effect of the first goals scored by all teams in the league, the champion

team and also teams finishing in the top four places in the league on the match result, their distribution according to time periods and the average points per match are presented.

Table 1. The effect of the first goals scored on the result of the match and the average points per match

General	F	%	Points per match average
Win	242	70.76	2.27
Draw	51	14.91	
Defeat	49	14.33	
Total	342		
Home	F	%	Points per match average
Win	133	76.88	2.45
Draw	25	14.45	
Defeat	15	8.67	
Total	173		
Away	F	%	Points per match average
Win	109	64.5	2.08
Draw	26	15.38	
Defeat	34	20.12	
Total	169		

F: Frequency %: Percentage

All teams in the league won 70.76%, lost 14.33% and drew 14.91% of the matches in which they scored the first goal. They won 76.88%, lost 8.67% and drew 14.45% of the home matches in which they scored the first goal. In the away matches, the team won 64.5 per cent, lost 20.12

per cent and drew 15.38 per cent. While the average points per match of all teams in the league in the matches in which they scored the first goal was 2.27, it was found to be 2.45 in the home field and 2.08 in the away field (Table 1).

Table 2. Distribution of the first goals scored by teams according to time periods

General	F	%	Home	F	%	Away	F	%
0-15 min.	117	34.21	0-15 min.	66	38.15	0-15 min.	51	30.18
16-30 min.	91	26.61	16-30 min.	48	27.75	16-30 min.	43	25.44
31-45 min.	54	15.79	31-45 min.	21	12.14	31-45 min.	33	19.53
46-60 min.	34	9.94	46-60 min.	16	9.25	46-60 min.	18	10.65
61-75 min.	25	7.31	61-75 min.	13	7.51	61-75 min.	12	7.1
76-90 min.	21	6.14	76-90 min.	9	5.20	76-90 min.	12	7.1
Total	342		Total	173		Total	169	

F: Frequency %: Percentage

When the distribution of the goals scored by all teams in the league according to time periods is

analysed; 117 goals (34.21%) were scored between 0-15th minutes, 91 goals (26.61%) were

scored between 16-30th minutes and 34 goals (15.79%) were scored between 31-45th minutes; 66 goals (38.15%) were scored between 0-15th

minutes in home matches and 51 goals (30.18%) were scored between 0-15th minutes in away matches (Table 2).

Table 3. The effect of the first goals scored by the champion team on the result of the match and the average points per match

General	F	%	Points per match average
Win	23	82.14	2.57
Draw	3	10.71	
Defeat	2	7.14	
Total	28		
Home	F	%	Points per match average
Win	11	78.57	2.50
Draw	2	14.29	
Defeat	1	7.14	
Total	14		
Away	F	%	Points per match average
Win	12	85.71	2.64
Draw	1	7.14	
Defeat	1	7.14	
Total	14		

F: Frequency %: Percentage

The Champion team won 82.14% of the matches in which they scored the first goal, lost 7.14% and drew 10.71%. They won 78.57%, lost 7.14% and drew 14.29% of the home matches in which they scored the first goal. They won 85.71 per cent of their away matches and lost 7.14 per

cent of the matches in which they scored their first goal. In the matches in which the champion team scored the first goal, the average points per match was 2.57, while it was found to be 2.50 at home and 2.64 at away matches (Table 3).

Table 4. Distribution of the first goals scored by the champion team according to time periods

General	F	%	Home	F	%	Away	F	%
0-15 min.	4	14.29	0-15 min.	2	14.29	0-15 min.	2	14.9
16-30 min.	11	39.29	16-30 min.	6	42.86	16-30 min.	5	35.71
31-45 min.	6	21.43	31-45 min.	3	21.43	31-45 min.	3	21.43
46-60 min.	5	17.85	46-60 min.	2	14.29	46-60 min.	3	21.43
61-75 min.	2	7.14	61-75 min.	1	7.13	61-75 min.	1	7.14
76-90 min.			76-90 min.			76-90 min.		
Total	28		Total	14		Total	14	

F: Frequency %: Percentage

In the study, when the distribution of the goals scored by the champion team in the league was analysed according to the time periods, it was found that the first goal was scored between 16-

30th minutes with 11 goals (39.29%), and the first goal was scored between 46-60th minutes with 5 goals (17.85%) (Table 4).

Table 5. The effect of the first goals conceded by the champion team on the result of the match and the average points per match

General	F	%	Points per match average
Win	4	44.44	1.44
Draw	1	11.12	
Defeat	4	44.44	
Total	9		
Home	F	%	Points per match average
Win	3	100	3
Draw			
Defeat			
Total	3		
Away	F	%	Points per match average
Win	1	16.67	0.66
Draw	1	16.67	
Defeat	4	66.66	
Total	6		

F: Frequency %: Percentage

The Champions of the league won 44.44% of the matches in which they conceded the first goal and drew 11.12% of the matches in which they conceded the first goal. The champion team conceded the first goal in all home matches, while

this rate remained at 16.67% in away matches. In the matches in which the champion team conceded the first goal, the average points per match was 1.44 (Table 5).

Table 6. Distribution of the first goals conceded by the champions according to time periods

General	F	%	Home	F	%	Away	F	%
0-15 min.	4	44.44	0-15 min.	3	100	0-15 min.	1	16.67
16-30 min.	2	22.22	16-30 min.			16-30 min.	2	33.33
31-45 min.	1	11.12	31-45 min.			31-45 min.	1	16.67
46-60 min.	2	22.22	46-60 min.			46-60 min.	2	33.33
61-75 min.			61-75 min.			61-75 min.		
76-90 min.			76-90 min.			76-90 min.		
Total	9		Total	3		Total	6	

F: Frequency %: Percentage

In the study, it was observed that the champion team in the league conceded the first goal between 0-15th minutes with 4 goals (44.44%), followed by the time period between 16-30th and 46-60th minutes with 2 goals each (22.22%) (Table 6).

The Teams finishing in the top four places in the league won 80% of the matches in which they

scored the first goal, lost 20% of the matches in which they conceded the first goal and only 2 matches ended in a goalless draw. At home, all teams won 90 per cent of the matches in which they scored the first goal, while 10 per cent of the matches ended in defeat. On the away field, 50 per cent of the matches were won and 50 per cent of the matches ended in defeat (Table 7).

Table 7. The effect of the first goals scored by the Teams finishing in the top four places in the league on the result of the match

General	F	%
Win	8	80
Draw		
Defeat	2	20
Total	10	
Home	F	%
Win	7	87.5
Draw		
Defeat	1	12.5
Total	8	
Away	F	%
Win	1	50
Draw		
Defeat	1	50
Total	2	

F: Frequency %: Percentage

DISCUSSION

In this study, it is analysed how the first goals scored by all teams, the champion team and the big four teams in the U-19 Elite Academy Football League in Turkey in the 2021-2022 season affect the match result, the distribution of goals in 15-minute time periods and the average points per match.

All teams in the league won 70.76% of the matches in which they scored the first goal, 76.88% at home and 64.5% away. The champions of the league won 82.14% of the matches in which they scored the first goal, 78.57% of the matches in which they scored the first goal at home and 85.71% of the matches in which they scored the first goal away from home. The big four in the league won 80 per cent of the matches in which they scored the first goal, 87.5 per cent of the matches in which they scored the first goal at home and 50 per cent of the matches in which they scored the first goal away from home. Within the scope of the research, when the effect of the first goals scored by all teams in the league, the champion team and the Big 4 teams on the match result was evaluated, it was found that the team that scored the first goal in the matches had a very high percentage of winning the match.

In matches at Euro 2012, the win rate was 70.97 per cent when teams scored the first goal (Leite, 2013). In the Greek Super League matches of 2006-2007, 71.43% of the matches ended with a victory in favour of the team that scored the first

goal and 12.8% with a defeat, and the study found that the first goal had a strong influence on the final result (Armatas et al. 2009). In the 2006 World Cup, in a study in which the goals scored by the teams were analysed and evaluated, it was concluded that the teams that scored the first goal had a winning rate of 73.21% and a losing rate of 7.14% (Armatas and Yiannakos, 2010). In the 2018 FIFA World Cup group stage and subsequent competitions, it was determined that the team that scored the first goal left the matches victorious with a high rate of 86% (Bilgin and Müniroğlu, 2022). In another study, 240 matches in the Portuguese Premier League were analysed and it was stated that 70% of the teams that scored the first goal in the matches won the competitions. (Pratas et al. 2016). It was concluded that in 19 matches after the 2014-2018 World Cup group stage, 17 teams that scored the first goal won their matches and only two teams lost the matches despite scoring the first goal, and it was concluded that finding the first goal had a high effect on winning the match with a rate of 89.5% (Bilgin et al. 2020). In the 2022 European Women's Football Championship, a total of 95 goals scored in 31 competitions were analysed, and it was found that 74% of the teams that scored the first goal in the competitions left the matches victorious, while 26% did not win the matches (Başkaya, 2023). An analysis of goals scored in the 2014 FIFA World Cup found that the teams that scored the first goal won 75.4% of their matches (Yiannis, 2014). In

another study, it was found that 1019 goals were scored in a total of 380 matches in the 2018-2019 Italian Serie A League, teams won 67.34% of the matches in which they scored the first goals, and the first goal had a strong effect on the match result (Charalampos et al. 2022). In the 2012 European Championship, the teams won the match with 70.97% in the matches in which they scored the first goal (Yiannis et al. 2013). In another study, the first goals scored in 64 matches played in the 21st World Cup held in Russia in 2018 were analysed, and it was found that the teams that scored the first goal won 71.4% of the matches, lost 9.5% and 19% of the matches ended in a draw (Alexandros et al. 2019; Çobanoğlu, 2019). In a total of 282 matches that ended with a goal in the Turkish Super League 2016-2017 season, 70.6% of the teams that scored the first goal won the match, while 12.4% lost the match. The champion team, on the other hand, was victorious in 23 of the 26 matches in which it scored the first goal (88.5%), while it failed to win any of the 6 matches in which it conceded the first goal. In the same study, the winning rate of the teams that finished in the first 3 places in the league was found to be 83.1% in matches where they scored the first goal (Yolgörmez, 2018; Yolgörmez and Kayatekin, 2023). On the importance of analysing the first goal parameter in the study of tournaments, many studies have highlighted the impact of the first goal (Bilgin and Müniroğlu, 2022). Göral and Öz, (2021) argued that scoring the first goal in a football match, whether at home or away, has a significant effect on winning the matches to a great extent and increasing the average points per match.

When analysed in the literature, it is seen that the results of the studies are similar to our study. These results show that the first goal in a football match is an important parameter affecting the match score and the team that scores the first goal wins the match at a high rate. Theis, (2012) states that the teams that score the first goal in football competitions have improved performance and increased self-confidence.

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football competitions have improved performance and increased self-confidence.

In the 2006 World Cup, in a study in which the goals scored by the teams were analysed and evaluated, it was stated that most of the goals scored occurred between 76-90th minutes (Armatas and Yiannakos, 2010). It was found that most of the goals scored in the Turkish Super League occurred in the 76th-90th minutes (Doğan et al. 2004). In the 2010 World Cup, it was determined that the highest number of goals occurred in the time period between 76-90th minutes (İmamoğlu et al. 2011). When the goals scored in 1998, 2002 and 2006 World Cups were analysed in terms of time periods, it was found that the goals scored were mostly between 76-90th minutes (Armatas et al. 2007; İmamoğlu et al. 2007). In an interesting study, it was found that most of the goals scored from set-pieces in 5 seasons in the Turkish Super League were scored between the 76th and 90th minutes (Cerrah et al. 2016). According to their 2009 Serie A Brazilian Championship analysis, they stated that the most goals were scored in the last 15 minutes of the match (Gomes et al. 2011). In another study conducted in 2007, the goals scored in 8 National Professional Football Leagues were analysed and it was found that more goals were scored in the second half of the competition and that these goals occurred between the 76th and 90th minutes (Silvia, 2007).

It has been stated in many studies above that the most goals in football competitions occur in the time period between the 76th and 90th minutes. Since there are not enough studies on the time periods when the first goal is scored in the literature, it is thought that our research will contribute to the literature in this respect. In our research, it was determined that the first goal was scored mostly in the first half of the competition between the 0-15th and 16-30th minutes. Considering that physical performance in football competitions will directly contribute to the technical, tactical and psychological performance of a team, it is predicted that the probability of scoring the first goal in the early stages of the competitions may be higher.

In the matches in which all teams in the league scored the first goal, the average points per match was 2.27, while it was found to be 2.45 at home and 2.08 away. In the matches in which the champion team scored the first goal, the average

points per match was 2.57, while it was found to be 2.50 at home and 2.64 at away matches.

In the analysis study conducted in different leagues in Turkey, it was stated that according to the average points per match index, the point range of "2.063-3.000" in the TFF 2nd League is classified as "very good", the point range of "2.243-3.000" in the 3rd League is classified as "very good", the point range of "1.558-2.062" in the TFF 2nd League is classified as "good" and the point range of "1.660-2.242" in the 3rd League is classified as "good". For the league championship, as the average points per match, "2.063±0.116" points in the 2nd League and "2.243±0.204" points in the 3rd League may be sufficient (Göral and Ayçan, 2014). According to the results of their study in 2021, Göral and Öz found the average points per game collected both at home (2.39 points) and away (2.00 points) in successful seasons and at home (1.94 points) and away (1.54 points) in unsuccessful seasons. When we compare the results of the studies in the literature with the results of our study, the average score of the teams in the league in the matches in which they scored the first goal is classified as "very good". It is seen that the average points per match of the champion team in this study is well above the point range in the 2nd League and 3rd League.

The results of this study reveal the importance of the first goal in football. Considering that reaching the first goal without conceding a goal in order to leave the competitions with a victory can directly affect the outcome of the matches, it can be argued that the teams can increase their probability of winning the match by preferring an attacking football understanding instead of a game understanding based on defence and trying to find the first goal in the first parts of the matches. In order to score the first goal in competitions, it is necessary to analyse the opponent's strengths and weaknesses well and develop tactical strategies. In addition, since the first goals are more often scored in the early stages of the competition, coaches and players may need to pay more attention to these stages tactically.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

This study is approved by the Sinop University (SNU) and Human Research Ethics Committee of the SNU (Approval Number and Subject: E-57428665-050.01.04-172275 and 2023/60).

Author Contributions

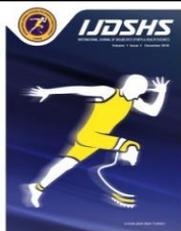
Planned by the authors: Study Design, Data Collection, Statistical Analysis, Data Interpretation, Manuscript Preparation, Literature Search. Authors have read and agreed to the published version of the manuscript.

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RESEARCH ARTICLE

Investigating The Effect of Short-Term Karate Training on Some Physical Fitness Parameters in Visually Impaired 10–12-Year-Olds

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Abstract

The aim of this study is to examine the effects of short-term karate training on some physical fitness parameters in visually impaired children aged 10-12. A total of 15 visually impaired individuals participated in the study. While the study group received karate training together with physical education lessons 1 day a week for 6 weeks, the control group only attended physical education lessons. Within the scope of the Eurofit Special Test, anthropometric measurements, long jump, medicine ball throwing, sit-up, sit-reach (flexibility), walking on the bench, and 25-meter running tests were applied to the participants. According to the research data, while there was a significant difference between the pre-post tests of the anthropometric measurements of the study group ($p < 0.001$), no significant difference was observed in the comparison of the two groups. While it was determined that there was a significant difference between the pretest-posttest values in the Eurofit Special test parameters of the study group ($p < 0.005$), there was no significant difference between the pre-posttest values of the control group. While there was no statistically significant difference between the pretests of Eurofit Special test measurements in which two independent groups were compared, a statistically significant difference was found in favor of the study group in all parameters in the posttest when two independent groups were compared ($p < 0.005$). As a result of the study, it was seen that short-term karate training gave positive results on some physical fitness parameters of visually impaired individuals between the ages of 10-12.

Keywords

Visually Impaired, Karate, Physical Fitness, Eurofit Special

INTRODUCTION

One of the best ways to reintegrate people with disabilities into society is through adapted physical education and sports activities. While sport is an important element for everyone's quality of life, it is much more important for people with disabilities (Yazıcıoğlu et al., 2020; Pekel, 2023). It becomes even more important because of its rehabilitative function, in addition to its effect on mental and emotional development (Savucu, 2019).

If there is no loss of vision from birth or infancy, the individual's developmental processes and physical condition do not cause inadequacy in its characteristics (Sevimay Ozer, 2005). However, the effects of environmental and genetic factors affect the social approach, motor development processes, and physical fitness in some cases, such as obstacle perception problems that develop after an obstacle. Their ability may be adversely affected. This negative effect has an impact on the

body's experience of movement in different environments and conditions. It can be reduced to a minimum with the help of education and physical activity.

Visually impaired individuals are present for recreational sports activities as well as competitive, high-performance disabled people. They can participate in adapted "Para" sports and the Olympics according to their level of vision. United States Blind According to the Athletes Association, visually impaired individuals can participate in sports activities in three different categories (Cengizel et al., 2022).

B1: Even if there is light perception in both eyes, there is no vision. He cannot recognize the shape of a hand from any distance or direction.

B2: The angle of vision is 5 degrees or less than 5 degrees. Visual acuity is no better than 20/600. In other words, you can see the shape of the hand from a distance of about 30 cm.

B3: Angles of vision are between 5-20°. Visual acuity is 20/600–60/600. In other words, you can see the shape of the hand from a distance of about 30 cm to 1 meter.

In 2006, the World Karate Federation (WKF) established the Para-Karate Commission to popularize karate among disabled people and encourage them to take up karate. Since then, Para-Karate has become part of the World Karate Federation's organizations. Para-Karate World Championships were officially held in Germany and Austria in 2014 and 2016, following the Para-Karate competition that was presented to the public in a demonstration competition at the World Championships held for the first time in Paris in 2012 (Argel, 2021). The development of Para-Karate organizations and participation in competitions is constantly increasing. This opens up a new field in which visually impaired people can exercise and improve their physical abilities.

In Para-Karate, competitions are organized in the "Kata" branch for physically handicapped athletes, visually impaired athletes, and mentally handicapped athletes (Argel et al., 2022). According to the WKF Para-Karate Classification, competitions are held in 4 classes and 2 separate categories for each class: men and women (Marin et al., 2022).

The curiosity of this research is to find out how much the branch of karate that uses stance, attack, defense, and walking forms will contribute

to the physical fitness of visually impaired people who start karate training.

Table 1. World Karate Federation Para-Karate Classification

K30	Physically Impairment
K22	Intellectual Impaired (Down-Syndrome) Athletes
K21	Intellectual Impaired Athlets
K10	Visually Impaired Athlets

MATERIALS AND METHODS

Model of the Research

This study is an experimental study with pre-test and post-test evaluations with study and control groups. Anthropometric measurements and the Eurofit Special Test were applied to the students who voluntarily participated in the research. (Ozer, 2020).

Research Group

The population of the research is all visually impaired people between the ages of 10 and 12. The sample consisted of individuals between the ages of 10 and 12 in Ankara who voluntarily agreed to participate in the research. A total of 15 visually impaired people participated in the study. 10 participants were included in the study group (6 boys, 4 girls), and 5 participants were included in the control group (2 boys, 3 girls). While the study group received karate training once a week for 6 weeks in addition to physical education, the control group attended only physical education and continued their daily lives.

The necessary permissions for this research were obtained from the Gazi University Ethics Committee, number 2022-871, dated April 19, 2022.

Inclusion criteria for the participants in the study

- the presence of a visually impaired person
- be between 10 and 12 years old.
- not to have any other disability associated with the visual impairment.
- have never practiced sports or taken part in sports competitions.

Exclusion criteria for the study participants

- had a physical injury or surgery in the last 6 months

- b) Failure to attend 50% of the total number of training sessions
- c) Failure to complete any of the measurements
- d) Voluntary withdrawal from the study at any stage

Limitations:

At the start of the study, the control group started with 9 people, but due to pandemic conditions and serious health problems, 4 people were excluded from the study.

Training Program: The karate training program used in the research for six weeks is given in Table 2.

Table 2. Karate training program for six weeks

KARATE-DO TRAINING	KIHON	DURATION / NUMBER
1 st week	YOI and SEIKEN TSUKI	10X3 / 1 min rest
2 nd week	OI TSUKI CHUDAN	10X3 / 1 min rest
3 rd week	OI TSUKI JODAN	10X3 / 1 min rest
4 th week	AGE OKE	10X3 / 1 min rest
5 th week	UCHI UKE	10X3 / 1 min rest
6 th week	MAE GERI	10X3 / 1 min rest

Data Collection Tools

Height

The height of the participants was measured with a German "Seca" stadiometer with an accuracy of ± 0.1 cm. With the head in the frontal plane, body weight was evenly distributed between both feet, and measurements were taken with bare feet and the heels in contact with the stadiometer (Marangoz et al., 2021).

Body Weight and Body Fat Percentage

Participants' body weight and body fat percentage were measured barefoot in sportswear with an accuracy of ± 0.1 kg using a 'Tanita' brand body composition analyzer developed in Japan (Erikoglu et al., 2019).

Body Mass Index

Body weight (kg) / height² (m). Participants' body mass indexes were calculated as the ratio of their body weight in kilograms to the square of their height in meters (Polat, 2013).

Eurofit Special Test

The Eurofit Special Test, developed for disabled people, was used to assess the physical fitness of the participants. The participants' long jump (tape measure), medicine ball throwing (Sveltus brand 1 kg), sit-up (Tokaido brand

stopwatch / 30 sec.), walking on the bench (3.5 m length, 30 cm height, 30 cm / 10 cm width / 30 sec.), and 25 m running (fox brand whistle, rattle stimulation), sit and reach (flexibility bench), and 25 m running (Fox brand whistle, rattle stimulus, and Tokaido brand stopwatch) were measured (Ozer, 2020).

Analysis of Data

SigmaPlot 11.0 was used to analyze the research data. In pre-test and post-test comparisons, the paired t-test was used for parametric data and the Wilcoxon test for non-parametric data. When comparing two independent groups, the t-test was used for parametric data and the Mann-Whitney U test for non-parametric data.

RESULTS

According to the results obtained from the research data, although there was a significant difference between the pre-test and post-test comparisons of the anthropometric measurements of the study group ($p < 0.001$), no significant difference was observed between the pre-test and post-test comparisons of the anthropometric measurements of the study and control groups

Table 3. Analysis of Study Group Anthropometric Measurement Pre-Post Test and Control Group Anthropometric Measurement Pre-Post Test Values

Anthropometric Measurements		Study Group (n= 10)				Control Group (n=5)				p	
		Pre-test		Post-test		Pre-test		Post-test		study	control
		x	sd	x	sd	x	sd	x	sd		
Height	(cm)	151,190	10,959	151,490	10,983	155,140	12,231	155,260	12,322	<0,001**	0,109
Body weight	(kg)	52,750	10,510	52,220	10,396	57,900	22,817	57,940	22,829	<0,001**	0,625
Body Mass Index	(kg/m ²)	28,080	7,874	27,050	7,772	28,180	12,198	28,200	12,172	<0,001**	0,621
Body Fat Percentage		23,052	3,898	22,735	3,881	23,444	7,090	23,426	7,078	<0,001**	0,595

*p<0,05; **p<0,01

Table 4. Analysis of Anthropometric Measurement Pre-Test and Post-Test Values of the Study and Control Groups

Anthropometric Measurements		Pretest (n=10)				Post-test (n=10)				p	
		Study Group		Control Group		Study Group		Control Group		Pre-test	Post-test
		x	sd	x	sd	x	sd	x	sd		
Height	(cm)	151,190	10,959	155,140	12,231	151,490	10,983	155,260	12,322	0,537	0,557
Body weight	(kg)	52,750	10,510	57,900	22,817	52,220	10,396	57,940	22,829	0,668	0,668
Body Mass Index	(kg/m ²)	28,080	7,874	28,180	12,198	27,050	7,772	28,200	12,172	0,985	0,826
Body Fat Percentage		23,052	3,898	23,444	7,090	22,735	3,881	23,426	7,078	0,951	0,951

*p<0,05; **p<0,01

While it was found that there was a significant difference between the pre- and post-test values for the Eurofit Special test parameters in the study group ($p<0.005$), there was no significant difference between the pre- and post-test values in the control group.

Table 5. Analysis of the Study Group Eurofit Special Test Pre-Post Test and Control Group Eurofit Test Pre-Post Test Values

Eurofit Special Test Parameters		StudyGroup (n = 10)				Control Group (n = 5)				p	
		Pre-test		Post-test		Pre-test		Post-test		study	control
		x	sd	x	sd	x	sd	x	sd		
Long Jump	(cm)	83,480	21,918	132,510	24,707	81,220	14,720	81,300	14,819	<0,001**	0,338
Throwing Medicine Ball.	(cm)	462,000	131,341	693,000	130,725	458,000	172,974	459,000	172,965	<0,001**	0,500
Sit-Up		15,000	5,312	28,400	6,293	15,000	4,183	14,800	4,382	<0,001**	1,000
Walking on Bench	(s)	21,299	2,149	16,427	3,006	20,546	1,570	20,552	1,576	<0,001**	0,305
Sit-Reach	(cm)	7,270	1,149	11,430	1,403	7,880	1,650	7,920	1,657	<0,001**	0,500
25 Meters Run	(s)	18,368	1,865	11,377	1,664	18,326	2,217	18,326	2,220	0,002**	1,000

*p<0,05; **p<0,01

While there was no statistically significant difference between the pre-test values of the Eurofit Special test measurements of the study and control groups, a statistically significant difference

was found in favor of the study group in all parameters in the post-test when two independent groups were compared ($p < 0.005$).

Table 6. Analysis of Eurofit Special Test Pre-Test and Post-Test Values of Study and Control Groups

Eurofit Special Test Parameters		Pre-test				Post-test				p	
		(n=10)		(n=5)		(n=10)		(n=5)			
		Study Group	Control Group	Study Group	Control Group	Study Group	Control Group	Study Group	Control Group	Pre-test	Post-test
		<i>x</i>	<i>sd</i>	<i>x</i>	<i>sd</i>	<i>x</i>	<i>sd</i>	<i>x</i>	<i>sd</i>		
Long Jump	(cm)	83,480	21,918	81,220	14,720	132,510	24,707	81,300	14,819	0,854	<0,001**
Throwing Medicine B.	(cm)	462,000	131,341	458,000	172,974	693,000	130,725	459,000	172,965	0,668	0,043*
Sit-Up		15,000	5,312	15,000	4,183	28,400	6,293	14,800	4,382	1,000	0,003**
Walking on Bench	(s)	21,299	2,149	20,546	1,570	16,427	3,006	20,552	1,576	0,951	0,014*
Sit-Reach	(cm)	7,270	1,149	7,880	1,650	11,430	1,403	7,920	1,657	0,415	0,003**
25 Meters Run	(s)	18,368	1,865	18,326	2,217	11,377	1,664	18,326	2,220	0,951	<0,001**

* $p < 0,05$; ** $p < 0,01$

DISCUSSION

Physical education, which has an important place in the education of children, has also started to take an important place in the education of children with special needs. Adapted physical education and sport practices included in physical education classes have a positive effect on the anatomical, physiological, and psychological conditions of children with disabilities, as well as on their social adaptation (Koparan, 2003).

Increasing the mobility capacity of visually impaired individuals and reducing their obstacle perception problems play an important role in improving their quality of life (Arslantekin et al., 2016). This study aimed to improve the physical fitness of visually impaired people using the Eurofit Special Test Battery. The results showed that there was a significant difference between the pre- and post-test anthropometric measurements of the study group ($p < 0.001$). However, on the anthropometric post-test comparing the two groups, there was no significant difference between the groups. The short duration of the study may explain this. The significance in the pre-post tests of the anthropometric measurements of the experimental group can be associated with supporting the general developmental processes of the children through karate training ($p < 0.001$).

Considering the significance observed between the pre- and post-test values in the Eurofit Special test parameters of the study group, it can be said that karate training, even for a short period of time, has a positive effect on the physical fitness level of children. ($p < 0.005$). Considering the results of the research, there was no significant difference between the pre-test values of the Eurofit Special test measurements of the study group and the control group, whereas a positive significance level was observed in the long jump, sit-up, flexibility, and speed parameters in favor of the study group in the post-test measurements where the two groups were compared ($p < 0.005$).

In a 2019 study, Mohanty et al. applied yoga training to 41 visually impaired children aged 9–16 years for 16 weeks and examined the participants' muscle strength, flexibility, endurance, coordination, and respiratory parameters at the end of the training. At the end of the 16 weeks of yoga training, they found that the visually impaired group that received yoga training had a significant difference at the $p < 0.001$ level in all physical fitness parameters compared to the control group (Mohanty et al., 2019). In another study conducted by Top in 2007, 29 visually impaired and non-visually impaired children aged 10–12 years participated in a 14-week physical activity program. They found that the visually impaired participants in the study group had a significant

difference at the $p < 0.005$ level compared to the sighted children in terms of BMI, height, claw strength, shuttle, 20 m, and hanging arms with bent arms (Top, 2007).

In the 2006 study by Caliskan et al., the physical fitness characteristics, postural development, and anxiety levels of visually impaired girls and boys aged 10–14 years were assessed at the end of a 12-week goalball sport and

In 2022, Kurtoglu and Konar examined some physiological and motor characteristics of visually impaired students who participate in sports and those who do not in Turkey. It was found that there was a significant difference at the $p < 0.005$ level in the parameters of height, arms-bent hanging, shuttle running, claw strength, vertical jump, flamingo balance, flexibility, standing long jump, and shuttle parameters between visually impaired students who participated in the research and those who did sports (Kurtoglu et al., 2022).

A total of 17 students aged 12–14 participated in Yilmaz's study in 2011. The visually impaired students were given basic judo training for 2 months, and their physical fitness was measured using the Brockport test battery. Considering the post-test parameters of the study, they found a significant difference at the $p < 0.001$ level in the parameters of running-walking, shuttle, and reverse shuttle. As a result of the research, they found that two months of basic judo training had positive effects on the physical development of visually impaired students (Yilmaz, 2011).

In a study conducted in 2016, Kim et al. examined whether taekwondo training is effective in improving the balance performance of children with autism spectrum disorder, unlike visual impairment. As a result of their 8-week taekwondo training, they concluded that taekwondo training can improve balance performance in children with autism spectrum disorder (Kim et al., 2016).

In a study conducted by Ansari et al. in 2021, they examined the effect of karate and water exercises on the balance performance of children with autism spectrum disorder, a different type of disability. They concluded that balance performance improved as a result of the 10-week training process in both groups, but kata training, which is a sub-branch of karate, improved balance performance more (Ansari et al., 2021). As a result of the literature review, no other study was found that examined the effect of karate training on

exercise training program. In the post-test analysis of the participants, they found a statistically significant difference at the $p < 0.001$ level in the shuttle, vertical jump, and 20-meter sprint scores. As a result of the research, they observed that the physical fitness of the visually impaired children who received goalball and exercise training for 12 weeks improved (Çalışkan et al., 2006).

physical fitness parameters in visually impaired individuals by applying karate training to visually impaired individuals as in this study. Therefore, this study is original research.

Conclusion

The results of the study are in parallel with the data in the literature. In this study, a significant difference was found at the level of $p < 0.001$ in the pre-post comparison of the anthropometric measurements of the visually impaired in the study group and the group receiving karate training, at the level of $p < 0.005$ in all pre-post tests of the physical fitness parameters of the study group examined by Eurofit Special Test, and at the level of $p < 0.005$ in favour of the group receiving karate training in the post-tests in which the two groups were compared. As a result, it was concluded that short-term karate training had a positive effect on the physical fitness of visually impaired children aged 10–12 years.

Author Note

This research was presented as a summary paper at the 20th International Congress of Sports Sciences in Antalya from November 28 to December 1.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

This study is approved by the Gazi University and Human Research Ethics Committee of the (Approval Number: 2022/871).

Author Contributions

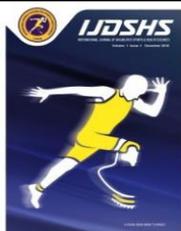
Study Design; CS-BY, Data Collection; CS-BY, Statistical Analysis; BY Data Interpretation; CS, Manuscript Preparation; CS-BY, Literature Search; CS-BY. Authors have read and agreed to the published version of the manuscript.

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RESEARCH ARTICLE

The Effect of Cognitive Status on Work Productivity and Activities in Multiple Sclerosis

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Abstract

Multiple Sclerosis (MS) is a recurrent, chronic disease of the central nervous system (CNS) characterized by various symptoms such as vision problems, balance, gait, and cognitive impairments. In MS, the decline in cognitive function can be a difficult symptom to detect, which may lead to negative consequences in work and social situations. Consequently, this decline could impact individuals' work productivity in multiple ways, including job termination, reduced working hours, and experiencing work-related adverse events. This study aims to examine the relationship between cognitive status and work productivity and activities in individuals with MS. Sociodemographic and occupational characteristics of the patients are also considered. The Brief International Cognitive Assessment for Multiple Sclerosis (BICAMS) is used to evaluate participants' cognitive status. The Work Productivity and Activity Impairment Questionnaire (WPAI:MS) is utilized to assess work productivity and activities in MS patients. Pearson correlation and regression analysis were performed to analyze the relationship between continuous variables in the study. A total of 144 patients participated in the study. Of these patients, 81.2% have relapsing-remitting MS (RRMS). Working patients make up 42.4% of these individuals. In this study, it was observed that BICAMS subtest scores for working patients were higher than those of the non-working patient group. When analyzing the causal relationship between working patients' cognitive status scores and work productivity and activities, no statistically significant result was obtained. On the other hand, it is advised to look into larger patient groups to investigate the relationship between cognitive status and employment in individuals with MS.

Keywords

Cognitive Status, Work Efficiency, Multiple Sclerosis

INTRODUCTION

Multiple Sclerosis (MS) is a central nervous system disorder characterized by persistent inflammation and widespread neurodegenerative areas in the brain and spinal cord (Mahad et al., 2015; Lassmann et al., 2019). By the end of 2020, it is estimated that the global number of MS patients reached 2.8 million (Walton et al., 2020). MS frequently impacts individuals during their prime years when they are planning their careers and families, leading to adverse effects on their

financial, occupational, and social lives (Yamout & Alroughani, 2018).

Cognitive dysfunction is a prevalent issue in MS, affecting between 40% and 65% of those with the condition (Fox et al., 2015; Amato et al., 2010). Research has also indicated that this dysfunction may be present from the early stages of the disease (DiGiuseppe et al., 2018; Anhoque et al., 2012). This decline typically impacts domains such as processing speed, verbal memory, and executive functions (Benedict, 2011; Rao et al., 1991a). Observable from the

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early stages of MS, cognitive impairment is a productivity (Amato et al., 1995; Kobelt et al., 2017). Cognitive difficulties are more prevalent among unemployed MS patients than employed ones (Langdon, 2011). A study on disease burden in a large European MS population reported that the unemployment rate for MS patients below retirement age was about 50% (Kobelt et al., 2017). A systematic review by Clemens and

The prompt identification and management of cognitive impairments in MS patients, which has been shown to directly influence work performance and employment, is a crucial concern. In our

MATERIALS AND METHODS

The 144 patients who applied to the MS outpatient clinic at the Şişli Florence Nightingale Hospital during the three-month data collection period and met the study's inclusion criteria made up the study's sample. Patients over the age of 18, without significant hearing and visual impairment, without motor disabilities that could limit hand movements, without neuropsychiatric conditions that could affect cognitive status, and with an Expanded Disability Status Scale (EDSS) score of ≤ 5.5 were eligible for inclusion (Kurtzke, 1983). Face-to-face interviews were used to collect the data. Approval was granted by the Koç University Ethics Committee (approval number: 2019. 235. IRB3. 128, date: 24.07.2019). Written authorization was received from the patent holders of the scales, and informed consent was obtained from the patients who participated in the study.

Patient Information Form

The Patient Information Form used in this study collected data on various sociodemographic, occupational, and clinical characteristics, including age, gender, education level, occupation, employment status, weekly working hours, job description, history of changing jobs due to illness, duration of illness, MS type, and EDSS score.

Brief International Cognitive Assessment for Multiple Sclerosis (BICAMS):

Benedict et al. developed the Brief International Cognitive Assessment for Multiple Sclerosis (BICAMS) in 2012, which is commonly used to assess cognitive impairment related to MS (Benedict et al., 2012). BICAMS comprises three subtests: the Symbol Digit Modalities Test

significant factor contributing to reduced work Langdon (2018) found that the key distinction between unemployed and employed MS patients is impaired processing speed and executive functioning. Another study reported that after disease onset, 25% to 33% of employed individuals had to modify their work arrangements or decrease their working hours (Schiavolin et al., 2013).

(SDMT) that measures information processing speed and working memory, the California Verbal Learning Test II (CVLT II) that evaluates verbal memory, learning, and recall, and the Brief Visuospatial Memory Test-Revised (BVMTR) that examines visual memory. Each of these tests has its own scoring system, and no overall score is calculated (Özakbaş et al., 2017). The evaluation takes approximately 15 minutes, and lower scores indicate greater cognitive impairment due to MS (Çınar et al., 2017).

Work Productivity and Activity Impairment Questionnaire: Multiple Sclerosis V2.0 (WPAI:MS)

The WPAI:MS is a self-reported survey designed to measure the impact of MS on work productivity and daily activities. The questionnaire comprises six questions that evaluate the extent of MS's impact on work productivity and daily activities. The questions ask about the patient's employment status, the number of work hours missed due to MS, the total working hours, the degree to which MS affects work productivity, and the extent to which MS affects non-work-related daily activities. The responses should pertain to the past seven days. Four outcomes are calculated from the WPAI:MS questionnaire: the percentage of work hours missed due to MS, the percentage of reduced work efficiency due to MS, the percentage of work productivity loss because of MS, and the percentage of decrease in non-work-related activities due to MS. Higher scores on the WPAI:MS scale indicate greater impairment (Reilly, 2021a; Glanz et al., 2012). The Work Productivity and Activity Impairment questionnaire was translated into Turkish by three independent translators, and the Turkish questionnaires were then re-translated into English for verification purposes (Reilly, 2021b; Lambert et al., 2014).

Data Analysis

In this study, the data were analyzed using the SPSS (Statistical Package for Social Sciences) Windows 22.0 program. Descriptive statistical methods, including number, percentage, mean and standard deviation, were used to evaluate the data. The Kolmogorov-Smirnov Normal Distribution Test was used to determine if the research variables had a normal distribution. Results showed that the study variables had a normal distribution ($p>0.05$). Parametric methods were applied for data analysis. The t-test was used to compare quantitative continuous data between two independent groups, while the One-way ANOVA test was used to compare quantitative continuous data between more than two independent groups. The Scheffe test was used as a complementary post-hoc analysis to identify differences following the ANOVA test. Pearson correlation and regression analysis were performed to analyze the relationship between continuous variables in the study.

RESULTS

A total of 144 MS patients were enrolled in this study, of whom 69.4% were female and 30.6% were male. The mean age of the patients was 40.7 ± 10.9 , and the mean duration of education was 11.9 ± 3.7 years. Among the MS characteristics, the mean disease duration was 9.5 ± 6.2 years, and the majority of patients (81.2%, $n=117$) had relapsing-remitting MS (RRMS). The mean Expanded Disability Status Scale (EDSS) score was 2.7 ± 1.3 ranging from 0.0 to 5.5. Of the participants, 42.4% ($n=61$) were currently employed, working an average of 44.2 ± 6.7 hours per week. Among working patients, 27.1% ($n=39$) had changed jobs at least once due to MS.

When the mean cognitive status scores of the patients were analyzed, the mean scores of "SDMT" were 36.4 ± 11.4 , "CVLTII" was 56.4 ± 12 , and "BVMTR" was 70.2 ± 17.7 , respectively. The mean scores of work efficiency and activities of the patients in the last week were as follows: "missed work time due to MS" means 10 ± 21.1 , "decreased work efficiency due to MS" means 29.7 ± 20.9 , "loss of work efficiency due to MS" means 36.4 ± 24.9 , "decreased activities outside of work due to MS" mean 46 ± 27.5 , respectively (Table 1).

Table 1. Participants' mean scores of cognitive status and job efficiency, activity ($n=144$)

	Mean	Ss.	Min.	Max.
SDMT	36,4	11,4	3,6	68,2
CVLT II	56,4	12	22,5	85
BVMTR	70,2	17,7	13,9	100
Work time missed due to MS	10	21,1	0	100
Decreased activity at work due to MS	29,7	20,9	0	70
Loss of work productivity due to MS	36,4	24,9	0	100
Reduction in non-work activities due to MS	46	27,5	0	100

When the correlation analyzes between EDSS, cognitive status, work efficiency and activities are examined, respectively; A negative correlation was found between SDMT, BVMTR, CVLT II and EDSS ($p<0.05$). A positive correlation was found between a decrease in MS-

induced non-work activities and EDSS, a negative correlation between SDMT, a negative correlation between CVLTII and a negative correlation between BVMTR (Table 2).

Table 2. Correlation Analysis Between EDSS Score, Cognitive Status and Job Efficiency Score

		EDSS	SDMT	CVLTII	BVMTR	Work time missed due to MS	Decreased activity at work due to MS	Loss of work productivity due to MS	Decreased activities outside of work caused by MS
EDSS	r	1							
	p	0,000							
SDMT	r	-0,503**	1						
	p	0,000	0,000						
CVLTII	r	-0,340**	0,611**	1					
	p	0,000	0,000	0,000					
BVMTR	r	-0,395**	0,650**	0,635**	1				
	p	0,000	0,000	0,000	0,000				
Work time missed due to MS	r	0,202	0,134	0,022	-0,011	1			
	p	0,119	0,305	0,868	0,93	0,000			
Decreased activity at work due to MS	r	0,052	0,036	-0,235	-0,242	0,074	1		
	p	0,691	0,785	0,068	0,06	0,573	0,000		
Loss of work productivity due to MS	r	0,173	0,107	-0,168	-0,202	0,597**	0,838**	1	
	p	0,181	0,412	0,196	0,118	0,000	0,000	0,000	
Decreased activities outside of work caused by MS	r	0,505**	-0,330**	-0,256**	-0,350**	0,223	0,785**	0,739**	1
	p	0,000	0,000	0,002	0,000	0,085	0,000	0,000	0,000

* $<0,05$; ** $<0,01$

As a result of the regression analysis performed to determine the cause and effect relationship between cognitive status and work efficiency and activities, the relationship between

SDMT, CVLTII, BVMTR and the decrease in MS-related activities outside of work was found to be significant ($p<0.05$) (Table 2).

Table 3. Effect of Cognitive Status on Work Efficiency and Activities

The dependent variable	Independent variable	β	t	p	F	Model (p)	R ²
Work time missed due to MS	Fixed	2,626	0,139	0,890			
	SDMT	0,408	1,101	0,275	0,424	0,736	0,030
	CVLTII	-0,104	-0,332	0,741			
	BVMTR	-0,043	-0,196	0,845			
Decreased activity at work due to MS	Fixed	58,115	3,280	0,002			
	SDMT	0,534	1,532	0,131	2,472	0,071	0,069
	CVLT II	-0,510	-1,738	0,088			
	BVMTR	-0,260	-1,249	0,217			
Loss of work productivity due to MS	Fixed	58,167	2,740	0,008			
	SDMT	0,775	1,856	0,069	2,173	0,101	0,055
	CVLT II	-0,528	-1,502	0,139			
	BVMTR	-0,290	-1,159	0,251			
Reduction in non-work activities due to MS	Fixed	87,218	8,113	0,000			
	SDMT	-0,430	-1,620	0,107	7,643	0,000	0,122
	CVLT II	0,004	0,017	0,987			
	BVMTR	-0,368	-2,103	0,037			

Statistically significant differences were found in the SDMT, CVLT II, and BVMTR scores based on age and education level ($P < 0.05$). Working patients had higher scores on these cognitive tests than non-working patients. In terms of the time of diagnosis, SDMT and BVMTR scores decreased as

the diagnosis time increased. Additionally, patients with clinically isolated syndrome (CIS) had higher SDMT, CVLT II, and BVMTR scores compared to those with relapsing-remitting MS (RRMS) and secondary progressive MS (SPMS) (Table 4).

Table 4. Differentiation of Cognitive Status by Descriptive Characteristics

Demographic features	n	SDMT	CVLTII	BVMTR
Age		Mean±SD	Mean±SD	Mean±SD
≤30	24	40,189±10,250	58,333±14,155	77,199±18,261
31-40	53	38,285±12,486	58,750±12,440	73,008±16,759
41-50	35	36,649±10,118	55,964±9,922	70,079±14,560
51≤	32	29,943±9,230	51,484±10,402	60,590±18,418
F=		5,239	2,802	5,308
p=		0,002	0,042	0,002
PostHoc=		1>4, 2>4, 3>4 ($p < 0.05$)	1>4, 2>4 ($p < 0.05$)	1>4, 2>4, 3>4 ($p < 0.05$)
Education Time		Mean±SD	Mean±SD	Mean±SD
≤10	27	24,949±8,337	50,324±8,740	58,230±15,360
11-15	102	37,558±9,350	56,299±11,538	71,650±17,355
16≤	15	48,667±11,783	67,917±12,244	82,222±11,151
F=		33,251	12,013	11,507
p=		0,000	0,000	0,000
PostHoc=		2>1, 3>1, 3>2 ($p < 0.05$)	2>1, 3>1, 3>2 ($p < 0.05$)	2>1, 3>1, 3>2 ($p < 0.05$)
Working Status		Mean±SD	Mean±SD	Mean±SD
Yes	61	41,490±8,803	59,836±11,336	77,231±13,961
No	83	32,574±11,619	53,855±11,869	65,094±18,370
t=		5,025	3,045	4,322
p=		0,000	0,003	0,000
Diagnosis Time		Mean±SD	Mean±SD	Mean±SD
1-5	45	41,879±11,098	58,944±10,553	77,531±14,839
6-10	49	35,046±8,822	57,041±12,118	67,914±15,141
11-15	26	34,266±11,916	55,913±12,220	69,872±19,715
16≤	24	30,909±12,384	50,781±12,789	61,690±20,560
F=		6,561	2,581	5,134
p=		0,000	0,056	0,002
PostHoc=		1>2, 1>3, 1>4 ($p < 0.05$)		1>2, 1>4 ($p < 0.05$)
Ms Type		Mean±SD	Mean±SD	Mean±SD
KIS	12	42,955±11,162	61,458±8,010	76,620±13,214
RRMS	117	37,405±10,138	57,564±11,399	71,985±15,926
SPMS	15	22,848±11,447	43,167±10,855	51,481±22,490
F=		15,791	12,510	11,234
p=		0,000	0,000	0,000
PostHoc=		1>3, 2>3 ($p < 0.05$)	1>3, 2>3 ($p < 0.05$)	1>3, 2>3 ($p < 0.05$)

After analyzing the differences between work efficiency, activities, and patient characteristics, it was found that there was a significant increase in the scores of decreased MS-related non-work activities as the patients' diagnosis period increased

($p < 0.05$). Patients with secondary progressive MS (SPMS) had higher scores for missed work time due to MS and a reduction in MS-related non-work activities compared to other types of MS (Table 5).

Table 5. Differentiation of Business Efficiency and Activities by Descriptive Characteristics

Demographic features	n	Work time missed due to MS	Decreased activity at work due to MS	Loss of work productivity due to MS	Reduction in non-work activities due to MS
Age		Mean±SD	Mean±SD	Mean±SD	Mean±SD
≤30	10	5,111±12,746	19,000±15,951	23,200±18,624	35,833±28,425
31-40	32	11,059±21,873	31,250±21,365	38,521±25,037	43,962±25,596
41-50	16	12,864±25,571	29,375±19,822	37,838±26,660	53,714±29,314
51 ≤	3	0,000±0,000	50,000±26,458	50,000±26,458	48,438±26,410
F=		0,514	1,969	1,358	2,243
p=		0,674	0,129	0,265	0,086
Education Time		Mean±SD	Mean±SD	Mean±SD	Mean±SD
≤10	4	3,000±6,000	42,500±30,957	43,400±32,056	53,704±26,040
11-15	49	8,865±18,835	28,980±20,539	35,103±23,524	45,980±27,656
16 ≤	8	20,556±34,890	27,500±18,323	40,806±31,647	32,000±25,411
F=		1,300	0,819	0,343	3,081
p=		0,280	0,446	0,711	0,049
PostHoc=					1>3 (p<0.05)
Diagnosis time		Mean±SD	Mean±SD	Mean±SD	Mean±SD
1-5 Year	23	8,504±22,104	30,435±24,951	35,667±29,445	34,444±24,079
6-10 Year	20	15,180±26,150	29,500±19,050	39,713±24,819	47,143±28,062
11-15 Year	11	1,741±5,774	30,000±21,909	31,219±22,279	47,308±25,699
16 years and more	7	13,212±14,847	27,143±11,127	37,439±11,639	63,750±25,506
F=		1,055	0,044	0,278	6,735
p=		0,375	0,988	0,841	0,000
PostHoc=					2>1, 3>1, 4>1, 4>2, 4>3 (p<0.05)
Ms Type		Mean±SD	Mean±SD	Mean±SD	Mean±SD
KİS	7	2,736±7,238	37,143±26,904	39,058±26,787	34,167±24,293
RRMS	51	8,856±18,416	28,431±20,530	34,405±23,761	44,274±26,888
SPMS	3	46,667±50,332	33,333±11,547	64,000±31,749	68,667±24,456
F=		5,802	0,575	2,130	6,952
p=		0,005	0,566	0,128	0,001
PostHoc=		3>1, 3>2 (p<0.05)			3>1, 3>2 (p<0.05)

DISCUSSION

The study aimed to investigate the impact of cognitive status on work productivity and activities in multiple sclerosis (MS). It also aimed to determine whether cognitive status and work productivity differ based on occupational,

demographic, and clinical characteristics. Findings showed that 27.1% of the participants changed jobs at least once due to MS, which is higher than the 6% reported by Julian et al. (2008). In terms of absenteeism, 10 % of the working participants in the study could not go to work in the

last seven days due to MS, and 36.3% experienced a decrease in work productivity. These figures are comparable to Glanz et al.'s (2012) study, which showed that approximately 11.9% of MS patients reported absenteeism in the past seven days. These data demonstrate that MS affects people's capacity to work efficiently.

The study found that as the duration of illness, EDSS scores, and MS severity increased, working patients had increased MS-related absenteeism and decreased non-work activities. This is consistent with several previous studies highlighting the impact of longer illness duration on work productivity and decreased work productivity in people with higher EDSS scores (Putzki et al., 2009; Beatty et al., 1995; Bøe Lunde et al., 2014). Patients with secondary progressive MS (SPMS) showed higher scores for missed work time and a reduction in MS-related non-work activities compared to other types of MS (Srpova et al., 2022; Kobelt et al., 2017; Rodriguez et al., 2022).

Working patients in the study had higher cognitive status scores than non-working patients. Schiavolin et al.'s (2013) study emphasized that higher cognitive status scores increase the probability of employment. The study also found differences in cognitive status scores among patients based on age, duration of education, and EDSS scores. Cognitive impairment was more pronounced in individuals with higher levels of physical disability (De Meo et al., 2015; Giedraitienė et al., 2015; Monica et al., 2022; Miller et al., 2006).

Patients with clinically isolated syndrome (CIS) had higher cognitive status scores than patients with relapsing-remitting MS (RRMS) and SPMS. The study of Benedict and Ziyadinov (2011) showed that individuals with progressive disease course have more cognitive impairment. Regression analysis found that only the Brief Visuospatial Memory Test-Revised (BVMTR) subtest of the Brief International Cognitive Assessment for MS (BICAMS) was associated with reduced levels of non-work activities associated with MS. A study by Benedict et al. (2005) found that patients with cognitive impairment were less likely to be employed or socially active.

In summary, our study highlights the significance of cognitive status in relation to work productivity and activities among individuals with

multiple sclerosis (MS). We found that cognitive status and work productivity were influenced by several factors such as age, length of education, duration of illness, and EDSS scores. Furthermore, our study suggests that better cognitive status is associated with increased employment and work productivity.

Healthcare professionals should consider these factors when designing interventions to support individuals with MS in the workplace. Rehabilitation programs that address cognitive impairments may help improve overall quality of life and employment opportunities for these patients. However, further research is necessary to develop more targeted and effective interventions that consider the unique demographic, occupational, and clinical characteristics of individuals with MS.

Our study has limitations, including a small sample size of working patients and being conducted in a single center, which prevented us from establishing a statistically significant relationship between cognitive status scores and work efficiency or activities. Early recognition of cognitive impairment in individuals with MS is essential in addressing employment challenges and maintaining business continuity. Further research with working MS patients can provide insight into the factors that affect work productivity and continuity.

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Conflict of Interest

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Ethical Aspects of The Study

Approval was granted by the Koç University Ethics Committee (approval number: 2019. 235. IRB3. 128, date: 24.07.2019). Written authorization was received from the patent holders of the scales, and informed consent was obtained from the patients who participated in the study.

Author Contributions

Study design: MKT and ŞÖ; Data collection: MKT; Data interpretation: MKT and ŞÖ; Manuscript preparation: MKT and ŞÖ; Literature review: MKT and ŞÖ. All authors have read and approved the published version of the manuscript.

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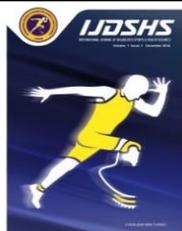
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RESEARCH ARTICLE

Exploring Isokinetic Test, Joint Position of Sense and Dynamic Balance in Anterior Cruciate Ligament Reconstruction versus Healthy Subjects

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Abstract

Reduced knee muscle strength, joint position sense (JPS), and dynamic balance are some of the impacts of anterior cruciate ligament (ACL) rupture that remained in patients after surgery. The goal of this study was to assess patients who had finished a sport rehabilitation programme and were back exercising with their healthy partners for the JPS, dynamic balance, and knee muscle strength. In this study, 40 male soccer players—20 participants with autograft reconstruction of the hamstring or surgery, and 20 uninjured participants—took part. By using isokinetic dynamometry, the flexor and extensor peak torque of the knee at angular velocities of 60 deg. s⁻¹, JPS at 60°, and dynamic stability were assessed in the dominant leg by using Y balance test. The independent t-test was utilized to compare the outcomes between the two groups. The findings demonstrated that there were no differences in any of the test parameters for determining muscle strength and JPS between the two groups at 60 degrees per second in the dominant leg. ($p > 0.05$). Furthermore, there was no observed difference in all directions of YBT between Injured and healthy groups in dominant leg ($p > 0.05$). The results of this study allow us to make the conclusion that when a rehabilitation programme has been completed successfully, surgically induced outcomes may be improved and the risk of re-injury in athletes may be decreased.

Keywords

Anterior Cruciate Ligament, Muscular Strength, Joint Position Sense, Dynamic Balance, Soccer

INTRODUCTION

Sports-related knee injuries like anterior cruciate ligament (ACL) injuries are frequent and severe. ACL reconstruction (ACLR) aims to get patients return to playing sports (Ordahan et al., 2015). Anatomical, genetic, hormonal, occupational, and neuromuscular abnormalities

are risk factors for ACL injuries. But there were other modifiable factors include neuromuscular control (Ahn & Lee, 2016). On the other hand, ACL injury decreases lower extremity neuromuscular control (Akbari et al., 2016). However, there is no standard test for assessing neuromuscular control following ACLR. The isokinetic test has become useful for ACL injury

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neuromuscular function evaluation. Peak torque is the gold standard in the isokinetic test (Ahn & Lee, 2016). Isokinetic dynamometry is used to assess physical condition, rehabilitation effectiveness, and injury risk factors in athletes, especially soccer players. As a result, either bilaterally or unilaterally, muscle imbalances can be detected using the ratios that are gained. The traditional ratio below 60% suggests hamstring weakness relative to the quadriceps, which increases the risk of hamstring and ACL injury (García-Pastor et al., 2022).

On the other hand, after ACL injury, knee and functional performance are evaluated using a range of clinical outcome measures, including patient-reported outcomes (Lysholm score, subjective score from the International Knee Documentation Committee, etc.), joint instability, muscle strength, and balance. Due to the fact that dynamic stability is one of the many components that must be checked during rehabilitation, it is an important feature to take into account during a knee ligament reconstruction exercise programme. In order to determine knee stabilization during dynamic tasks, normalized dynamic stability tests that incorporate a variety of muscle activations, such as the Star Excursion Balance Test (SEBT) and Y-Balance Test (YBT), have been employed often (Cervenka et al., 2018). The reduced hamstring muscle activation and decreased joint position sense make it difficult to maintain balance following an ACL injury (Kim et al., 2022). Therefore, evaluation of dynamic balance may be a useful strategy for assessing the functionality of the sensory motor system following ACL injury (Lee et al., 2019). The ACL also contributes to proprioceptive activities through the mechanoreceptors found within its structure, in addition to providing mechanical stability (Ordahan et al., 2015).

These mechanoreceptors in the ACL fibres have been demonstrated to monitor changes in tension, velocity, acceleration, movement direction, and knee joint position. ACL deficit reduces proprioceptive and neuromuscular control and delays quadriceps and hamstring muscle response times. Proprioceptive system dysfunction can affect neuromuscular control, protective muscle activity, and joint stabilization (Ordahan et al., 2015). A particular sensory modality called proprioception carries out three functions: awareness of static joint location, detection of joint

acceleration (kinesthesia), and efferent activity controlling reflex muscle contractions (Kosy & Mandalia, 2018). In order to prevent these effects, proprioception training may be discussed throughout ACL rehabilitation and preventative programs (Jebreen et al., 2023). Because compensatory activation of other knee joint mechanoreceptors occurred in spite of the loss of local mechanoreceptors caused on by ACL damage, compensatory muscles were activated to stabilize the joint (Akbari et al., 2016).

According to a recent study, mechanoreceptor impairment caused by ACL injury reduces knee proprioception. In consequently, individuals with ACL injuries frequently report balance deficits, ostensibly for the same reason (Karimijashni et al., 2023). Because, Xu et al (Xu et al., 2022). stated that the ACL is essential for knee joint stability, helping to prevent anterior translation and trigger the "screw home" mechanism. As a result, functional instability and impairment brought on by an ACL rupture can result in meniscal tears and the degradation of articular cartilage. Additionally, Hu et al. discovered that there is a greater link between strength and dynamic stability in patients who have had anterior cruciate ligament restoration. The hamstring/quadriceps ratio may shift further due to consistent muscle weakness, causing dynamic instability and increasing the risk of additional injury. For stability during functional activities, it is typically necessary to have sufficient strength of the agonist and antagonist muscles across the joints (Hu et al., 2023). Lastly, according to Cervenka et al, 2018 research, the involved limb of individuals with ACL injury will have significantly fewer strength and stability than the uninvolved limb (Cervenka et al., 2018). According to previous studies and the lack of research on the isokinetic strength of agonist and antagonist muscles, JPS, and dynamic balance in people who experienced at least one year of ACLR, the goal of this investigation is to compare the dynamic balance, JPS, and isokinetic test results between ACLR and healthy individuals.

MATERIALS AND METHODS

Subjects

The sample size for the current retrospective cohort study was chosen based on relevant earlier

studies (Cyjetkovic et al., 2015; Machado et al., 2018). Therefore, 40 male soccer players age 18-30 years were evaluated and then were divided to ACL reconstruction either in isolation or in combination with a meniscal repair (ACLRG: n = 20) and uninjured (UIG: n = 20) groups. The subjects included in the ACLRG were individuals who had undergone ACLR surgery with a hamstring graft in their dominant limb at least a year prior. These individuals had participated in the same ACL rehabilitation program, which comprised a variety of exercises such as range of motion, strengthening, proprioception and balance, agility and coordination, plyometric, core strengthening, and functional exercises. The program was conducted by the same athletic trainer (O.M.) for a minimum duration of six

months. In the UIG group, participants were qualified to enter the study if they had not previously participated in any injury prevention programs. Exclusion criteria included being unable to complete the study's tests, feeling discomfort in the lower limb joints, and having a history of quadriceps and/or hamstring injuries in both limbs. The study was authorised by the University of Shahid Bahonar Kerman's ethics committee (IR.UK.REC.1400.015), and all subjects gave written informed consent before enrolling in the study. The subject demographic data have been listed in Table 1. The independent t-test showed that there were no significant differences between the two groups.

Table 1. Demographic characteristics. Mean (SD)

Variables	ACLRG	UIG	P
Age (years)	22.55 (3.99)	21.00 (4.74)	0.27
Height (cm)	177.55 (4.93)	176.60 (6.02)	0.58
Weight (kg)	72.70 (6.44)	71.30 (5.63)	0.46
BMI (kg/m ²)	23.03 (1.40)	22.84 (1.00)	0.62

Note: ACLRG= ACL reconstruction group; UIG= Uninjured group, Significant level set as $p < 0.05$

Procedure

Before starting the study, all eligible subjects were invited and were given aims of current study in details by one of researchers. Then, subjects were instructed how each test is done. A day after education course, the UIG performed tests and then ACLRG performed those a day after UIG. It is noteworthy, the subjects were given 3 trials to practice and familiarize before each test and also to prevent injury, subjects a warm-up for 10 minutes consisted of dynamic stretching for lower limbs and knee flexion and extension 5 times for each leg by isokinetic dynamometer at 60 degrees/second. Moreover, after completion of each test, subjects took a rest for 5 minutes for reducing effect of fatigue and the got ready to perform next test.

Evaluation of tests

Isokinetic test

To evaluate the knee muscle testing (Fig.1a), it was done on Biodex System (Biodex System single Pro, Shirley, New York, USA). The subject was strapped across their chests and sat upright on a dynamometer chair with his dominant hip and knee limb flexed at a 90-degree angle. Attached to

the dominant lateral malleolus of leg was the dynamometer attachment. In order to maintain complete ankle dorsiflexion, the resistance pad was placed as far away from the tibia as possible. The ROM was set to fully extend (0 degrees) to flexion of 90 degrees while the knee was being tested (Lim et al., 2019). Variables such as peak torque, maximum total work, average power, and the relationship between the peak torque of the flexor (Flex) and extensor (EX) leg muscles (the hamstrings/quadriceps (H/Q) relationship) were tested and analyzed at 180 degrees per second to evaluate the dominant limb in isokinetic test. In this study, the 60degrees/second was selected because of most commonly used in past studies (Lim et al., 2019; Machado et al., 2018). The subjects performed the isokinetic test in 3 sets and 5 repetitions in each set. 30 seconds were given to subjects after performing each set to take a rest. During the test, by using verbal stimulation, the subjects were encouraged to use their maximum strength. The best results among sets were considered for comparing between groups.

Joint position sense (JPS) test

To measure joint position sense (absolute angular error) at the threshold of passive motion detection at 60°, an isokinetic dynamometer (Biodex System single Pro, Shirley, New York, USA) was utilized (Kalimuthu & Mokhtar, 2017). The rotation axis for the dynamometer was chosen to be the lateral femoral epicondyle. (Fig.1b). The range of motion was calculated to be from 0° (full extension) to 90° (flexion). The dominant leg was in the first 90° flexion position and rested for 10 seconds. The subject was then instructed to remember this position after the device had passively flexed it into a 60° angle at a 2°/sec angular speed. The leg was brought back to its starting position after a 10-second resting period the participant was then instructed to fix the dynamometer to the target angle after being certain that he had reached it passively (Kalimuthu & Mokhtar, 2017).

Y balance test (YBT)

The YBT was employed as a dynamic balance test to assess the function of the lower extremities. In both clinical and research settings,

this test is often employed. Performance on this exam can be measured as the maximum reach distance in a particular direction (anterior (ANT), posteromedial (PM) and posterolateral (PL)) or a calculated composite score (average reach distance across all directions) (Bulow et al., 2021). All subjects completed YBT with using YBT kit (Tavan Gostar Company, Tehran, Iran). After the practice trials, the first test trial's distance from the YBT apex of the most proximal edge of the reach indicator was measured, while Participants moved in three directions: ANT, PM, and PL. The support leg was the dominant limb (Fig.1c). From the anterior superior iliac spine to the farthest point of the ipsilateral medial malleolus in a supine position, all reach distances were measured and normalised as a percentage of each participant's stance-limb length (%LL)(Bulow et al., 2021). In this study, each direction three times was repeated and the average of them was calculated.

Normalized reach distance = (reach distance / limb length) x 100



Fig. 1. Measurement of tests; A: Isokinetic test, B: JPS test and C: YBT

Statistical analysis

To ensure that the results were distributed normally, the Kolmogorov-Smirnov test was applied. The independent t-test was applied to analyze the data between ACLRG and UIG. The statistical analysis was conducted using SPSS 26.0 for Windows (SPSS Inc., Chicago, IL, USA), and

the level of statistical significance was established at α values 0.05. The effect sizes of 2-independent groups were tested using Cohen's d [$d = (M1 - M2) / \sqrt{((SD1^2 + SD2^2) / 2)}$], (0.1, 0.3, and 0.5 as small, medium, and large effects, respectively) (Alimoradi et al., 2021).

RESULTS

The significance of the difference between the ACLRG and UIG evaluated variables was assessed using an independent t-test, and the findings are shown in Table 2. It is important to mention that the Kolmogorov-Smirnov test results revealed that the data distribution for all research variables was normal ($p > 0.05$). Thus, the use of independent t-test was possible. The obtained isokinetic results were compared and showed in EX ($t = 0.48$, $p = 0.63$, Cohen's $d = 0.78$), Flex ($t = 0.69$, $p = 0.49$, Cohen's $d = 0.64$) peak torques, max total work (EX: $t = 0.62$, $p = 0.53$, Cohen's $d = 0.55$; Flex: $t = 0.79$, $p = 0.43$, Cohen's $d = 0.59$), average of power (EX: $t = 0.74$, $p = 0.46$, Cohen's $d = 0.88$; Flex: $t = 0.64$, $p = 0.52$, Cohen's $d =$

0.65) and H/Q ratio ($t = 1.04$, $p = 0.30$, Cohen's $d = 0.67$) between ACLRG and UIG no significant difference was found. The comparison of proprioception results indicated the ACLRG participants, who had participated in ACL program sessions, had no significant difference in knee dominant leg proprioception with UIG ones ($t = 1.33$, $p = 0.19$, Cohen's $d = 0.71$). Moreover, in YBT test, the findings showed there is no significant difference in YBT directions between two groups (ANT: $t = 0.38$, $p = 0.70$, Cohen's $d = 0.53$; PM: $t = 1.64$, $p = 0.10$, Cohen's $d = 0.60$; PL: $t = 0.49$, $p = 0.62$, Cohen's $d = 0.49$) and also in YBT- total scores, the results showed no significant difference between ACLRG and UIG ($t = 1.15$, $p = 0.25$, Cohen's $d = 0.56$).

Table 2. Comparison Mean (SD) in dominant leg between two groups (ACLRG and UIG)

Variables	ACLRG	UIG	CI
EX- peak torque 60°/s (Nm/kg)	176.81 (46.81)	182.84 (30.44)	(-19.24) – (31.31)
Flex- peak torque 60°/s (Nm/kg)	99.86 (19.42)	104.94 (26.66)	(-9.84) – (20.02)
EX- max total work	166.21 (53.63)	174.42 (25.16)	(-18.60) – (35.02)
Flex -max total work	107.20 (32.07)	114.85 (28.61)	(-11.81) – (27.10)
AVG- EX power	105.16 (34.72)	112.20 (24.11)	(-12.09) – (26.17)
AVG- Flex power	69.15 (19.13)	73.10 (19.37)	(-8.38) – (16.27)
H/Q ratio (%)	56.54 (9.89)	60.72 (14.87)	(-3.90) – (12.27)
Proprioception (Degree)	2.81 (1.75)	3.67 (2.28)	(-0.44) – (2.16)
YBT- ANT (cm)	87.38 (4.38)	88.01 (5.71)	(-2.64) – (3.88)
YBT- PM (cm)	88.12 (3.81)	90.36 (4.73)	(-0.51) – (4.99)
YBT- PL (cm)	91.37 (3.98)	92.07 (4.89)	(-2.15) – (3.55)
YBT- total (cm)	93.38 (5.98)	95.62 (6.33)	(-1.70) – (6.18)

Note: ACLRG= ACL reconstruction group, UIG= uninjured group, CI= Confidence interval of difference, EX= Extension, Flex= Flexion, max= Maximum, AVG= Average YBT- ANT= Y balance test- anterior direction, YBT- PM= Y balance test – posteromedial, YBT – PL= Y balance test – posterolateral. Significant level set as $p < 0.05$

DISCUSSION

The results of the current study showed that in the isokinetic test at 60°/s, JPS test, and YBT, there was not a significant difference between athletes with ACLR who followed a specific rehabilitation regimen and athletes who were in healthy condition.

Our results in isokinetic test showed that athletes who received rehabilitation after an ACL reconstruction did not exhibit muscle imbalance in their knee flexor and extensor muscles. These outcomes are consistent with findings of Konishi et al (Konishi et al., 2012). showed after 18 months ACLR surgery, patients who followed rehabilitation process had no significant difference with uninjured group in knee muscle torque at

velocity of 60°/s. They indicated that the results may be impacted by the restoration of high threshold motor unit recruitment at 18 months following ACL surgery. Çınar-Medeni et al (Çınar-Medeni et al., 2019). also compared isokinetic knee muscle strength six months after ACLR between injured and uninjured limbs. They no observed difference between two limbs due to the fact that athletes performed their ACL rehabilitation protocol (Çınar-Medeni et al., 2019). Furthermore, despite the fact that Hoffman et al. (1999) used a different surgical procedure (patellar tendon graft), our findings disagree with their findings. Additionally, the ratio of hamstring to quadriceps strength has been utilized to determine the proper balance of knee flexors and

extensors.(Cvjetkovic et al., 2015). It is a very important factor in determining when a person can return to sporting activity.. Our ACLR athletes after at least a year of the rehabilitation have the required H/Q ratio level(Cvjetkovic et al., 2015) which allows them to go back into sports activities. Previous studies showed when ACL injury happens, the afferent feedback to nervous system decreases and it causes reduced motor unit recruitment. Thus, at least 18 months after ACLR are needed that motor units to be restored completely(Konishi et al., 2012). In addition, after ACL injury In addition, after ACL injury, the strength of muscles around knee joint is reduced, especially quadriceps muscle, or length of muscles owing to muscle imbalance are shortened(Kim & Lee, 2018; Vairo et al., 2008). However, after reconstruction surgery and following rehabilitation exercises help muscles to be activated and to be returned to initial length(Sharifi & Esmaili, 2020). Due to current study's results, it seems a year after reconstruction surgery and performing neuromuscular trainings at rehabilitation process improve the deficit in somatosensory system and active motor units around knee joint. These factors may cause no difference between injured and uninjured athletes.

However, we all know that quadriceps recovery is very slow and up to two years may be needed to obtain normal quadriceps muscle performance following ACLR(Cvjetkovic et al., 2015). Even though, our results demonstrate that there are no significant differences in quadriceps strength muscle between ACLRG and UIG.

JPS deficit of a knee with an ACL tear has been widely described in earlier studies (Angoules et al., 2011; Jerosch et al., 1996).This is probably caused by the degeneration of ligamentous mechanoreceptors, which also causes the loss of proprioceptive feedback.(Angoules et al., 2011). As a result, in addition to the mechanical interruption, the knee suffers from instability(Angoules et al., 2011). After ACLR the cortical activity is altered. For instance, scientists observed reduced JPS before ACLR surgery and improved JPS after ACLR(Baumeister et al., 2008). It has been reported rehabilitation exercises can be effective to enhance JPS in knee joint after ACLR(Muaidi et al., 2009). Moreover, another factor is enhancement of static mechanic is provided by graft. The graft builds a stable environment for joint that improves sensorimotor

complex activity(Muaidi et al., 2009). The findings of the present investigation are consistent with Sharifi et al(Sharifi & Esmaili, 2020). and Rostami et al(Rostami Haji-Abadi et al., 2014). Sharifi et al. evaluated the knee JPS in dominant and non-dominant legs between basketball players with experience of ACL surgery with autograft reconstruction hamstring and healthy ones. They found no significant difference in two legs(Sharifi & Esmaili, 2020). Rostami et al. also compared knee JPS in injured and uninjured legs in athletes that had been underwent ACLR by hamstring graft and had followed the rehabilitation process. Their findings showed there was no significant difference in knee JPS in two legs. However, the results of Laboute et al(Laboute et al., 2019). were differential. They reported the knee JPS in injured limb's athletes that it had taken three to nine months after ACLR was lower than uninjured leg. The reasons such as study design, sex, type of graft that athletes had been had surgery and the period time after surgery the JPS had been assessed can be explained to clarify different results between present study and Laboute et al(Laboute et al., 2019).

Dynamic balance has been identified as a risk factor for sports-related soft tissue injuries, including ACL tears(Myers et al., 2018). One of functional tests that is used by clinicians for assessing dynamic balance is YBT(Gonell et al., 2015). Soccer players were discovered to be nearly two times more likely to suffer injuries if their scores fell below the mean in each directions. (Gonell et al., 2015). Poor balance, impaired motor control, and a lack of neuromuscular control are all factors that put athletes' lower limbs at risk of injury(McGuine et al., 2000). In addition, it has been shown if the dynamic balance is poor, it would increase the ACL re-injury(Paterno et al., 2010). In the current research, athletes who had ACLR had not significant differences with healthy ones in all directions of YBT. Akbari et al(Akbari et al., 2016). evaluated the effect of balance training on dynamic balance in individuals who had ACLR(Akbari et al., 2016). Their results showed could partially enhanced balance stability in initial stage of ACLR rehabilitation. Therefore, they recommended include these exercises in the rehabilitation process after ACLR (Akbari et al., 2016). One of causal factor that may effect on YBT in the current study is increased strength in lower limbs, especially quadriceps muscle,

following balance exercises in rehabilitation program after ACLR because balance training may improve neuromotor recruitment, thus enhancing strength muscle (Cooper et al., 2005; Nunes et al., 2018).

Limitations

The current study has limitations, just like any other study. Due to the fact that this study was conducted as a retrospective cohort. Thus, This design can only investigate associations, not causality. The study's second limitation was small sample size, and also all subjects were males. Because of this, caution should be taken when applying the study findings to a larger heterogeneous population. The YBT and SEBT (Star Excursion Balance Test) are closely related, although they are not interchangeable. Since the SEBT may be more clinically feasible than the YBT, caution must be taken when applying the study's findings to performance on the SEBT. Similar to this, as one repetition maximum and hand-held dynamometry were excluded from the current investigation, comparisons of these alternative methods of strength testing should be done with caution.

Conclusion

Based on the findings of the present study, athletes who undergo the complete rehabilitation process and subsequently return to sports would be able to restore muscle strength and neuromuscular control in the injured limb. Since muscle strength and neuromuscular control are critical components for participating in sport, athletes can train in maximum condition and also the risk of re-injury is reduced.

Acknowledgement

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Conflict of interest

The authors affirm that they have no relevant financial or non-financial interests to disclose with regard to this work.

Author Contributions

Study design: OM and MA; Data collection: OM, MA, MA; Data interpretation: MA and MA; Manuscript preparation: OM and RB; Literature review: AM and RB. All authors have read and approved the published version of the manuscript.

Ethical Aspects of The Study

Approval was granted by the Research Ethics Committees of Shahid Bahonar University of Kerman (IR.UK.REC.1400.015. Approval Date:2021-07-27). Written authorization was received from the patent holders of the scales, and informed consent was obtained from the patients who participated in the study.

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RESEARCH ARTICLE

Adapted Physical Education for Autism Spectrum Disorder: A Bibliography Analysis in Publication 2001-2023

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Abstract

This study chose the Pubmed database (one of the world's leading databases) as the research sample and data source to be used in the bibliometric analysis. The research sample of 143 articles was published following keyword search conditions. To explore and identify key thematic areas as well as emerging topics using keyword co-occurrence analysis. To support the visualization and analysis process of the data obtained, the Vosviewer application is used. The results of this study show that APE for ASD is a research field that still needs development, this is seen from the productivity in publications ranging from 2001 to 2023, whose publication range is still below 85 articles per five years. In the visualization section, the density of high keywords is presented in 5 clusters, namely: (1) disorder; (2) service; (3) quality; (4); student (5) intervention. Bibliometric analysis in the form of mapping this analysis provides conveyance to the public regarding the pattern of publication development in the field of APE for ASD. With these findings, it helping make a multi-year research roadmap. Furthermore, it contributes to further next research, namely such as: 1) The need for holistic research on the dimensions of disorder, service, quality, and student that cluster; and, 2) the need for in-depth research focusing on one or more of the themes that are still rarely studied. such as motor skills, eating, COVID, autistic adult, Emily, home, depression, mother, care, and autistic individual

Keywords

Adapted Physical Education, Autism Spectrum Disorder, Bibliography, VOSviewer

INTRODUCTION

Adaptive physical education (APE) can include students who are not identified by the school in a particular regional unit (eg: applied at

the subdistrict, district, provincial, up to national levels. APE is intended for persons with disabilities stipulated in law. People with disabilities in question are those who have unique needs that require a tailor-made program. such groups may include learners who have limitations

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due to injury or other medical conditions; those with low fitness (including unusually thin or obese), inadequate motor development, or low skills; or those with poor functional posture. These learners may require individually designed programming to meet unique goals and objectives (Martin, 2014; Winnick & Porretta, 2017).

APE with disabilities of a certain age requires intervention services due to delays in cognitive, physical, communication, and social & emotional development. that is diagnosed as having a high likelihood of causing developmental delays (Kaloka et al., 2019; Winnick & Porretta, 2017). Although APE can be intended for several age levels with unique needs, one of the emphases of adaptive physical education is on children with Autism Spectrum Disorder (ASD). ASD is those who experience emotional and behavioral barriers, and communication and are accompanied by certain other conditions (Phytanza et al., 2023; Phytanza & Burhaein, 2019). The general characteristics of autistic children are as follows (American Psychiatric Association, 2013): (1) Continuous deficits in communication and social interaction in various situations throughout life, from birth to the present; (2) Limited patterns of repetitive behavior, interests, or activities as indicated by at least two of the following statements on history from birth to present; (3) symptoms must be present early in development (although they may not fully manifest until social demands exceed limited capacity, or maybe hidden by strategies learned later in life); (4) Symptoms cause clinically significant obstacles to current social, occupational, or other important areas of functioning.

Disability with ASD barriers has certain differences compared to those with intellectual disabilities (intellectual disabilities) or intellectual development disorders. Intellectual impairment and autism are possible and possible because these obstacle conditions occur simultaneously in ABK individuals (American Psychiatric Association, 2013; Phytanza et al., 2021). To make a concomitant comorbid diagnosis between autism and intellectual impairment, it is necessary to analyze social communication at the level of development of disability in general.

Several writings related to ASD in APE, one of which is the writing of Bodnar et al. (2020) which reviews literature studies related to the structure and influence of intervention programs. His writing used scientific study methods in 2000-2019 on the effect of implementing PE programs papers). The publication year range used is 2001-2023.

Research Design

To get the metadata of the article, researchers searched for the phrase in the PubMed

for children with ASD, participants generally varied in age, level of functional ability, and intelligence quotient. Short trial duration (8-14 weeks); The frequency of intervention is not the same, training sessions last 45-60 minutes. Sports activities with proven effectiveness are swimming as well as water games, running, walking, imitating horse riding, elements of yoga, and oriental martial (Bodnar et al., 2020; Phytanza et al., 2022).

Next is Hortal-Quesada & Sanchis-Sanchis (2022) related to the study of physical education literature in elementary school ASD. The results obtained suggest the implementation of cooperative learning strategies to increase their participation; introduction of psychomotor activities, as well as team, play to reduce stereotyped behavior, improve behavior and emotional control, and foster social and communicative skills; and provide tasks and games aimed at developing basic motor skills as well as coordination abilities to improve motor skills (Hortal-Quesada & Sanchis-Sanchis, 2022).

Therefore, one of the gaps that will be developed as well as the reason why this research was conducted by reviewing extensively related to APE in ASD. The research process focused on the following research questions: (1) how is the APE for ASD children viewed from the publication map? (2) What is interesting for academics in terms of thematic areas? and (3) What topics are often written about in publications?

MATERIALS AND METHODS

Source

This study chose the Pubmed database (one of the world's leading databases) as the research sample and data source to be used in the bibliometric analysis. In order to approach action to implement the framework Helsinki Statement, one of the key activities that build capacity is to build research capacity. It says, "Efforts should be made to share expertise and allow access to quality data and technical assistance across sectors." (WHO, 2014).

Data was collected on May 10, 2023, using keywords in the title of the article "Physical education autism spectrum disorder". Researchers managed to get the publication of scientific papers amounting to one hundred and forty-three (143

database on May 10, 2023, which included a Title Search for "physical education autism spectrum disorder". There are 143 publications indexed by PubMed. The tracing procedure is presented in Figure 1.

This study used bibliometric analysis using publication mapping and keyword co-occurrence analysis, which is a type of co-word analysis (Kaparathi, 2005). Researchers map search results from Publish or Perish then perform inputs in VOSViewer, apply keyword co-occurrence analysis to determine publication trends, and drill down into the main theme or topics that appear in the publication.

At the data presentation stage, the researcher visualized it assisted by an application, namely

Vosviewer. This application was developed by researchers affiliated in Leiden University (van Eck & Waltman, 2010). Researchers use several parameters in VOSViewer in obtaining article metadata, including 1) Type of analysis (Co-occurrence analysis), 2) Unit of analysis (All keywords), 3) Calculation method (Full counting), and 4) the Minimum number of authors documents (10 documents).

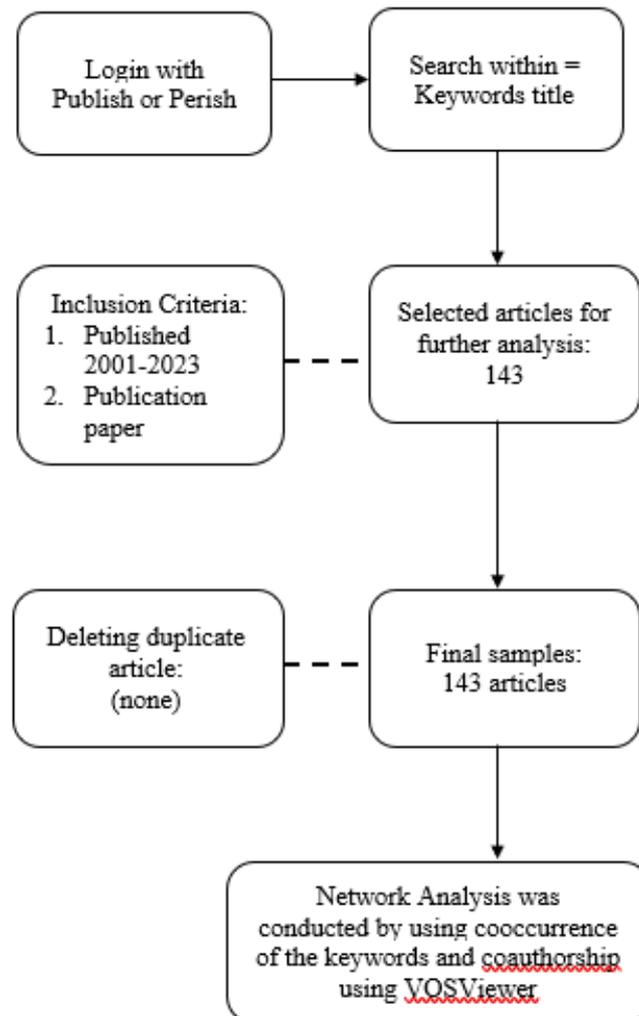


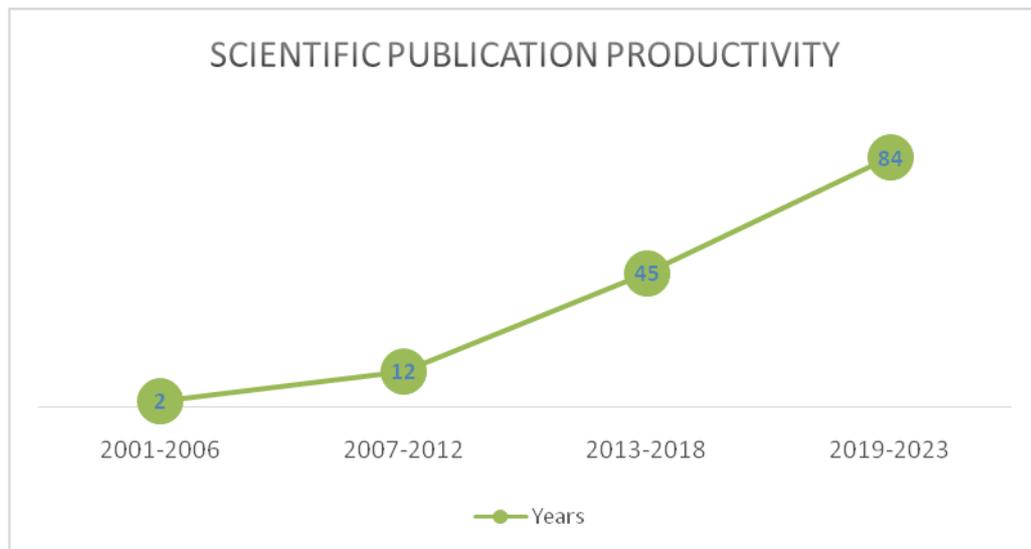
Figure 1. Search design of article metadata

RESULTS

APE for ASD was reviewed by Publication Map

Search for article publications with the title and keywords "physical education autism spectrum disorder" published in the range of 2001-2023 (22 years). In 2021-2006 with the discovery of two scientific article publications.

There was an increase in 2007-2012 of 12 articles. From 2013-2018 there was also an increase in the use of around 45 published articles. The peak of the increase is in the 2019-2023 period with 84 scientific article publications. The dynamics of change (range of years) in the number of publications can be seen in Figure 2.

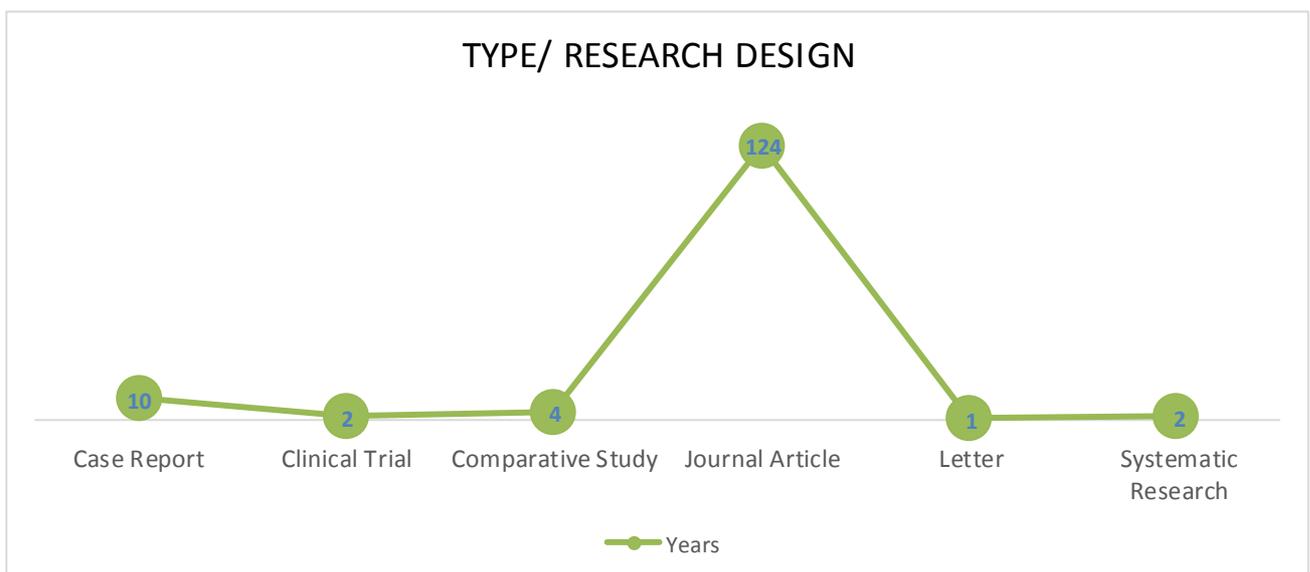


Source: Research data taken from pubmed database by publish or perish

Figure 2. Productivity from the Publication of Scientific Papers Entitled “Physical Education Autism Spectrum Disorder” from 2001-2023.

From the publications recorded, there are several types/research designs from 143 publications used in assessing the APE field for ASD in the Pubmed database. Case study There are about 10 articles on this research design. 2 articles using clinical trial research design. Furthermore, about 4 articles use the type of

comparative study. The majority of article types are journal articles, namely 124 publication articles. In type letter, there is 1 article, and the last is with type/design, namely systematic research a number of two article publications. More details can be seen in more details as in Figure 3.



Source: Research data taken from pubmed database by publish or perish

Figure 3. Type/ research design titled “Physical Education Autism Spectrum Disorder” from 2001-2023.

APE for ASD as Thematic Cluster

The results of data visualization using Vosviewer analyze keywords that appear dominant from search keywords, namely

"physical education autism spectrum disorder". VosViewer analysis on the dense keyword density visualization section is presented in Figure 4.

The visualization in Figure 5 can be identified into 5 thematic clusters. These five clusters are in Table 1, namely: (1) disorder; (2)

service; (3) quality; (4) student; (5) intervention. Bolded keywords are those with the highest number of occurrence frequencies

Table 1. High-frequency keyword groups related to ape publications for ASD

Cluster	Number of keywords (items)	Keywords
Cluster 1/Disorder/ Red	29	(1) activity, (2) ADHD, (3) association, (4) autistic deficit hyperactivity disorder, (5) autism, (6) autistic spectrum disorder, (7) boy, (8) case, (9) children, (10) control group, (11) disability, (12) disorder, (13) gender, (14) intellectual disability, (15) language, (16) month, (17) mother, (18) motor, (19) motor skill, (20) participation, (21) prevalence, (22) risk, (23) score, (24) severity, (25) significant difference, (26) therapy, (27) treatment, (28) type, and (29) week
Cluster 2/service/green	17	(1) access, (2) area, (3) autism spectrum, (4) barrier, (5) care, (6) collaboration, (7) covid, (8) family, (9) feasibility, (10) lack, (11) pandemic, (12) person, (13) physical activity, (14) role, (15) service, (16) support, and (17) technology
Cluster 3/quality/blue	13	(1) adult, (2) autistic adult, (3) autistic individual, (4) childhood, (5) clinician, (6) depression, (7) exercise, (8) life, (9) mental health, (10) patient, (11) QOL, (12) quality, and (13) relationship.
Cluster 4/student/yellow	12	(1) classroom, (2) diagnosis, (3) emily, (4) evaluation, (5) experience, (6) peer, (7) performance, (8) physical education, (9) recommendation, (10) school, (11) student, and (11) youth.
Cluster 5/intervention/purple	11	(1) difficulty, (2) eating, (3) effective, (4) evidence, (5) home, (6) intervention, (7) professional, (8) review, (9) survey, (10) systematic review, and (11) young child.

Source: Research Data Vosviewer

Appearing Topic: APE for ASD

The output of data analysis using Vosviewer as shown in Figure 6 can be visualized with at least three colors. The colors include yellow, green, and blue. This visualization shows a different meaning according to the color. The blue color indicates the initial period of the year of publication. Next, the visualization of the transition from green to yellow color gives the meaning of the final year of publication. The overlay visualization means the dominance of the

latest publication update keywords, which is visualized by the yellow color which is located in the cluster 5 area (on the right side of the map) and cluster 3 (placed on the top side of the map). Intermediate novelty publications are in clusters 2 and 4 (on the middle side of the map) and cluster 3 (on the left side of the map) visualized in green. While cluster 1 classifies keywords with the earliest average published year visualized in dark blue.

The fifth cluster is intervention. Intervention is defined as certain actions in order to change a process that has previously been running with the aim of changing in the direction as planned or the goal of a process change (American Psychological Association, 2023a). Based on the analysis of findings from the intervention cluster, keywords related to (1) difficulty, (2) eating, (3) effective, (4) evidence, (5) home, (6) intervention, (7) professional, (8) review, (9) survey, (10) systematic review, and (11) young child.

Conclusion

This study provides findings that the field of study of APE for ASD requires further research steps in efforts to develop this field, this is seen from the productivity in publications between 2001 to 2023, whose publication range is still below 85 articles per five years. In the visualization section, the density of high keywords is presented in 5 clusters, namely: (1) disorder; (2) service; (3) quality; (4); student; (5) intervention. Bibliometric analysis in the form of mapping provides conveyance to the public regarding the pattern of publication development in the field of APE for ASD. With these findings, it contributes to further research, namely: 1) The need for holistic research on the dimensions of disorder, service, quality, and student; and, 2) In-depth research needs to focus on one or more themes that are still rarely studied such as motor skills, eating, covid, autistic adult, Emily, home, depression, mother, care, and autistic individual.

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Conflict of Interest

We declare that this article we wrote has no involvement in any particular conflict of interest.

Ethics Statement

The writing of this article has gone through all ethical procedures related to the academic realm.

Authors Contribution

First author: problem formulation, methodology, data collection, data analysis, discussion, and article writing. Second author: methodology, data collection, data analysis,

discussion, and article writing. Third author: methodology, data analysis, and discussion. Fourth author: methodology, data analysis, and discussion. While the contribution of the fifth author is the same as the fourth author.

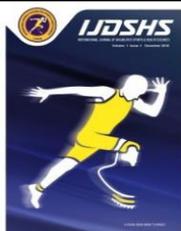
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RESEARCH ARTICLE

The Role of Sport in Acceptance of Disability and Resilience

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Abstract

It is claimed that sport is an influential mechanism that could withstand against a great many negativities with regard to life for disabled people. To this end, the purpose of the current study was to investigate the relationship between the acceptance of disability and resilience levels of athletes and non-athletes. The group of the research was made up of 140 athletes and 165 non-athletes (90 female, 215 male). In this study, which was designed in a descriptive research model, Acceptance Disability Scale (ADS) and Connor-Davidson Resilience Scale (CD-RISC) were used as the data collection tools. It was found that both the acceptance of disability and the resilience levels of athletes were high compared to disabled ones and that there was a significant difference ($p < 0.01$). In addition, it has been understood that the average scores of individuals who are successful in international competitions are higher than those who are successful in national competitions. It was concluded that there is a good level of positive relationship between acceptance of disability and resilience levels. As a result, the sport seemed to affect both acceptance of disability and resilience significantly.

Keywords

Acceptance of Disability, Resilience, Disability Sport, Physical Disability

INTRODUCTION

When it is thought that sport is a part of social integration for the disabled, the perceptions of individuals showing different developments with regard to their own self come to the fore and it comprises the basic dynamism of a sort of existence struggle. According to World Health Organization findings, almost 16% of the world population are disabled (WHO, 2023) while it is nearly 13% in Turkey (TSI, 2018). This undeniable part of the community tries to survive under the effect of different inefficacy. Even though individuals live in these troubles, they cannot reach the freedom as much as a healthy individual can in most cases. It would certainly be wrong to say the disabled individuals have

problems arising only from their handicaps. The handicap a person has does not only mean that the person cannot fulfill that task, but it also has an impact on the whole life of the person. The interaction of man who is a social being makes him a part of community. In this sense, every sportive activity is a basic social experience (İlhan & Suveren, 2010). Sport is a social asset that is offered as a public service and encompasses social dynamics (Çolakoğlu & Solmaz, 2017). In addition, sport, which is thought to be presenting social dynamics to individuals as a whole, has the same task for the disabled individuals and has a role of a bridge in the interaction of the disabled individuals with society despite its physical disabilities making him different from healthy individuals.

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In the conceptual framework and basis of sport is competition (Mellalieu, Hanton, & Fletcher, 2006; Mellalieu, Neil, Hanton, & Fletcher, 2009). Competition is to exhibit a struggle, dealing with hardships and determination. In this sense, it is the integrity of sport phenomenon of the mechanism that will provide the disabled sportspersons with enduring the problems they meet, fight against the inabilities raising from his disability and what's more have the will to be able make him different from the healthy individuals by ignoring these negative conditions. However, the perspective of society towards the disabled individuals could spoil this interaction to some extent. Karataş (2002) explains it as follows: "In the basis of the handicap the disabled individual meets lie not the handicap a person has but the preventive attitudes of a community which has an excuse of the difference creating that handicap developed towards the disabled, and the experience of being a disabled is a kind of social pressure". Because of these reasons not only the handicap cases of the disabled but also the psychological cases could also have an effect on their lives.

Resilience is defined as a fact that a human being could adapt to the changes in the process emerging after the interaction of the risk factors with the protective factors when encountered with the hard and negative life experiences (Karairmak, 2007). Depending on this definition, it is likely to say that the disabled have negative life experiences because of their handicaps and that they are psychologically influenced from this case. When the fact that the disabled individuals have to carry on their lives with these negativities throughout their lives is taken into consideration, it is clear that their resilience levels are of great importance in making them endure such a case. Furthermore, the fact that a disabled person accepts his disability and that he knows he has to live with this disability is of great importance in this psychological process. Studies show that the resilience levels of the individuals accepting their disabilities are higher (Attawong & Kovindha, 2005; Casier et al., 2008; McCracken & Zhao-O'Brien, 2010).

Embracing every part of a community, sport could be regarded as a great source of rehabilitation for the disabled. The higher the self-esteem of the disabled athletes is, the better their harmony with their environment and friends is,

and thus their mental health is more balanced and arranged (İlhan, 2010). Depending on this fact, it is believed that the regular sport has an impact on daily life and their communication they make with the community and their psychological cases are more positive compared to sedentary disabled individuals. In addition, there are some environmental factors affecting the spirituals ways of individuals in their lives (Parry, Robinson, Watson, & Nesti, 2007). An individual is under the effect of the dominant qualities of the society he lives in with his psycho-social features (Watson & Nesti, 2005). It shows a really complex structure. It is possible to attribute the good or bad, successful or unsuccessful, happy or unhappy conditions he is in. For that reason, it is of importance to evaluate the features of individuals as a whole.

The fact that physically disabled individuals attain an identity of a sportsman, their being a part of a team, their attaining success in national and international competitions make them closer to the social status of the normally developed individuals (Kırmoğlu, İlhan, & Çağlayan, 2011). Soyer et al. (2013) studied the resilience levels of physically disabled individuals doing sport in terms of some variables and found significant results in their studies. Even though the fact that disabled individuals do the sports their handicaps allows them to do so means that they accept their disability, and accordingly this case leads to curiosity in terms of both sportive success and communication with society.

In the literature regarding the concept of acceptance of disability, only a study by Şen (2016) was found in the Turkish literature. When it comes to the fact that acceptance of disability and resilience concepts are highly connected to each other (Berry, Elliott, & Rivera, 2007; Fujikawa et al., 2013; Grooms & Leahy, 2002), this lack in the literature is striking. In addition, it is of curiosity whether these two concepts of sport are related to each other. For that reason, the current research aims at determining the acceptance of disability and resilience levels of the disabled individuals who are a part of community even the completing part of it in terms of different variables with sport in the first place and investigate the relation between these two features within the content of physically disabled athletes.

MATERIALS AND METHODS

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and was initiated with the approval of the Gazi University Ethics Committee (77082166-302.08.01). The research was carried out on the basis of voluntary participation, and in this context, data were collected from the participants both face-to-face and electronically.

Participants

The athletes in the group of the research were made up of 140 physically disabled (45.0% from birth-55.0% after birth) sports individuals, 31 female and 109 male, in the branches of Amputee Football (%30.0), Wheelchair Basketball (%24.3), Sitting Volleyball (%11.4), Badminton (%10.7), Table Tennis (%9.3), Athletics (%7.9) and Swimming (%6.4) which take place among the sports branches of Turkish Sport Federation of the Physically Disabled with the ages varying from 18 to 45 ($M=27.84$) and sports experience varying from 1 to 30 ($M=10.38$). The other group of the research was made up of 165 non-athletes physically disabled in total (30.9% congenital, 69.1% afterwards), 59 female and 106 male with a different physical disability (Cerebral Palsy %28.5, Spinal Cord Injury %23.6, Poliomyelitis %23.0, Stroke %17.0, Spina Bifida %7.9) with an age varying from 18 to 56 ($M=36.45$). The failure rate in the research that was designed to have 90% power was determined as 0.05. It was thought that the sampling number which was calculated with the accompany of means and general standard deviations based on the sampling calculation formula given in the literature (Rosner, 2015) was enough.

Data Collection

The data collection tool that was prepared so as to obtain the data was made up of three parts. In the first part was personal information, in the second part was Acceptance Disability Scale (ADS) and in the third and final part was Connor-Davidson Resilience Scale (CD-RISC).

Acceptance of Disability Scale:

ADS, the original form of which was revised by Groomes and Linkowski (2007) and adapted to Turkish by Şen (2016) in order to evaluate the perceptions of the physically disabled individuals towards their disability was used. The original form of the scale was prepared by Linkowski in

1971. The scale, which had 50 items in its original form, was observed that the number of the items was decreased to 32. In the adaptation study by Şen, some items based on a social model were added and the revised form of the scale was used, and it was seen that the number of items decreased to 25 after the validity-reliability study. The scale that was used for the research data was made up of three subscales (*Transformation* ($\alpha=.76$), *Containment* ($\alpha=.85$), *Enlargement* ($\alpha=.84$)).

Transformation: “It means that an individual with disability does not compare his or her limitations and liabilities with others and accentuates his or her assets and disabilities” (Sample item-*Having my disability, I am unable to do things like people without disabilities do*).

Containment: “It means that an individual with disabilities does not expand and intensify his/her disability condition to their other functioning aspects” (Sample item-*My disability prevents me from doing just about everything I really want to do and from becoming the kind of person I want to be*).

Enlargement: “It means that individuals turned from values that were lost due to their disabilities to those which are not related with their disabilities” (Sample item-*Though I have a disability, my life is full*) (Linkowski, 1971).

The Cronbach's alpha coefficient of each subscale analyzed within the content of the group were found as .70, .87 and .84 respectively and the coefficient of the total scale was calculated as .91. The items of the scale that was arranged in the four-point Likert scale were graded as (1) Totally Disagree, (2) Partly Agree, (3) Agree and (4) Totally Agree.

Connor-Davidson Resilience Scale:

In order to determine the resilience levels of the disabled individuals, Connor-Davidson Resilience Scale (CD-RISC) that was developed by Connor and Davidson (2003) and was translated by Kararmak (2010) was used. The Turkish version of the scale has a 3-factor structure consisting of 24 items (Tenacity and personal competence ($\alpha = .93$), Tolerance of negative affect ($\alpha = .79$) and Tendency toward spirituality ($\alpha = .50$). *Tenacity and personal competence*: “It means that the individual can decisively resist negative life experiences” (Sample item-*One can achieve one's goals*)

Tolerance of negative affect: “It means that the individual can tolerate these effects in the face of negative life experiences” (Sample item-*Under pressure, focus and think clearly*)

Tendency toward spirituality: “It means the individual tends towards the fact that something come from God and are something he knows but we do not know” (Sample item-*Sometimes fate and God can help*) (Kararimak, 2010).

The Cronbach’s alpha coefficients of the subscales after the analysis in line with the data obtained from the group were calculated as .93, .83, .50 respectively and the coefficient of the whole scale was calculated as .94. The scale was arranged in five-point Likert type and the items were graded between Not True at all (1) and Always True (5).

Data Analysis

After the data input was completed, the incorrect and missing data were examined and 11 missing data (4 athletes, 7 non-athletes) were determined in the answers given for the whole parts of the two scales by individuals. Upon the literature review, (Carpita & Manisera, 2011; Downey & King, 1998; Duncan, Duncan, & Li, 1998; Little, 1988) it was determined that there were such techniques as assigning a value or leaving it as out of analysis (deleting) for the missing data problem and it was found that when 5% or less of the data is lost incidentally, there will not be very serious problems and any similar method to be used to solve the related problems will give similar results (Rubin, 1976). Taking the number of the group and the lack of the answers given to the items of the scales in these 11 data into consideration, it was decided to exclude this data.

In order to determine the appropriateness of the scales used in the research, confirmatory factor Table 1. Confirmatory factor analysis results

	χ^2	df	p	χ^2/df	RMSEA	RMR	SRMR	GFI	AGFI	NFI	NNFI	CFI	IFI
CD-RISC ADS	632.89	266	.00	2.38	.069	.05	.06	.85	.82	.94	.96	.97	.97
	676.12	238	.00	2.84	.078	.87	.06	.84	.80	.95	.96	.97	.97

Confirmatory factor analysis through the Lisrel 8.8 packet program showed that the RMSEA values for the two scales were .69 (ADS) and .78 (CD-RISC). When we look at the literature, it is seen that a value of .08 is a good fit (Brown, 2015) and a value higher than 10 is a poor

analysis was applied to both scales and structural validity was tested. In this analysis, χ^2/df Chi-square/Degree of freedom, Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residual (RMR), Standardized Root Mean Square Residual (SRMR), Goodness of Fit Index Values were assessed by taking into account the adjusted fit goodness index (AGFI), normed fit index (NFI), non-normed fit index (NNFI), comparison fit index (CFI), and Incremental Fit Index (IFI) model fit indices.

In order to investigate the relationship between the two features as well as the descriptive statistical methods in data analysis, Pearson correlation analysis was used and in order to determine the significant differences in terms of variables, independent t-test was used. The independent t-test applied to determine the significant differences between variables was applied separately for the subscales and total scores in order not to have an inflate problem in the p value and all the values were given in just one table instead of making a different table for each analysis. Cohen’s d statistics with regard to the level of being affected by the differences between means of the significant difference obtained as a result of analysis was calculated. If this value is .20, it is regarded as “small”, if it is .50, it is regarded as “medium” and if it is .80, it is thought as “large” (Cohen, 1988). The significance level was taken as 0.05.

RESULTS

The findings of the statistical analyses within the content of the acceptance of disability and resilience levels of the athletes and non-athletes were given in Table 1, 2, 3, and 4.

fit (Harrington, 2009; Kline, 2015). After these proposals were made, the compliance goodness indices were examined on two measures and the values were presented as evidence for the suitability of the models (Table 1.)

Table 2. Independent groups t-test results (athletes and non-athletes)

			N	M	ss	df	t	p	Cohen's d
Acceptance of Disability	1	Athletes	140	3.28	.61	303	3.98	.00	.45
		Non-Athletes	165	2.97	.76				
	2	Athletes	140	3.24	.52	303	3.65	.00	.42
		Non-Athletes	165	3.00	.61				
	3	Athletes	140	3.01	.61	303	2.61	.01	.30
		Non-Athletes	165	2.83	.57				
	4	Athletes	140	3.18	.52	303	3.93	.00	.46
		Non-Athletes	165	2.93	.56				
Resilience	1	Athletes	140	3.93	.81	303	2.56	.01	.29
		Non-Athletes	165	3.68	.89				
	2	Athletes	140	3.57	.81	303	3.48	.00	.41
		Non-Athletes	165	3.20	1.00				
	3	Athletes	140	3.49	.81	303	1.87	.06	.22
		Non-Athletes	165	3.29	1.01				
	4	Athletes	140	3.66	.70	303	3.16	.00	.36
		Non-Athletes	165	3.39	.78				

Acceptance of Disability: 1=Containment, 2=Transformation, 3=Enlargement, 4= Total Score; Resilience: 1= Tenacity and personal competence, 2= Tolerance of negative affect, 3= Tendency toward spirituality, 4= Total Score

In Table 2, the significant difference between the acceptance of disability and resilience levels of athletes and non-athletes is clear. When we have a close look at the subscale of “Containment” (t(303)=3.98, p=0.00), “Transformation” (t(303)=3.65, p=0.00), “Enlargement” (t(303)=2.61, p=0,01) in the acceptance of disability and “Total Score” (t(303)=3.93, p=0.00), the significant difference can be seen and when it comes to the mean scores (M=3.28, M=3.24, M=3.01, M=3.18 respectively), it is likely to see that this difference is in favor of athletes. As for resilience data, a significant difference was found at “Tenacity and personal

competence” (t(303)=2.56, p=0.01), “Tolerance of negative affect” (t(303)=3.48, p=0.00), and “Total Score” (t(303)=3.16, p=0.00) while no difference was found at the subscale of “Tendency toward spirituality” (t(303)=1.87, p=0.06). With regard to the mean scores (M=3.68, M=3.57, M=3.66, respectively), it was found that sportsperson individuals differed significantly compared to sedentary individuals at the levels of resilience as in the acceptance of disability, while no difference was found at the subscale of “Tendency toward spirituality”. It can be said that the Cohen's d value calculated from the difference between the averages is generally close to the medium effect.

Table 3. Independent groups t-test results (success at national and international level)

			N	M	ss	df	t	p	Cohen's d
Acceptance of Disability	1	National	77	3.09	.59	138	-4.40	.00	.76
		International	63	3.52	.54				
	2	National	77	3.09	.50	138	-4.00	.00	.67
		International	63	3.42	.48				
	3	National	77	2.81	.57	138	-4.69	.00	.80
		International	63	3.26	.56				
	4	National	77	3.00	.49	138	-4.97	.00	.84
		International	63	3.40	.46				
Resilience	1	National	77	3.74	.83	138	-3.12	.00	.54
		International	63	4.16	.73				
	2	National	77	3.41	.82	138	-2.57	.01	.44
		International	63	3.76	.76				
	3	National	77	3.41	.87	138	-1.35	.18	.22
		International	63	3.59	.73				
	4	National	77	3.52	.75	138	-2.70	.00	.47
		International	63	3.84	.60				

Acceptance of Disability: 1=Containment, 2=Transformation, 3=Enlargement, 4= Total Score; Resilience: 1= Tenacity and personal competence, 2= Tolerance of negative affect, 3= Tendency toward spirituality, 4= Total Score

As given in Table 3 concerning the acceptance of disability and resilience levels based on whether physically disabled athletes had any success at national and international level, statistically significant differences were found in the subscales of the acceptance of disability “Containment” (t(138)= -4.40, p=0.00), “Transformation” (t(138)= -4.00, p=0.00), “Enlargement” (t(138)= -4.69, p=0.00) and in the total score (t(138)= -4.97, p=0.00), and also in the subscale of Tenacity and personal competence” (t(138)= -3.12, p=0.00), “Tolerance of negative affect” (t(138)= -2.75, p=0.01) and in total score (t(138)= -2.70, p=0.00) of resilience scale. While no significant difference was found in the subscale of “Tendency toward spirituality”, it was found that the mean scores of the participants racing at international races and having a success (M=3.59) in this subscale as in other subscales and total scores were higher. When the calculated Cohen's d value for the significant difference between the averages is examined, it can be said that the ADS has a generally large effect. For CD-RISC, a medium effect is remarkable.

Table 4. Correlation analysis results

V	1	2	3	4	5	6	7	8	9	M	SD
1	-									27.75	7.64
2	.531**	-								10.38	6.47
3	.296**	.280**	-							3.28	.61
4	.219**	.232**	.810**	-						3.24	.52
5	.213*	.191*	.694**	.608**	-					3.01	.61
6	.334**	.172*	.610**	.497**	.737**	-				3.93	.81
7	.286**	.161	.576**	.514**	.637**	.796**	-			3.57	.81
8	.063	.077	.308**	.281**	.443**	.569**	.552**	-		3.49	.81
9	.272**	.261**	.933**	.888**	.866**	.693**	.646**	.415**	-	3.18	.52
10	.261**	.157	.598**	.494**	.695**	.905**	.898**	.812**	.671**	3.66	.70

* p<0.05 ** p<0.01 Variables: 1=Age, 2=Sports experience, 3=Containment, 4=Transformation, 5=Enlargement, 6= Tenacity and personal competence, 7= Tolerance of negative affect, 8= Tendency toward spirituality, 9= AD Total, 10=R Total

As shown in Table 4 where the correlation data was given, a significant relationship was found in positive way and low level with all the subscales and total score of the acceptance of disability in terms of age factor. When it comes to the relation of the same factor with resilience data, a low level relation was found with the subscales of “Tenacity and personal competence” and “Tolerance of negative affect” and total score, while no relation was found with “Tendency toward spirituality”. As for the sports experience as a variable, it is likely to say that there is a positive, low level relation with all subscales and total score of the acceptance of disability, there is a positive, low level relation in only “Tenacity and personal competence” between the resilience and sports experience factor. No relation was found between the other subscales and total score of the same factor. With regard to the findings between the two features, a positive medium level was found between the subscales of “Containment”, “Enlargement” and “Transformation” of the acceptance of disability and those of “Tenacity and personal competence” and “Tolerance of negative affect” of the resilience, and a positive low level

relation with the subscale of “Tendency toward spirituality”.

DISCUSSION

The findings of the current research aiming at determining the acceptance of disability and resilience levels of the physically disabled athletes and non-athletes and explaining the relation between them reveal the existence of the relation between these two features and indicate that there are differences around variables. At the end of the statistical analysis made between athletes and non-athletes, it was determined that athletes both had higher levels in the acceptance of disability and were better in their resilience. Earlier studies support these findings (Ahn, Lee & So, 2021; Benson & Jones, 1992; Henschen, Horvat, & French, 1984; Kırımoğlu, İlhan, Kayıhan, Aksoy, & Yılmaz, 2016; Mira et al., 2023; Patrick, 1986). Campbell and Jones (1994) in their studies investigating the psychological well-being of the wheelchair sport participants and nonparticipants, a significant difference was found between the two groups and the difference was in favor of the athletes. In addition, Shapiro and Martin (2014)

studied the relationship between the sportive personal perceptions of the physically disabled athletes and their social well-being and found a relation between social acceptance and close friendship. In the literature review carried out depending on this result, it was observed that the two-relation feature of the disabled individuals doing sports was positive (Martin, 2006; Seymour, Reid, & Bloom, 2009; Shapiro & Martin, 2010). In addition, it is likely to think that the significant difference in the subscale of the transformation of ADS results from the fact that the athletes are aware of their own limits significantly with an approach over their incompetency rather than competency (DePauw, 1986; DePauw & Doll-Tepper, 2000) compared to the non-athletes. It is also likely to say that the statistical difference between the two groups in the containment subscale can result from the fact that athletes accept their levels of being affected by their disabilities in different ways but they regard it as a factor limiting them individually and socially in their whole lives through various references. Such dynamics which sports presents to individuals in its natural structure as communication, socialization, catching new opportunities, being able to look through a different perspective, problem solving (Cooper, 1990; Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005; Fox, 1999; Goodwin, Thurmeier, & Gustafson, 2004; Laferrier, Teodorski, & Cooper, 2015) and so on, could get athletes to attain valuable gains and could lead to being aware of the values (Zhang, Pease, & Hui, 1996) within their lives as well. However, when a sedentary life style is preferred, it is rather hard to catch these opportunities. For that reason, the reason for the difference in the enlargement subscale indicates it. The significant difference in favour of the athletes in the subscale of tenancy and personal competence was regarded as the fact that sports could form the infrastructure that a athlete could fight against the hardships (Crocker & Bouffard, 1992) the disabled individuals experience. The repertoire of the negative experiences in the past could increase the negative expectations regarding the steps to be taken in the future. However, the athletes experience this feeling in their races many times and they sometimes win and sometimes lose. Coming to the terms when they lose it and congratulating their opponents is actually just like the simulation of life. The fact that sport in this

sense is an effective mechanism teaching the individuals who are in the heart of life to win and lose and providing them with becoming internalized (Sherrill, 1998; Williams & Taylor, 1994) shows the reason for the significant difference in the subscale of tolerance of negative affect. The reason why there is no statistically significant difference between two groups in the subscale of tendency toward spirituality is thought to result from cultural differences. It is believed that the spiritual feelings of the athletes of a country almost all of whose population is Muslim and of the all non-athletes disabled individuals are similar. It is likely to say in the light of these findings that even though the disabled individuals doing sports have some problems compared to healthy individuals, they are able to hold onto the life using their mobility as much as their handicap case allows them to do so and this case makes them different from sedentary individuals, making them both accept their disability and have relatively higher level of resilience.

When the success status of the participants is taken into consideration, it was found that the individuals racing in international competitions and having certain success had higher level of acceptance of disability and resilience compared to those having a success in national level. While some significant differences were found between the two groups in all subscales and total score at the level of acceptance of disability, a significant relation was found with regard to individuals having an international success in “tenacity and personal competence”, “tolerance of negative affect” and in total scores also at the levels of resilience, however, no significant difference was found in the dimension of “tendency toward spirituality” despite high mean scores of the same group.

In their studies carried out into the psychological well-being of the individuals doing and not doing wheelchair sports, Campbell and Jones (1994) divided the athletes into 4 groups as those competing in international, national and local races and the ones doing sports for fun and found that the disabled athletes racing in international competitions had better psychological well-beings compared to other 3 groups and also had higher level of self-esteem. In addition, the case of anxiety in 3 groups was found higher compared to the ones participating in international competitions and a difference was determined between them. In

order that physically disabled athletes can participate into international races just like healthy athletes and be successful, it is necessary that they be prepared both physically and psychologically (Martin, 2005, 2015). Therefore, it is believed that the disabled individuals could be successful by being aware of the fact that their disability is not a handicap for their branch and ignoring or accepting this case and making themselves ready psychologically (Campbell & Jones, 1994). In this sense, when it comes to the fact that the individual has a status with the success to be obtained with the importance and the result of the races they involve, it is likely to say that the significant difference between the individuals racing in national races and those racing in international arena results from it. The difference in favour of international group in subscales of ADS indicates that the awareness of these athletes of their competence, their being aware of the fact that their disability is not a handicap for a success and the positive outcomes of different life dynamics (Campbell & Jones, 1994) accompanied with this success is higher compared to national group. With regard to the level of difficulty of the races in international arena, the effort they make to participate in an activity at this level, the competency and more importantly the idea that they can deal with any kind of troubles they are likely to meet make the individuals competing in this arena different (Campbell & Jones, 2002; Giacobbi et al., 2006; Martin, 2015). It is likely to say that the difference in the two subscales of CD-RISC results from it. Having no difference in the subscale of tendency towards spirituality results also from cultural and religious features. Supported by the literature, these findings show that the disabled accepted their handicap and they differed from a great part of the community thanks to the success they obtained by regarding this case positively after reaching psychological tenancy.

In the correlation table formed as a result of the analyses of the data obtained from the athletes, significant and positive relations were determined in the two features in terms of the variables of age and sports age. While a significant difference at low level was found between the subscales and total score at the level of acceptance of disability of the age variable, a significant relation at low level was found in “tenacity and personal competence”, “tolerance of negative affect” and in total scores at the levels of resilience, however, no

significant difference was found in the dimension of “tendency toward spirituality” between the group. In terms of the sports age, findings showed a significant, positive relation at total score and subscales of the acceptance of disability at low level while a significant and positive relation was found only between “Tenacity and personal competence” subscale and the resilience scale of the same variable. Earlier studies show that there are some results not showing a similarity with the findings of the current research and a negative relation was found between the acceptance of disability and age (Aceron & Savage, 2004; Araten-Bergman, Tal-Katz, & Stein, 2015; Li & Moore, 1998; Şen, 2016). While these results do not support the obtained results, it is striking that there is no significant relationship between the age variable and the acceptance of disability in some research studies (Beder, 2014; Heinemann, Goranson, Ginsburg, & Schnoll, 1989). On the other hand, Aceron and Savage (2004) pointed out the positive and significant relationship between the onset of disability and acceptance of disability in their studies where they studied the onset of disability as a variable. In their study carried out into the relationship between the levels of acceptance of disability between Thai Buddhists and American Christians, Chen et al. (2015) found a negative, significant relation between the ages and the acceptance of disability in Thai Buddhists while a positive relation between the onset of disability with the same feature came to the fore. Upon the investigation of these two different cases, it is likely to say that the duration in disability and age go in parallel and it shows a positive increase in the acceptance of disability level. The high rate in the levels of the acceptance of disability for the young disabled individuals in the literature contradicts with the results of the individuals accepting their disability as the disability time increases. The findings obtained in the current research show that both variables have a positive relation. The above mentioned studies are the ones carried out in the sampling of sedentary physically disabled individuals. As for sports, it is an active mechanism touching on all features of life, having a power being able to cope with psycho-social negativities experienced when truly formalized. It is likely to say that both the acceptance of disability and the resilience levels of the physically disabled athletes have a positive relation with the age. In addition, sportive

experience, vocational experience and an increase in the experiences make a social contribution and it makes the person both accept it and have a psychological comfort. The sportive experiences increasing by age, positive life experiences gained through this success (Campbell & Jones, 1994), being aware of the competencies thanks to it and also the effective mechanism developed through the sport against negativities (Crocker & Bouffard, 1992) make athletes different from other individuals. It was found in the literature that sports experience was not studied for both features and in this sense no data was reached similar to or contradicting with the findings of the current research.

Another finding obtained as a result of correlation showed a strong significant relation between acceptance of disability and resilience levels in the subscales of “enlargement” and “tenacity and personal competence” for the sampling of physically disabled athletes while a medium level significant, positive relation was found in total score. In addition, it was found at the end of the regression analysis that acceptance of disability is a significant predictor of resilience. In their study carried out into the acceptance of disability and resilience levels of the burn patients experiencing a stress disorder after the trauma, Xia et al (2014) found a negative relation between their stress levels and both acceptance of disability levels and and resilience levels of them. Also, while a neative relation between anxiety and acceptance of disability in the literature (McCracken & Zhao-O'Brien, 2010; Şen, 2016), a strong positive relation between the acceptance of disability and resilience was found (Berry et al., 2007; Fujikawa et al., 2013; Martin, 2008; Şen, 2016). It is likely to say that the positive relation between the acceptance of disability and resilience is a finding showing that the disabled individuals having an activity limitation accept their case and learn how to live with it and express that they are able to carry on living thanks to mobility their other organs provide despite some limitations and in this way they have a psychologically strong body. In addition, when we consider that the individual is aware of his competences despite his disability (DePauw, 1986; DePauw & Doll-Tepper, 2000) and this awareness is a factor having a positive effect both individually and socially (Fox, 1999; Taylor, Sallis, & Needle, 1985; Yazıcıoğlu, Pekel, Kemiş & İlhan, 2020),

this result shows that the disabled individual could deal with the negative living conditions and so they can define their physical deficiencies psychologically.

The results of the current research carried out to determine the acceptance of disability and resilience levels of the physically disabled athletes and non-athletes and to investigate the relation between them showed that the two features of the athletes differed compared to non-athletes and the significant relation between them was in favour of athletes. In addition, it was found in line with the data obtained from physically disabled athletes that age, sports experience and success status variables differed in evaluation of the acceptance of disability and resilience levels in the group. The concept of sport making a physical contribution to individual as well cognitive ones does not ignore disabled individuals and involve them in this phenomenon as much as their handicap cases allow them to do so. The results of the research revealed that the benefit of sport on healthy individuals showed the same result on the disabled individuals. The fact that the disabled athletes are in the same position as the non-athletes but that the athletes are better psychologically highlights the contribution of sport. It is believed that studying into the two features in terms of other parametres different from the variables studied in the research would make a contribution to the literature. Besides that, it is recommended to study into the relation between the “acceptance of disability” and different values of the individual that will be assessed with psychometric tests in order to evaluate the personal perspective a disabled individual has even though there are some studies investigating the case of whether the families of the disabled person accept this case or not in Turkey.

Conflict of interest

The authors do not have a statement of conflict regarding the research.

Ethics Statement

The study protocol was approved by Gazi University Ethics Committee (77082166-302.08.01).

Author Contributions

Both authors contributed equally at all stages of the research.

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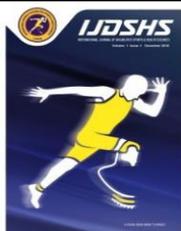
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RESEARCH ARTICLE

Every Camp Has a Story: Barrier Free Youth Camp with Teacher Narratives

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Abstract

This study was carried out to investigate the opinions of teachers who participated in the youth camp without disabilities organized for individuals with intellectual disabilities. The research was conducted in twelve teachers who participated in the barrier-free youth camp organized in Mersin province Silifke district and were selected through easily accessible situation sampling. Data were collected by means of personal information forms created by the researchers together with semi-structured interview questions, while the content analysis method was used for data analysis. Five main themes and ten sub-themes, dependent on the former, emerged from the findings. The expectations of the participating teachers before the camp started were determined to contribute to the socialization of the students, and their expectations regarding the camp environment were positive. Relating their experiences during the camp, the teachers stated that the activities prepared for the students were organized according to the latter's characteristics, with enriched and well-developed content. Although the camp was suitable for students with intellectual disabilities in terms of accessibility, they reported that there was no canteen in the camp to meet their daily needs. They found the camp to be beneficial for students to integrate, socialize and act independently. After the camp had finished, the teachers expressed their satisfaction with the experience, concluding that it had been productive both for their professional development and for the students. However, they suggested increasing the duration and number of the camps and simplifying the arrival and departure procedures.

Keywords

Barrier Free Youth Camp, Teacher, Opinion

INTRODUCTION

Social policies for disabled people in Turkey were first introduced in 1976 and gained momentum in the 1980s. The National Coordination Board for the Protection of the Disabled was established in 1981; that same year, the constitution of the Republic of Turkey guaranteed the rights of persons with disabilities. In 2005, the Law on the Disabled came into effect. With these steps, the principles of preventing discrimination against persons with disabilities

while allowing them equal opportunities and full participation in all stages of social life were adopted into law. These laws encouraged the inclusion of people with disabilities in all areas of social life, from programs to schools, sports, and entertainment services (Seyyar, 2015). In order to ensure the full participation of disabled people in society, ministries strive both within their own bodies and in cooperation with other ministries to work for people with disabilities. The duties and responsibilities of the Ministry of Youth and Sports (MYS), which carries out activities

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throughout Turkey, published in 2011 in its Decree on the Organization and Duties of the Ministry of Youth and Sports, are as follows: *“To create policies that support the personal and social development of young people and to enable them to realize their potential by taking into account the needs of different youth groups. To develop proposals to ensure effective participation in decision-making and implementation processes and all areas of social life, to carry out activities with this aim, and to ensure coordination and cooperation in the services of relevant institutions concerning youth.”* Thus, “Youth Camp” activities are organized under the auspices of the ministry in line with its principles.

The goal of these camps is to contribute to the holistic development of the individuals who attend them, to respond to their social, athletic, cultural, and personal needs, and to expand these activities throughout the country. Today, the camps stand out as facilities established for the purpose of making productive use of the free time of young people with various cultural, social, and sports activities. Youth camps are organized under the names of “Free Sea Camps” for youths aged 12 – 15 and “Free Nature Camps” for those aged 16 – 22, hence including all young people. The camps aim to provide a guiding program for young people to identify their skills and interests by making the most of their free time with themed activities. In addition, “Barrier Free Youth Camps” are also organized for disabled youth by the Ministry of Youth and Sports acting in collaboration with the Ministry of National Education (MNE). The aim is to enable students with special needs to take part in social life together with their peers through various social and cultural activities. Barrier Free Youth Camps are located in different provinces throughout Turkey, and participation is open to students with special needs and their teachers, who are involved in the education and training of these students while accompanying them at the camps. The ultimate objective is thus to provide the highest level of benefit from out-of-school learning environments (MYS, 2023).

Learning is the social structuring of knowledge in a collaborative, social interaction incorporating flexible and hands-on activities, both inside and outside the school environment (Güloğlu & Çetin, 2021). Camps represent important sports and recreational activity areas

outside of school for disabled youths to communicate, interact, and develop meaningful relationships, providing them with numerous positive experiences and new skills. The learning experiences that transpire during camp activities enable the participants to learn about themselves as well as to develop their capacity to work together and improve their problem-solving skills. Social communication and interaction occur within educational environments that help disabled youths to overcome their obstacles (D'Eloia & Price 2018). In camp environments, disabled youths have the opportunity to participate in various physical activities such as horse riding, cycling, archery, folk dances, street games, swimming, basketball, and volleyball (MYS, 2023). The camps also allow disabled youths to develop social interaction and communication skills with their peers (Schelbe et al., 2018, Anderson et al., 2018; Flynn et al., 2019), to participate in fun and developmentally appropriate physical activities (Clark & Nwokah, 2010, Bell, 2021), offer opportunities for them to develop self-esteem (Aggerholm & Moltke Martiny, 2017; Willis et al., 2017), and improve their health-related quality of life (Kapsal et al., 2019). In addition to all of these contributions, camp staff members foster an environment conducive to learning by implementing strategies and activities that incorporate their knowledge of disabilities and by encouraging the disabled youths to become active learners (Flynn et al., 2019). Furthermore, the participation of teachers in accessible youth camps, who are familiar with the students' knowledge and skill levels, helps both the camp personnel and the learning environments of the disabled students, as it is the duty of teachers to develop their students' knowledge and skills, enabling them to benefit from them (Singal & Swann, 2011). Thus far, studies in the literature have concentrated on disabled individuals, families, or camp officials participating in such camps (Michalski, et al., 2003; Wozencroft, et al., 2019; Goodwin, & Staples, 2005), whereas no study has been published on the presence of companion teachers in these camps. For this reason, we believe that it is necessary to examine the camp experiences of teachers accompanying students with special needs and to offer suggestions accordingly. Hence, the present study focused on the experiences of teachers who participated in an barrier free youth camp.

MATERIALS AND METHODS

Research Model

The research was conducted following the case study design, a qualitative research approach, in order to determine the current situation of the teachers participating in The Barrier Free Youth Camp and to examine their views on this experience in detail. A case study is defined as the investigation of one or more particular situations or circumstances. In other words, the factors (events, environment, individuals) present in a given situation are investigated using a holistic approach, with a focus on how they affect and are affected by the relevant situation (Yıldırım & Şimşek, 2013).

Participants

A total of twelve teachers were interviewed by contacting participants in the Barrier Free Youth Camp held in the Silifke district of Mersin province through easily accessible case sampling. In the study, the code names PT1, PT2, etc. (PT: participating teacher) were used in order to conceal the names of the teachers. The data obtained from the teachers interviewed within the scope of the study are presented below.

PT1, 25 years old male, special education teacher. Second year in the profession. He has been working at the Special Education School for two years. There is no previous camping experience and there is no disabled person in his family.

PT2, a 33-year-old male psychological counseling and guidance teacher. Tenth year in the profession. He has been working at the Special Education School for ten years. There is no previous camping experience and there is no disabled person in his family.

PT3, 28 years old male special education teacher. Second year in the profession. He has been working at the Special Education School for two years. There is no previous camping experience and there is no disabled person in his family.

PT4, 34 years old male special education teacher. Tenth year in the profession. He has been working at the Special Education School for seven years. There is no previous camping experience and there is a disabled person in his family.

PT5, 52 years old male psychological counseling and guidance teacher. Twenty-seventh year in the profession. He has been working at the

Special Education School for seventeen years. He has had one camping experience before and there is no disabled person in his family.

PT6, 46 years old male special education teacher. Twenty-second year in the profession. He has been working at the Special Education School for five years. There is no previous camping experience and there is a disabled person in his family.

PT7, 26 years old male special education teacher. Fifth year in the profession. He has been working at the Special Education School for four years. He has had one camping experience before and there is no disabled person in his family.

PT8, 48 years old male physical education and sports teacher. Twenty-fourth year in the profession. He has been working at the Special Education School for nine years. There is a camping experience twice before and there is a disabled person in his family.

PT9, 36 years old male special education teacher. His fourteenth year in the profession. He has been working at the Special Education School for five years. He has had two camping experiences before and there is no disabled person in his family.

PT10, 40 years old male special education teacher. His seventeenth year in the profession. He has been working at the Special Education School for eleven years. There is no previous camping experience and there is no disabled person in his family.

PT11, 49 years old male fine arts teacher. Twenty-first year in the profession. He has been working at the Special Education School for eleven years. He had a camping experience once before and there is a disabled person in his family.

PT12, 34 years old male psychological counseling and guidance teacher. Tenth year in the profession. He has been working at the Special Education School for four years. There is no previous camping experience and there is no disabled person in his family.

Data Collection Tools

Data collection was conducted in the form of individual interviews employing a semi-structured interview technique. The interview questions were prepared by the researchers based on a review of the literature and in accordance with the objectives of the study. Additionally, the interview questions were approved by two academics, both experts in

the field, who gave the questions their final form by making the necessary revisions. The questions posed to the teachers for this study were as follows:

1. What were your expectations prior to the start of the camp?
2. What are your thoughts on the suitability of the camp activities organized for the children?
3. What are your thoughts on the suitability of the campsite in terms of accessibility for the children?
4. What were the effects of the camp on the social development of the children?
5. What were your experiences after the camp finished?

Data Collection

The Barrier Free Youth Camps within the scope of the research is a one-week sea camp program for individuals with intellectual disabilities. Program activities are organized as sea and land activities organized by MYS, program managers. The program manager and camp leaders took part in the implementation of the program. The activities were carried out in the company of camp leaders and accompanying teachers who accompanied the students.

The researchers collected the data by conducting individual interviews in person (face-to-face) with the teachers. Before being interviewed, the teachers were informed of the subject of the research and gave their consent. Interviews were held at the camp during the evening rest hours on the fifth day of the camp. Interviews with the twelve teachers lasted between 30 and 35 minutes each and were recorded using a voice recorder with the permission of the participants. Permission for the study was obtained from the Scientific Research and Publication Ethics Committee of Muş Alparslan University (document date and number: 04.07.2022-55505).

Data Analysis

The qualitative data obtained from the interviews were transferred from the voice recorder to a computer by transcription before undergoing content analysis. Content analysis involves the basic process of compiling similar data within the framework of certain concepts and themes, and arranging and interpreting the data in such a way as to be comprehensible (Yıldırım & Şimşek, 2013). After being coded and themed separately by three different researchers, the data were then finalized by identifying common codes

and themes. The coherence of the codes and themes was confirmed by an independent academic with expertise in the field who performs qualitative studies. Finally, the analysis process was completed with the generation and interpretation of the findings.

Validity and Reliability

In qualitative research, validity refers to the ability of researchers to verify their findings (Yıldırım & Şimşek, 2013). For the validity of the present study, a deep-focused data collection process was applied in the interviews with the teachers, a literature review was conducted prior to preparing the questions, expert opinions were consulted during the question preparation process, and the method section included a detailed description. Reliability involves taking detailed notes such that each and every step of the research process can be followed (Yıldırım & Şimşek, 2013). To ensure the internal reliability of this research, separate codes and themes were determined by three different researchers, and the common codes and themes were then finalized. In addition, two independent academics, who are experts in the field and in qualitative research, applied content analysis and checked the suitability of the codes and themes obtained using a holistic approach. The agreement between the coders was determined to be 94%. Miles and Huberman (1994) reported that for a good study, intercoder agreement should be at least 80% according to the internal consistency formula (consensus / (consensus + disagreement)) (Miles and Huberman, 1994). In order to ensure the external reliability of the present study, data collection process and the overall method study were explained in detail. Articles prepared in accordance with the principles of writing and approved by the review board are published.

RESULTS

This section contains the findings of the content analysis, according to which a total of five main themes and ten sub-themes emerged

The codes of the sub-themes are shown in the table. Under the main theme “What did I expect”, there are two sub-themes, “social interaction” and “venue conditions”. The sub-themes “suitability of activities” and “inadequacy of activities” comprise the main theme “Scope of Activities”. The next main theme, “Was it

accessible”, includes the sub-themes “accessible without problem” and “need for a canteen”. For the main theme “Social Development”, the sub-themes “two heads are better than one” and “becoming independent” were created. The final main theme, “What did I find”, consists of the sub-themes “invaluable” and “legislation barriers”. Certain views expressed by the participants with respect to the above sub-themes and codes are presented in the following paragraphs.

The main theme “What did I expect” concerns the teachers’ expectations prior to the start of the camp and includes two sub-themes, “social interaction” and “venue conditions”. Concerning the former, PT1 answered thusly: “I did not know what we would encounter in the camp. In general, my expectation was an environment where students from different schools could spend time together playing, engaging in aquatic activities, socializing, and talking with each other.” PT8 responded as follows: “My expectation was that the students who came here would come together and socialize, make new friends, realize their self-worth, and enjoy themselves with games and aquatic activities.” With respect to the “venue conditions” sub-theme, PT4 said: “Actually, when I heard about the camp, I expected that fun activities would be held in a pleasant environment, in a clean and well-kept space, within a program prepared beforehand.” Regarding the same topic, PT10 stated: “Actually, I didn’t have much in the way of expectations because I thought that everything would be done through a ready-made program. My sole expectation was that the first children would arrive safely and have their needs met in a safe environment, and I expected the program managers in other sections to act with all of these points in mind and organize the activities accordingly.”

The main theme “Scope of Activities” concerns the views of the teachers regarding the appropriateness of the activities organized in the camp for children. Under this main theme, the two sub-themes “suitability of activities” and “inadequacy of activities” were created. suitability and activity inadequacy. With respect to the first sub-theme, PT2 replied as follows: “There are aquatic activities. There is no sea where we and the children come from, so the children’s swimming skills are not developed, they have not encountered the sea much. From this point of view,

this is a very good thing, we endeavor to help the children acquire swimming skills. Apart from that, there are activities carried out by the camp administrators in order to develop the children’s social skills and ensure their integration. I think it is appropriate because these activities are organized in the form of structured games and activities, taking into account the situations of the children.” PT7 responded: “(There are) children with mild intellectual impairment and hearing impairment. It is debatable whether they are all different from each other or if they are affected to the same extent. But I can say that with the adaptations made, things have been brought to the same level for the children. For example, one student knows which is the right side, the other does not. For this reason, the teacher made it suitable for children by pointing to his right side, using verbal cues or including an example in the activity.” In response to the sub-theme “inadequacy of activities”, PT5 stated: “The activities within the scope of the camp program were aimed at children. But the variety of activities was minimal, and there were occasional problems with the aquatic activities. Because most of the children who come here have not seen the sea. Aquatic activities could have been incorporated more regularly, different game groups could have been established. Children get bored and want to do something in their free time. For this, some tools or activities could have been utilized. After all, these children need special developmental support. In this sense, their needs could have been met.” PT12 commented thus: “There are not enough activities in the camp, the level of activities is suitable for the children, but the activities needed to be developed. There were 3-4 activities and their duration was very short, they were not activities that would take much of the students’ time.”

The main theme “Was it accessible” pertains to the teachers’ views on the suitability of the camp for children. Within this theme, two sub-themes were created, “accessible without problem” and “need for a canteen”. In response to the issue of accessibility, PT9 answered: “It was suitable. Our students had mild intellectual disabilities anyway. Despite that, there were ramps, signs, signage. Access to the places within the camp was easy.” PT6 stated: “I did not see any shortcomings in accessibility. It was possible to roam easily. The width of the ramps, signage, signs, interior

corridors, and rooms were all appropriate. The circulation between the buildings and the access to the sea were convenient.” To the topic of “need for a canteen”, PT3 responded: “There is no problem in accessing the dining hall, dormitory, and the sea within the campground, but the campground itself is a closed area within certain limits, and the children cannot go out and sometimes they want things, so not being able to leave or have a place like a canteen that meets their needs created a problem.” PT10 expressed the opinion that “The facility was strong in terms of accessibility for children. There was simply no place for children to provide for their individual care needs and wishes. The children were told to bring their own supplies, but they cannot bring a washing machine themselves. Sometimes they may need something they don’t have. There should have been a washing machine in each room, or a laundry room, and a place where they could obtain what they wanted.”

The main theme “Social Development”, which interrogates the teachers’ thoughts on the effects of the camp on the social development of the children, contains two sub-themes, “two heads are better than one” and “becoming independent”. Regarding the first sub-theme, PT5 was of the view that “The effects on the children’s social development are absolutely very positive. We see that our students, who did not speak at all when we first came, communicate with students from other provinces and chat with them. I think these camps will be more beneficial in integrating them by placing them together with their typically-developing peers.” PT8 responded thus: “We organize events with our students for their schools all year. Similar activities were held here as well. However, the difference was that here the child felt that he was cared for. They met students from different provinces, socialized, and felt that they were not alone. They made new friends and when we saw the happiness on their faces, we realized that they had a lovely camp experience as well.” With respect to the sub-theme “becoming independent”, PT4 commented: “There was very serious socialization between the students, there was mixing and socialization both among themselves and with students from outside, and they influenced each other. They could not meet their own needs on their own, their families helped, but seeing each other here, they started to

do their own work, for example, making their beds, arranging their closets, arranging their belongings, etc., they saw that they could do this.” PT5 replied: “During the one-week camp, I witnessed the positive aspects of this, socialization took place at a high level, there was commingling, I saw that the environment for establishing friendships with each other was very, very good, I think that their ability to act on their own developed in this direction. I saw my students, who previously could not go anywhere without permission, could get food on their own, go to the bathroom on their, go to the doctor on their own after getting a sunburn at the sea. I never saw any of my students ask if I could go together with them or take them to the doctor after getting sunburned, instead I witnessed them going on their own, and this made me very happy.”

The main theme “What did I find”, concerning teachers’ thoughts about their post-camp experience, consists of two sub-themes, “invaluable” and “legislation barriers”. Regarding the first, “invaluable”, PT9 remarked: “There was an unexpected situation when it came to this. I didn’t know what to expect at the camp. Now I know what the camp is. That would create different expectations, and there was a thought about how I could involve these children in such activities. We were aware of such things before, but I did not know that it could be so effective and productive for the children.” PT6 commented: “I wish that there were more such activities from the Ministry. I expect inter-provincial and inter-regional [activities]. I believe that will be more useful. Here, we met with teachers from other provinces, we shared our professional knowledge, and I think we will be more useful in our school by eliminating the shortcomings we see in ourselves.” In the sub-theme of “legislation barriers”, PT7 answered, “Actually, I have known the organization since the beginning. Getting to and from the camp could have been a little easier. Buying tickets, canceling them, and making payments to the company were tiring for the school administrators. Perhaps MYS or MNE vehicles could have been used to come here. Or, if the transportation contract were to include a clause that the contractor company shall provide free transportation for social events, I think the transportation problem would be eliminated. It is necessary to reduce bureaucracy.

When people are coming on holiday to relieve the year's exhaustion, they shouldn't have to be in a rush, I think we should be able to solve this very easily." PT11 expressed the following views: *"From now on, if such a camp is planned, we can proceed a little more professionally. For example, one-stop solutions can be produced for problems such as pre-camp correspondence and transport to the camp. We might want the camp to be in a different area, we might want it to be in a different region. When we participate in such activities, we can contribute to the work of enriching the very activities that will take place during the camp."*

DISCUSSION

Leisure time activities, which include physical exercise and artistic/cultural activities, contribute to the development of social behaviors while satisfying the individual's spiritual needs and improving their mood (Doster et al., 2006). Youth camps, organized with the goal of putting the leisure time of young people to good use, enable young people to gain new life experiences, spend time together and share spaces with their peers, realize their shortcomings during group work, and recognize their abilities (Fort et al., 2017). In line with this, our study was conducted to investigate the views of the teachers who participated in an barrier free youth camp as regards their experiences prior to, during, and after the camp. On the subject of "social interaction", a sub-theme of the main theme "What did I expect", the teachers commented that they had expected a camp environment full of aquatic activities, programs suited to the development level of the students, sports activities, and educational games. In addition, they expected the camp to provide an environment for communication, in which students from different provinces and different schools would socialize, and new friendships would be established among the children. They expressed a general optimism regarding the future of the accessible camp, that it would continue with various activities, with positive effects on the social development of the children. Outdoor activities performed with teams have been found to foster the development of self-confidence in children and young people, reciprocally enhancing their communication (Marchant et al., 2019; Slingerland et al., 2020; Anderson vd., 2018; Flynn vd., 2019). Esentaş et al. (2016) concluded

in their study that nature camps offer positive cultural, social, and spiritual contributions to students. These results support the expectations of the teachers elicited in the present study as regards the "social interaction" sub-theme.

The sub-theme "venue conditions", also under the main theme "What did I expect", investigated the teachers' views on such matters as ensuring the security of the location where the camp would be held, providing a beautiful, clean and well-kept area, and preparing the camp environment for activities and to satisfy basic needs. In this vein, meeting the security needs of the participants and providing a clean and well-maintained environment in which they can feel comfortable can create a satisfactory experience for them. The sense of peace associated with an individual's security, privacy, and comfort (Schlesinger, Cervera, & Cabanero, 2014) should include people's need for security and privacy in a single place (Amoah, Radder, & Eyk 2016). Aksoz et al. (2012) reported that the primary concern of the participants who had experiences with camps prior to joining the camp in their study was how to meet their daily needs (showers, meals, etc.). These findings are consistent with the expectations of the teachers in our study pertaining to venue conditions.

With respect to "suitability of activities", a sub-theme of the main theme "Scope of Activities", the teachers considered the camp activities to be appropriate for the level of the students, having been adapted according to their levels both during the camp activities of the teachers and with the support of the camp leaders, and thought that students easily performed the activities, which were implemented in a certain order. In contrast, examining the sub-theme "inadequacy of activities", some teachers stated that the number and variety of the programs are insufficient, that activities involving coordinative skills in some sea and land activities are difficult for students, preliminary preparations cannot be made before the activities, and they are unaware of most of the activities. In addition, the importance of enriching the programs, increasing the number of activities, diversifying and developing the activities, choosing team leaders, creating different game groups and getting the opinions of the participating teachers before the camp has emerged. There was no consensus concerning the implementation of the activities in

accordance with the stated objectives camp and for the development of the students. Activities in which people participate in their leisure time create important opportunities in terms of personal development such as expressing themselves, recognizing their abilities, evaluating their creativity, and improving their language, consciousness, social, emotional, and motor skills (Aytaç, 2003). Certain adaptations to athletic programs are necessary in order for individuals with special needs to participate in sports activities and benefit from them (Schultheis, Boswell & Decker, 2000; Clark ve Nwokah, 2010, Bell, 2021). Avan et al. (2019) reported that activities associated with daily life and carried out in a practical manner enhance learning, supporting the views of the teachers in our study on the sub-theme of “suitability of activities”. However, in order for the camp program to achieve its purpose, it is essential to plan the camp activities so that they meet the needs of the students, secure the close participation of expert teachers familiar with the students’ strengths and deficiencies during the planning stage. Outside the classroom environment, educational activities that activate all the sense organs and enable students to grasp elements of the environment should be carried out (Gruno & Gibbons, 2020). In general, camp programs for people with disabilities are carried out in an environment where materials are specially identified, staff assistance is available, and appropriate activities are available (Knapp et al., 2015). Yükseltürk et al. (2016) reported an increase in students’ perception levels related to problem-solving skills in their summer camp study, but the significance of the findings could not be determined; they emphasized that the number of activities should be increased and similar activities disseminated. These results align with the opinions of the teachers with regard to the sub-theme “inadequacy of activities”.

Regarding accessibility, the first sub-theme “accessible without problem” reflects the teachers’ statements that they had no difficulties in reaching the camp nor finding their way around the camp, where they were guided by the camp managers after their arrival. A camp should be planned in such a way as to be accessible to all participants, so they arrive smoothly and comfortably, thus generating positive feelings about the camp. In order for integration to be successful, the participant needs to be socially integrated into the

program. In addition, the program should ensure the participation of all individuals collectively while being accessible to all participants; at a minimum, these two criteria must be fulfilled (Brookman, 2003; D’Eloia & Price, 2018). Experiences with other aspects, including accommodation, outdoor activities, and transportation, also affect the satisfaction level of camp visitors (Öztürk & Başarangil, 2019). In a qualitative study conducted by Hırça (2012), the teachers expressed the opinion that “the location of the camp was ideal for transportation, security, and providing all kinds of facilities”, thus supporting the importance of this sub-theme as indicated by the views of the participants in our study.

On the topic of the sub-theme “need for a canteen”, the consensus emerged that due to the lack of a canteen, the students were not always able to meet their alimentary and other individual needs and that the location of the camp afforded limited opportunities to reach places such as canteens and buffets. The habit of snacking is central to the modern diet and therefore may be considered within the framework of basic needs. Studies in the literature have reported that the regular eating habits of adolescent students are quite insufficient and they thus have adopted the habit of eating snacks between meals (Büyük and Özdemir, 2018; Özmen et al., 2007). Glasser (2005) stated that the level at which one’s daily needs are met contributes to the individual’s well-being and happiness. In this vein, the fact that the students who attended the camp expressed the desire to meet their daily needs for snacks and other personal needs supports the findings of that study.

Regarding the sub-theme “two heads are better than one”, under the main theme “Social Development”, the teachers observed that the camp provided students a chance to get to know each other and form friendships, mingle with students from different provinces, improve communication skills, meet social needs, and develop play skills. The teachers also noted that the students felt that they were cared for and that they were not alone. Furthermore, the teachers stated that mixed camps should be planned and implemented, given that there is no place other than school and family life for these students to socialize. Well-planned barrier free youth camps are important for students with disabilities in terms of communicating with their peers, acquiring

friendships, and developing socialization skills. Camps represent a great opportunity for students both with and without disabilities to become better acquainted with and accept their peers (Stewart, 2017) while guiding students toward healthy social development (Knapp et al., 2015). Leisure activities are important for all individuals, but leisure activities are even more so for people with disabilities by allowing them to fully integrate with their social environment (Pagán-Rodríguez, 2014; Melbøe & Ytterhus, 2017). These results support the views of the teachers revealed in our study pertaining to the sub-theme “two heads are better than one”.

On the topic of the sub-theme “becoming independent”, the teachers expressed the view that the students acquired experience in meeting their personal needs, could act without assistance, and would be able to lead their lives without being dependent on others. Participation in an accessible youth camp contributes to the acquisition of basic life skills for students with disabilities, allowing them to gain experience in meeting their needs. Experience is formed by directly observing individual or actual participation in activities (Sathish & Venkatesakumar, 2011). In this vein, students participating in camp activities contribute to their ability to act independently. Therapeutic Recreation has been defined as a holistic process that deliberately employs recreational and experiential interventions to achieve social, emotional, intellectual, physical, and/or spiritual change in order to maintain and improve health status, functional capacities, and quality of life (Carter & Van Andel, 2019). This concept confirms the idea that individuals contribute to the development of independent living skills in a camp environment. Studies have shown that disabled students participating in a camp improve their independent decision-making skills while also learning teamwork through camp activities (Henderson, 2007; Daughrity et al., 2020). Cobanoglu et al. (2020) found that the students who participated in their study enjoyed the activities carried out in the camp and felt more independent and free in the camp environment, results which are aligned with the views of the teachers in the present study.

The sub-theme “invaluable”, under the main theme “What did I find”, concerns the teachers’ views on the positive outcomes afforded by the camp. The feedback obtained from the teachers

was that the students were happy to participate in the camp, that the latter was productive and contributed to the students’ acquisition of independent living skills, but that the camps should be further developed and duplicated in different regions of the country. Additionally, they stated that they had earned camp experience for themselves, learned about the camp, recognized their deficiencies, had the chance to meet their colleagues, shared information, and acquired different experiences. When barrier free youth camps are completed, students with disabilities may demonstrate progress in numerous ways, gaining positive experiences while having fun. Learning environments outside of school enable students to acquire fun, varied, and natural experiences thanks to the different activities they offer, while providing rich learning opportunities by eschewing books and the classroom environment (Saraç, 2017). A camp environment, as a learning environment, can also affect the personality and social development of individuals, affording opportunities to make new friends, take part in group activities and become acquainted with group members, as well as acclimate them to social life (Povilaitis & Tamminen, 2018). A review of the literature reveals that various camp programs implemented for groups with different characteristics engender positive outcomes, especially therapeutic recreation, and camps operating within this scope positively affect the health, social, and psychological development of individuals (Wozencroft et al., 2019; Neville et al., 2019). Outdoor learning activities in nature provide multifaceted benefits, especially for the cognitive, sensory, social, and health development of individuals, as our results for this sub-theme indicate.

Regarding “legislation barriers”, the second sub-theme of the main theme “What did I find”, the teachers commented that the duration of the camp was insufficient, the bureaucratic processes involved in camp participation should be reduced, the content requires enrichment, the planning should be more professional, and a greater number of more diverse youth camps should be organized in different regions. Well-designed, efficient preparation, implementation, and termination processes for barrier free youth camps are critical for fostering a more successful camp experience (Esentaş et al., 2017). Concerning the disadvantages of field trips, Kubat (2018) reported

that many of the pre-service teachers stated that legal proceedings progressed slowly and that potential security problems may arise. These results are consistent with the views of the teachers participating in the current study on this topic.

Based on the themes obtained as a result of our research, the participating teachers were found to have positive expectations regarding the camp environment, and these pre-camp expectations would contribute to the socialization of the students. As for their experiences during the camp, the teachers stated that although the activities prepared for the students were arranged with a view to the students' characteristics, the content should be further enriched and developed. Regarding the issue of accessibility in the camp, they commented that it was suitable for students with intellectual disabilities, but expressed concern over the lack of a canteen for the students to meet their daily needs. They also remarked that the camp was beneficial for students to integrate, socialize, and act independently. At the conclusion of the camp, the teachers confirmed that the time spent in the camp was productive both for their professional development and for the students and that they were satisfied, but specified that the duration and number of camps should be increased while the arrival and departure procedures require simplification. In line with these results, we offer the following suggestions:

- Eliminate the deficiencies of barrier free youth camps and include field experts in planning.
- Provide camp leaders with training within the scope of in-service adapted physical activity, oriented toward their program responsibilities.
- Organize the camps more than once a year in different regions, in such a way that students with different types of disability can coexist.
- Organize mixed and inclusive youth camps where students will be together with their typically developing peers.
- The procedures employed at the point of participation and transportation to the camp should be simplified.

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Conflict of interest

The authors do not have a statement of conflict regarding the research.

Ethics Statement

The study protocol was approved by Muş Alpaslan University Ethics Committee (04.07.2022-55505).

Author Contributions

Both authors contributed equally at all stages of the research

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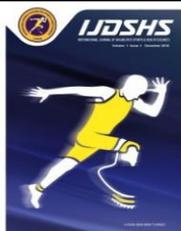
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RESEARCH ARTICLE

Effect of Custom Design Insole Applications with 3D Modelling on Baropodometric Parameters in Individuals with Pes Planus

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Abstract

It was aimed to investigate the effect of custom made insoles on baropodometric analysis parameters in individuals with pes planus, using objective measurement and production methods. 100 individuals with pes planus, aged between 4-18 years in the study. Individuals who met the inclusion criteria and the medial longitudinal arch index were included in the study. Valgus angles of individuals, plantar measurements of the feet before the use of insoles and after 6 months of the use of insoles were evaluated with the Sensor Medica® device. When the measurement results of the ankle valgus angles of the individuals before and after the insoles were examined, it was observed that there was a statistical decrease in the mean results in both feet ($p < 0,05$). When the plantar pressure results were examined, the load on the medial side of the right foot was reduced significantly ($p = 0,012$). Although there was a decrease in medial longitudinal arch of the right foot, it was not significant. There were no change in the lateral side of the right foot and the medial side of the right rearfoot. The load on the medial left rearfoot and the left medial longitudinal arch were reduced significantly ($p = 0,004$, $p = 0,021$). In study in individuals with pes planus, it was concluded that the foot should be well evaluated before and after technological based applications. Whether the insoles used provide benefits in foot development should be followed up with controls and their suitability should be checked, and changes in their physical capacities should be observed.

Keywords

Foot, 3D Design, Insole, Pes Planus, Plantar Pressure

INTRODUCTION

Pes planus is a foot deformity characterised by a decrease in arch height below normal values, decreased or absent height of the medial longitudinal arch, valgus of the rearfoot and abduction of the midfoot relative to the heel (Dare and Dodwell, 2014). According to studies, the incidence of pes planus has been reported to be 20-37% (Raj et al. 2022; Benvenuti et al.1995). Pes planus can be seen in two forms as flexible or rigid. In flexible pes planus, the cavity of the medial longitudinal arch is preserved when no load

is applied on the foot, while flattening occurs in the cavity when load is applied. In rigid pes planus, the medial arch cavity is flat in both cases.

In a structurally normal foot in the neutral position, the load-bearing line passes through the 2nd metatarsal, the forefoot is perpendicular to the leg and the calcaneus is on the same line with the tibia. Collapses occurring in the medial longitudinal arch are due to increased pronation and decreased plantar flexion-adduction muscle force (Hajizadeh et al. 2022). Increased pressure in the medial line of 36 the foot also negatively affects physical performance. As the loads on the

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medial heel, 1st and 2nd metatarsals increase, all segments in the kinetic chain are affected and physical performance parameters such as jumping and changing direction decrease (Zhao et al. 2017).

In individuals with pes planus, the longitudinal arch of the foot may lose its ability to return to its initial height during weight bearing. Therefore, a foot orthosis should be able to regulate the arch height in different weight-bearing situations and prevent excessive pronation. Also, insoles used for individuals with pes planus should be flexible to facilitate adequate movement of the foot joints. In recent studies, flexible orthoses that maintain and/or increase arch height while standing have been emphasised (Williams and McClay, 2000; Banwell et al. 2014; Huang et al. 2004).

The prescription of insoles for pes planus aims to optimise the structure of the foot and the natural orientation of its associated function. This protects the medial longitudinal arch from abnormal stresses, preventing further deformity while attempting to promote optimal foot function and stability. Studies have shown that insoles reduce subtalar pronation and bring the results of lower extremity kinetic and kinematic analyses closer to normal (Murley et al. 2010; Mündermann et al. 2003). Materials and construction techniques in insoles are changing in parallel with the developing technology. Insoles made of Ethylene Vinyl Acetate (EVA) material using 3D modelling and CAD/CAM (Computer Aided Design / Computer Aided Manufacturing) method are widely used in the production of custom made insoles (Ahmad et al. 2012).

Plantar pressure analysis generates CAD data that is accurate to within a fraction of a millimetre. It also creates a 3D image of different areas of each foot in different colours to provide a clinical record of the analysis. There is software that measures plantar pressure on the basis of the scanned image. The information is transferred through mathematical transformation so that system users can determine the thickness required to design the insoles. The customised insoles (CAM), either hard or soft, are then manufactured using computer numerically controlled (CNC) milling machines. This method makes the design of the insoles much more precise, allowing rapid production and making them more ergonomic and comfortable (Huang et al. 2011; Turner et al. 2020). The aim of our study was to investigate the

effect of 3D modelling of custom made insoles on baropodometric parameters in individuals with pes planus.

MATERIALS AND METHODS

Individuals

The study included 100 voluntary patients between the ages of 4-18 years who were diagnosed with Pes Planus. Sample size was calculated with 3.1.9.5 version of the G*power software. Type-1 error rate was accepted as 0.05 and power rate as 95%. The effect size was taken as 0.5 using the reference study data. The number of people included in the power analysis was 47. Individuals who had undergone foot and ankle surgery in the last 1 year, who had previously used insoles made with 3D modelling, who had pain, who had received treatment for pes planus, who were not ambulatory whose foot anatomical integrity was not complete were not included in the study.

The study was conducted in accordance with the Principles of the Declaration of Helsinki and was found ethically appropriate with the file number E-10840098-772.02-58338 at the meeting of Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee dated 26/10/2020.

The individuals participating in the study were informed verbally and in writing about the purpose, duration, and evaluation parameters to be applied. "Informed Voluntary Consent Form" was read by the participants and their signatures and their consent was obtained. The study was conducted between October 2020 and March 2021 at the Aktif Prosthetics and Orthotics Centre and the Istanbul Medipol University Prosthetics and Orthotics Centre.

Method

In order to ensure that the measurement, evaluation and production methods used were in line with objective data, the arch height index was measured using a computer-aided baropodometry device from Sensor Medica and a Vulcan Computer Numerical Control (CNC) machine was used for insoles production. Evaluation and measurement analyzes of the foot were made by a physiotherapist. Insoles were applied by an orthotist. Insoles were started to be used for at least 5 hours a day, starting from 1-2 hours a day in the first week and gradually increasing the

number of hours. It is expected to get used to in a period of approximately 2-3 weeks. The participant was called to the clinic and checked in to assess the improvement with the use of insoles, examine the pressure areas and adjust the corrections if necessary. Checks were made every 3rd, 6th and 12th months to assess whether the child still needs insoles. Insoles suitable for the length of the foot were provided to the participant when the foot length increased.

Age, gender, height, weight, body mass index and foot size were recorded as demographic information. Static and dynamic analyses were performed with a baropodometer for individuals with an arch height index below 0.275.

Medial longitudinal arch height index measurement system

The medial longitudinal arch height index measurement system was validated and recognised by Williams and Mc Clay in 2000. It is used to measure the height of the medial longitudinal arch (MLA) and categorises the foot into pes planus, normal and pes cavus. The ratio of the dorsal height measured at 50% of the foot length to the distance from the metatarsal head to the heel gives the MLA height index. If this ratio is 0.356 or greater, it is considered pes cavus, and if it is 0.275 or less, it is considered pes planus (Williams and McClay, 2000).

Pedobarographic analysis

Sensor Medica baropodometry device and Freestep software were used to measure plantar pressure distribution. There are many studies that use software with validity and reliability (Szczepanowska-Wołowiec et al.; Sgrò et al. 2014). Sensor Medica Freemed is a 120 x 50 cm foot plantar pressure distribution analysis device with a pressure platform made of aluminium, 8 mm thickness, 10000 sensors with a sensor life of 1,000,000 cycles, 2.5 dpi XY, 8 bit Z resolution, and a maximum pressure of 150 N/cm² (Sensor Medica, Rome, Italy). Pedobarographic evaluation was performed as static and dynamic analysis. During static analysis, the participants were in a static position with open eyes for 5 seconds. Dynamic analysis was performed by walking the individual on the platform for 6 rounds. In the static analysis, the ankle valgus angle was recorded. Ankle valgus angle measurements were measured with the goniometer in the Freestep software before and after insoles. In dynamic analysis, medial and lateral load distribution

percentages (%), medial longitudinal arch distribution percentages (%), medial and lateral heel load distribution percentages (%), and load distribution percentages of the medial rearfoot (%) were measured for both feet in the sagittal axis in the middle of the stance phase of gait.

Custom made insoles production process with CAD/CAM method

Custom made insoles were produced in line with the recorded data and evaluations. As a result of the foot evaluation of the individuals participating in the study, it was deemed appropriate to use Ethylene Vinyl Acetate (EVA) material with a hardness value of Shore A 35 in all insoles. As a result of the pedobarographic evaluations of the individuals, medial and transverse arch reinforcements were added to the insoles according to the pressure distribution. In order to help palmar grip, supports were designed in 3D with EasyCad modelling interface. With the subtalar joint in neutral position, the medial longitudinal arch reinforcement was added to the insoles in a convex structure starting from the tuberosity of the calcaneus, reaching the apex at the navicular tubercle and extending to the head of the 1st metatarsal. After these procedures, the insoles from EVA material in blocks were adjusted in the CNC milling machine to be suitable for the patient's shoes and the compatibility was checked.

Data analysis

Statistical Package for Social Sciences (SPSS) Version 20.0 (SPSS inc. Chicago, IL, USA) was used for data analysis. Data expressed in numbers were expressed as n (%) and data expressed in measurements were expressed as arithmetic mean \pm standard deviation ($X \pm SD$). Statistical significance level was accepted as $p < 0.05$ in all analyses. Normality test showed that the data were not normally distributed. For this reason, the study was performed with Wilcoxon test, one of the non-parametric tests.

RESULTS

The study included 100 individuals with pes planus, 60 males and 40 females aged 4-18 years. The mean age of the individuals was 10.32 ± 3.19 years, mean height was 139.18 ± 19.65 cm, mean body weight was 39.12 ± 16.65 kg, mean Body Mass Index (BMI) was 19.25 ± 3.95 kg/m² and mean foot size was 35.07 ± 4.45 .

When the valgus angle measurement results of the individuals (Table 1) and the comparison of valgus angles according to age range (Table 2) were analysed before and after the insoles, it was seen that there was an average 32% decrease in the left and right foot. The most statistically strongest results were the reduction in valgus angle ($p < 0.05$).

The results of baropodometric measurements before and after 6 months of insoles use are shown in Table 3 and the comparison of plantar pressure measurements according to the age range of the individuals is shown in Table 4. According to the

results of baropodometric measurements before and after 6 months of insoles, the load on the medial aspect of the right foot decreased significantly ($p = 0.012$), although the load distribution in the medial longitudinal arch of the right foot decreased on average, it was not statistically significant ($p > 0.05$). The load on the left medial rearfoot and medial longitudinal arch of the left foot decreased significantly ($p = 0.004$, $p = 0.021$). Although the mean load distribution on the medial left foot decreased, it was not statistically significant ($p > 0.05$).

Table 1. Comparison of valgus angles of individual

STATIC ANALYSIS	Variables	Min- Max Before Insoles	Min- Max After Insoles	Before Insoles X \pm SD	After Insoles X \pm SD	Wilcoxon Signed Ranks Test	
						z	p*
	Left foot valgus angle (°)	5.00-21.00	2.00-16.00	11.06 \pm 3.29	7.76 \pm 2.87	-8.081	0.005*
	Right foot valgus angle (°)	4.00-18.00	1.00-16.00	10.8 \pm 3.16	7.04 \pm 2.94	-8.527	0.005*

%; Percentage, SD: Standard Deviation, X: Mean, Wilcoxon Signed Ranks Test, Statistical significance $p < 0.05$ *

Table 2. Comparison of valgus angles according to age range of individual%; Percentage, SD: Standard Deviation,

STATIC ANALYSIS	Variables	Before Insoles X \pm SD	After Insoles X \pm SD	Wilcoxon Signed Ranks Test	
				z	p*
4-10 age range (N=55)					
	Left foot valgus angle (°)	10.65 \pm 3.2	7.67 \pm 2.63	-5.940	0.005*
	Right foot valgus angle (°)	10.58 \pm 3.23	6.87 \pm 2.92	-6.266	0.005*
11-18 age range (N=45)					
	Left foot valgus angle (°)	11.55 \pm 3.36	7.85 \pm 3.18	-5.515	0.005*
	Right foot valgus angle (°)	11.06 \pm 3.08	7.25 \pm 3.99	-5.792	0.005*

X: Mean, Wilcoxon Signed Ranks Test, Statistical significance $p < 0.05$ *

Table 3. Comparison of plantar pressure measurements of individuals

DYNAMIC ANALYSIS	Variables	Before Insoles X \pm SD	After Insoles X \pm SD	Wilcoxon Signed Ranks Test	
				z	p*
	Left Foot Lateral (%)	22.96 \pm 4.32	23.73 \pm 3.94	-1.710	0.074
	Left Foot Medial (%)	26.61 \pm 4.07	27 \pm 4.11	-0.799	0.424
	Right Foot Lateral (%)	25.36 \pm 4.84	24.43 \pm 4.45	-1.319	0.187
	Right Foot Medial (%)	23.46 \pm 3.92	22.28 \pm 4.29	-2.332	0.012*
	Medial Arch of the Left Foot (%)	5.09 \pm 5.54	3.87 \pm 4.74	-2.309	0.021*
	Medial Arch of the Right Foot (%)	4.31 \pm 4.46	4.01 \pm 4.68	-0.684	0.494
	Left Medial Rearfoot (%)	16.94 \pm 5.05	15.91 \pm 5.58	-2.878	0.004*
	Right Medial Rearfoot (%)	17.41 \pm 5.04	16.74 \pm 5.37	-1.518	0.129

%; Percentage, SD: Standard Deviation, X: Mean, Wilcoxon Signed Ranks Test, Statistical significance $p < 0.05$ *

Table 4. Comparison of plantar pressure measurements according to age range of individuals

4-10 age range (N=55)				
Variables	Before Insoles X±SD	After Insoles X±SD	Wilcoxon Signed Ranks Test	
			z	p*
Left Foot Lateral (%)	22.72±4.46	23.25±3.72	-1.142	0.253
Left Foot Medial (%)	26.29±3.90	26.47±3.98	-.389	0.697
Right Foot Lateral (%)	25.58±5.21	24.74±4.95	-.920	0.358
Right Foot Medial (%)	23.23±3.98	22.28±4.73	-1.525	0.127
Medial Arch of the Left Foot (%)	5.26 ±4.85	3.48±4.51	-2.671	0.008*
Medial Arch of the Right Foot (%)	4.56 ±3.88	3.29±3.57	-1.788	0.074
Left Medial Rearfoot (%)	15.87±6.22	16.08±3.92	-1.466	0.143
Right Medial Rearfoot (%)	17.09±5.10	16.35±4.58	-.666	0.505
11-18 age range (N=45)				
Left Foot Lateral (%)	23.17±4.15	24.12±4.18	-1.278	0.201
Left Foot Medial (%)	27±4.36	27.61±4.18	-.822	0.411
Right Foot Lateral (%)	24.95±4.35	24.06±3.69	-.972	0.331
Right Foot Medial (%)	23.70±3.82	22.46±3.76	-1.858	0.063
Medial Arch of the Left Foot (%)	5.26 ±6.59	5.06±6.05	-.054	0.957
Medial Arch of the Right Foot (%)	4.34 ±5.31	5.88±7.26	-1.568	0.117
Left Medial Rearfoot (%)	15.73±4.94	17.76±6.03	-2.762	0.006
Right Medial Rearfoot (%)	16.41±5.62	18.80±5.37	-2.963	0.003*

%: Percentage, SD: Standard Deviation, X: Mean, Wilcoxon Signed Ranks Test, Statistical significance p<0.05*

DISCUSSION

In our study, the effect of custom made insoles produced by CAD/CAM method on baropodometric parameters in individuals with pes planus was investigated. Individuals with pes planus were included in our study by calculating the arch height index. In 200 feet, the rearfoot eversion angle was between 4 degrees and 21 degrees. After 6 months of insoles use, 32% reduction in ankle valgus angle was observed. Decreased valgus angle in both feet, decreased contact surface of the medial longitudinal arch, decreased load on the medial side of the foot and increased load on the lateral side during walking showed that the biomechanical alignment approached normative values. In our study, it was concluded that as age increases, the physiological pes planus-based foot medial loading decreases due to normal development.

The medial longitudinal arch develops in the first decade of life. In many scans, although the majority of children are born with pes planus, the prevalence of pes planus has been reported to be between 44% and 68% at the age of 3 years and between 14% and 25% at school age (Sheikh and

Feldman, 2015; Drefus et al. 2017). Bresnahan and Juanto suggested that paediatric flatfoot should not be ignored and conservative corrective treatment procedures are appropriate before surgical interventions (Bresnahan and Juanto, 2015). Hsieh et al. (Hsieh et al. 2018). evaluated 52 children aged 3-10 years with flexible pes planus in a prospective randomised controlled clinical trial in which 26 children used insoles made of EVA for 12 weeks, while 26 children in the control group did not use insoles. They found that 76.2% of the children improved and the treatment group showed significant improvements in pain/discomfort, physical health and function, stair climbing time, transfer and basic mobility compared to the control group. In this study, which was followed up for 12 weeks and subjective scales were used as measurement methods, the effects of age range and custom made insoles were seen to reduce the loading, which supported our study. The contact of the medial longitudinal arch support of the insoles with the foot is thought to reduce the load on the arch structures by preventing increased pronation of the foot, and this result is supportive of the literature. As reported in the literature, if appropriate and effective treatment is performed in

the early period, it reduces the presence of deformity. Xu R. et al. (Xu R. et al. 2019) compared the effects of CAD/CAM produced insoles and prefabricated insoles on plantar pressure and comfort before insoles and after 8 weeks of insoles use. 80 individuals with symptomatic pes planus in the control group used prefabricated insoles and those in the experimental group used customised insoles. They found that there was an increase in the comfort of the patients in the experimental group, a significant decrease in the load on the metatarsal heads, and an increase in midfoot pressure in the control group. It is seen that customized 3D printed insoles were more effective than prefabricated insoles and offered better comfort for patients with symptomatic flatfoot.

Although there are studies using angles that can be measured by methods in which radiography is accepted as the gold standard when examining the foot structure or comparing these methods with pedobarographic methods, evaluations related to foot structure are most commonly performed with pedobarographic measurements in the literature (Sheikh and Feldman, 2015). Measurement and evaluation methods are updated with the advancement of technology. In this study, EasyCad modelling interface, which is an alternative way for design and production of insoles and orthoses with much faster, reliable, custom made designs and reinforcement needs, was revealed by using 3D design technology (Daryabor et al.2022). Lee et al. (Lee et al. 2022). examined the effect of 3D designed insoles in paediatric flexible pes planus patients. They evaluated the individuals with radiographic images and FootScan pedobarography device. They concluded that the use of custom made insoles with 3D modelling had a corrective effect on valgus angle, but did not affect the change in midfoot pressure in dynamic plantar pressure analysis. Similarly, in our study, it was observed that valgus angles decreased after the use of insoles in both age groups. In our study, in which radiographic method was not used, evaluation was performed with Sensor Medica device similar to FootScan device. The most important advantage of pedobarographic measurement compared to radiographic measurements is that it can evaluate the foot not only statically but also dynamically during the gait cycle (Yin et al. 2018). Pedobarographic devices are an important

evaluation tool in terms of orthosis selection and application.

Sheykhi-Dolagh et al. (Sheykhi-Dolagh et al. 2015) compared the effect of polypropylene material (UCBL), semi-rigid and soft insoles on foot mobility and arch height index in a study of 20 individuals with flexible pes planus. UCBL insoles gave the best results in AHI with its rigid structure and prevented the mobility of the arches of the feet. However, they reported that UCBL insoles were stiff and painful during walking. In our study, Shore 35-40 insoles made of medium hard EVA were used. Thus, it was concluded that the insoles should be made by considering the mobility of the foot structure in different movement situations, taking into account the materials and methods. It was thought that AHI score could be preferred as an objective measurement in the clinic due to its ease of use, and objectivity could be increased with pedobarography device.

Alsancak et al. (Alsancak et al. 2021) associated age, sex and body weight with the diagnosis of pes planus according to the footprints obtained by pedobarography method in 335 children aged 6-10 years. They concluded that the prevalence of pes planus decreased with increasing age. In a cross-sectional study, the prevalence of pathological pes planus was 10.3% in a total of 667 children aged 7-14 years, but it was reported that this prevalence decreased with age (Sadeghi-Demneh et al. 2018). In another study, when dynamic footprints of both feet of a total of 1059 children aged 6-13 years were taken, it was concluded that the prevalence of pes planus decreased with age and the rigid arch structure of the foot was formed at the age of 12-13 years (Khodaei et al. 2017). In a 3-year prospective study, Martínez-Nova et al. reported that paediatric pes planus and pronated foot transformed into a neutral Foot Posture Index-6 (FPI-6) foot type with increasing age. It has been reported that pronated foot posture can be expected in children under 9-10 years of age and may decrease spontaneously without any treatment (Martínez-Nova et al. 2018). In time, foot bone alignment and structure deteriorate and the contact area in the midfoot increases. In our study, it was observed that individuals with pes planus contacted the medial heel more due to valgus in their feet, and the percentage of forefoot contact decreased as a result of supination occurring in the forefoot relative to

the rearfoot. At the same time, this situation decreases with age. 6-month regular use of insoles was found to be effective in correcting sole pressure distributions and preventing overload in certain areas by increasing the contact surface. Pedobarographic evaluation should be performed by the orthotist and changes in foot pressure distribution with age should be observed. If there is a risk, we think that the patient should be followed up and orthotics should be started at an early age.

Jarboe et al. (Jarboe et al. 2003) stated that the use of insoles should create a wider contact area to ensure the comfort of the sole of the foot. Based on this statement, the evaluations performed before and after the use of insoles in our study showed that the insoles could distribute the loads on the foot more accurately by contacting the ground and the sole of the foot in a wider area. We think that the production method of the insoles is an important factor in the approximation of the foot to the neutral position with customised insoles.

Studies show that the use of baropodometric parameters in the pre- and post-assessment of foot-ankle applications in prosthetic orthotic centres contributes to accurate decision-making not only for the production of insoles but also for the production of other planned orthoses. Our study shows that custom made insoles produced with computer-aided design positively affect the static and dynamic plantar load distribution of individuals. In our study, in which we included individuals with pes planus in the 4-18 age group, it was concluded that the foot should be evaluated well before and after technological-based applications. Although insoles produced by CNC machine with 3D modelling method have become widespread in recent years, studies in this field are very limited in terms of both the number of individuals and the follow-up period. The production of customised insoles in a short time reduces the practitioner error. The follow-up of CAD/CAM insoles application for 6 months is the strength of our study. It was concluded that randomised controlled long-term studies with the addition of a control group are needed.

Conclusion

In our study, it was concluded that insoles made with CAD/CAM production, which bring the subtalar joint to a neutral position and allow natural movement at the same time, are effective in

balancing load distribution and reducing medial loading in individuals with pes planus. We think that the evaluation of foot-ankle structures by specialists preschool and during school age would be beneficial in terms of biomechanics.

Conflict of Interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Statement

The study was conducted in accordance with the Principles of the Declaration of Helsinki and was found ethically appropriate with the file number E-10840098-772.02-58338 at the meeting of Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee dated 26/10/2020.

Author Contributions

D.T., E.A.: Study design, development of the study, review of data analysis Ö.A.: Research, data collection, data analysis, NHY Article writing, data analysis, translation

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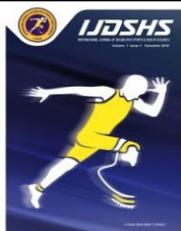
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RESEARCH ARTICLE

Investigation of The Relationship of Anaerobic Power and Upper Extremity Strength of Sports Climbers and Competition Performances

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Abstract

The aim of this study is to examine the relationship between sport climbers, anaerobic power and upper extremity strength parameters and competition performance. A total of 52 volunteer athletes, 31 male and 21 female, participated in the study in the "Leader Climbing" discipline in the sport climbing competition. Before the competition, finger strength (FS), hand grip strength (HGS), back strength (BS) and medicine ball throwing (MBT) tests were performed to measure the upper extremity strength of the athletes, and the vertical jump test (VJT) was performed for the measurement of anaerobic power. The results of the competition were collected and the relationship between the measurements taken and the scoring was analyzed with the SPSS (ver.23.0) program. According to the correlation analysis between competition performances, anaerobic power and upper extremity strength measurements, in women; relative hand grip strength right (RHGSright), relative hand grip strength left (RHGSleft), relative fingertip grip right (RFTGright), relative fingertip grip left (RFTGleft), relative palmar grip strength right (RPGSright), relative palmar grip strength left (RPGSleft), relative back strength (RBS) values in males; A significant positive correlation was found between the competition scores and the values of HGSright, RHGSright, HGSleft, RHGSleft, RFTGleft, RPGSright, palmar grip strength right (PGSright), RPGSleft, PGSleft, RBS values ($p < 0.05$). In conclusion; significant relationships were found between upper extremity strength values and the result of the competition, but they could not be detected in anaerobic power measurement. It has been determined that upper extremity strength is a determinant in the performance of athletes.

Keywords

Climbing, Upper Extremity Strength, Power, Performance

INTRODUCTION

Sport climbing has not only been recreational activities for those who are involved in extreme sports in recent years, but has also become a sport discipline based on competitive competition and making a name for itself. Sport climbing will also be featured at the Paris 2024 and Los Angeles 2028 Olympic Games after it is

included in the official schedule of the 2020 Olympic Games in Tokyo. It is stated that there are more than 25 million climbers in approximately 150 countries around the world today. The emergence of climbing as a competitive discipline has led to research on many subjects. When the studies carried out considering the factors that will affect the climbing are examined; risk taking and motivation (Martha et al. 2009; Jones et al. 2017),

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physiological aspects (España-Romero et al. 2012), biomechanical features (Vigouroux et al. 2011), injuries (Jones et al. 2018) has been studied. In many studies, to evaluate sport climbing performance; anthropometric variables (Mermier, 2000; Watts, 2004; Magiera et al. 2013; Laffaye et al. 2014), upper extremity strength and power, assessment of technical skills (Sibella et al. 2007), and strengths such as hand, finger or forearm strength. Evaluation studies have been carried out (McDonald et al. 2011; Amca et al. 2012; Philippe et al. 2012). In the studies conducted to define the high-efficiency climber, it is discussed which one may be more effective on the climbing performance in general.

In studies, it is mentioned that the forearm muscles and fingers, which are especially the upper extremity strength, require continuous and intermittent isometric contractions and that forearm strength is an important factor in climbing (Billat et al. 1995) It has been emphasized that climbing the routes in sport climbing requires extra skill, energy, mental acuity and hand-finger strength (Michael et al. 2019). In addition, it has been mentioned that the arms, forearms, hands and fingers, which are defined as upper extremity strength, should be used intensively in order to maintain balance and change place on the wall while climbing (Vigouroux et al. 2015). It is mentioned that it will be advantageous to have more endurance and strength in the shoulders and arms, which are among the upper extremity strength muscles, in parallel with the increase in the difficulty in climbing (Mermier, 2000; Giles et al. 2006). The point that draws attention as a result of the studies is that the ratio of maximum isometric contraction and finger flexor strength to body weight is significantly different in climbers compared to non-climbers (Quaine et al. 2003; Vigouroux and Quaine 2006; Macleod et al. 2007; Macdonald and Callender 2011; Philippe et al. 2012; Fryer et al. 2015). In addition, it is emphasized that especially anaerobic power is important in speed-based climbing competitions. It has been stated that the energy metabolism, which is active to overcome the difficult transitions encountered for the boulder and leader disciplines in climbing, is with anaerobic power (McArdle et al. 2010).

Based on the literature studies, it was aimed to contribute to the literature by examining the relationship between the competition

performances, upper extremity strength parameters and anaerobic power outputs of the athletes

MATERIALS AND METHODS

Participants

Volunteer athletes who participated in discipline of "Leader Climbing" the Turkey Interschool Climbing Championship organized by the Turkish Mountaineering Federation (TMF) participated in this study. A total of 52 volunteer athletes consisting of 31 men ($16,45 \pm 1,23$ years) and 21 ($16,47 \pm 1,12$ years) women randomly selected. The study approval was obtained from Giresun University, Social Sciences, Science and Engineering Research Ethics Committee with the decision numbered 50288587- 050.01.04-80503 and dated 09 March 2022 and numbered 20/23. All stages of the study were carried out in accordance with the Declaration of Helsinki.

Inclusion criteria of our study included participating in a sport climbing competition, being actively involved in sports and not having any disability. Lack of inclusion criteria as study exclusion criteria.

Data Collection Tools

Before the competition, height (stadiometer), weight and BMI values (Tanita), anaerobic power (vertical jump test on the Fusion Sport jump mat) and upper extremity strength tests from the athletes who accepted the study voluntarily; back strength (back-leg dynamometer), medicine ball throwing (medicine ball), hand grip strength (handgrip dynamometer), finger strength (pinchmeter device) were measured. After the competition, the rankings of the climbers were taken as a result of the competition. Test measurements are taken in the competition hall. The evaluated factors are as follows:

Height and Body Weight Measurements

The height of the climbers was measured with a Holtain brand stadiometer, and body weight (BW) and Body Mass Index (BMI) measurements were measured with the Tanita MC-580 body analyzer. The bioelectrical impedance measurement method (TANITA), which is one of the measurement methods of body composition, is a fast and relatively inexpensive measurement compared to other methods. Bioelectrical impedance is the measurement of the resistance of body tissues to a small amount of harmless electric current. With these results, information such as

height, weight and gender are used to determine the body fat ratio of the person (Uludag, 2015).

Vertical Jump Test Measurement

Vertical jump values were made using Fusion Sport brand electronic jump mat. Vertical jump test 15-minute active warm-up; It was applied after 5 minutes of running, 5 minutes of short jumps, 5 minutes of stretching and the athletes jumped to the highest point they could jump as soon as they felt ready and the values were recorded. The jump distances of the athletes were measured electronically in "cm" and the best of 3 attempts was recorded. The measured "cm" value is converted to "watt" units. In our study, anaerobic power measurement was obtained from the vertical jump test (Sarvan Cengiz and Orcutas, 2019). The conversion of the data obtained by performing the vertical jump test to the peak power is provided by the following formula developed by Harman et al.

Peak Power (W) = 61.9 x jump distance (cm) + 36 x body weight (kg) + 1,822 (Harman et al. 1991)

Back Strength Measurement

Measurements were made using the Takei TKK-5402 back-leg dynamometer. After placing the feet on the dynamometer table with the knees tense, the values obtained by the participants after they pulled the dynamometer bar that they grasped with their hands vertically upwards at the maximum level, while the arms were tense, the back straight and the body slightly bent forward, the traction was repeated three times and the best result was in "kg" recorded (Gökhan et al. 2015).

Medicine Ball Throw Measurement

Measurement of throwing medicine balls, 2 kilograms of medicine ball and a 10-meter tape measure were used. In the sitting position, the back, shoulders and head are against the wall, and the upper extremity is 90° abducted and the elbows are flexed, and a 2 kg medicine ball is held between both hands. In this position, it was requested to throw the ball forward as far as possible. Three shots were fired with maximum effort. Among the results obtained, the highest value was taken in "cm" (Buke et al. 2019).

Hand Grip Strength Measurement

Participants' hand grip strength was measured with a 0.1 kg precision digital grip strength dynamometer (TKK 5401 GRIP D; Takei, Japan) with an adjustable grip span, capable of measuring between 5.0 and 100.0 kg of force. In the measurement application, the participants were asked to stand upright with their feet hip-width apart and to look forward with their elbows in full extension. They were asked to hold the dynamometer in a neutral, relaxed position (not in extension or flexion) by the testing hand, with the index finger flexed to 90°. Participants were instructed to squeeze the grip with full strength for at least 3 seconds. During the test, they were informed not to shake the dynamometer and not to hold their breath. Participants will alternately perform three attempts for each hand, and the average of the three attempts will be recorded in kilograms (kg). A time of 60 seconds was given between each trial (Kim et al., 2018).

Relative hand grip strength

Measured hand grip strength values were divided by body mass and relative hand grip strength (RHGS) values (kg/kg) were determined.

Pinch Finger Strength Measurement

A pinchmeter (Baseline®) was used to evaluate the finger grip strength of the participants. The measurement application is the standard position recommended by the American Association of Hand Therapists (ASHT), sitting in a chair with back support, shoulder adduction and neutral rotation, elbow 90° flexed, forearm midrotation and supported, wrist neutral, fingertip grip (2 points), palmar grip (C3-point pad) and lateral grip (key), three types of finger grip strength were measured. Each test was started with the dominant hand. In the test procedure, three measurements were made with 60-second intervals between each measurement for finger grip strength, and the averages were taken and recorded in kilograms (kg) (Haidar et al, 2004; Halpern et al, 1996; Özen et al, 2011). In order to prevent the pinchmeter from falling, the person taking the measurement held it from the distal end. In the test procedure, 3 measurements were made with one minute intervals between each measurement for finger strengths (lateral grip (key), palmar grip (C3- point pad), fingertip grip (2 points) and the highest value was taken and recorded in kg.

Relative finger grip strength

Measured finger grip strength values were divided by body mass and relative finger grip strength values (kg/kg) were determined.

Performance Assessment

The sport climbing competition was held in the "Leader Climb" area and the scoring system was determined according to the one who holds the most handles. The design of the climbing walls consists of four routes determined by the route builder assigned by the Turkish Mountaineering Federation (TMF) according to the VI /VI+ difficulty levels according to the UIAA route measurement rating system. The athletes who have done the warm-up training were rated by the referees assigned by the TMF when it came to the turn of the competition. The scoring system was determined according to the one who holds the most handles, and in the competition, points were made according to the ranking between 0 and 100 points according to the number of handles the climber could hold. While 21+ handles in men were evaluated as 100 points, 37+ handles in women were evaluated as 100 points, and the person who could not hold any handle was accepted as 0 points. Before performing the climbing activity, the strength and anaerobic power test measurements were taken for the athlete whose turn it was to climb.

Statistical analysis

The analysis of the data obtained in the study was carried out with the SPSS (ver.23.0) program. Skewness-Kurtosis test was used to measure the skewness and kurtosis values in relation to the normal distribution of the study data. When the values of the parameters for the Skewness-Kurtosis test are between -1.5 and +1.5, the pattern is considered to have a normal distribution (Tabachnick and Fidel 2013). In our study, it was determined that all the parameters processed in the data set by SPSS were found to be in this range and it was found to provide a normal distribution. The relationship between the variables that have a normal distribution and determine our research model and the performance was examined with the Pearson Correlation Coefficient method. The correlation method is one of the commonly used methods to determine the positive or negative relationship between two variables. The

significance level between the variables was accepted as $p < 0.05$ and the confidence interval was 95%.

RESULTS

Our study included a total of 52 people, 31 male and 21 female climbers. The average age of participants was $16,55 \pm 1,32$ years, height average was $170,9 \pm 7,9$ cm, weight average was $58,2 \pm 7,8$ kg, BMI average was $18,6 \pm 1,8$ kg/m²,

The descriptive statistics of the demographic information of the participants are given in Table 1. The results of the competition of male and female athletes participating in the research are shown in Table 2. The mean scores of the male athletes were found to be $76,66 \pm 20,04$ and $73,21 \pm 22,35$ of the female athletes. The anaerobic power (vertical jump test value) and upper extremity test (medicine ball throwing, hand grip strength, pinch finger strength, back strength) evaluation averages of the male and female participants in the study are shown in Table 3. Considering the relationship between the values obtained by the vertical jump test applied to the male ($r = -0,086$, $p = 0,322$) and female ($r = -0,48$, $p = 0,418$) athletes participating in the study to determine their anaerobic power and the competition scores, no significant relationship was found between the peak power and the competition score ($p > 0,05$) (Table 4). According to the correlation analysis of the climbing experience of the athletes participating in the study and the competition scores, a significant positive moderate relationship was found between the climbing experience and the competition score in men ($r = 0,619$, $p = 0,001$) and in female athletes ($r = 0,479$, $p = 0,014$) (Table 5). According to correlation analysis between upper extremity strength values and competition scores of male climbers in the study; RHGS right ($r = 0,618$, $p = 0,001$), RHGS left ($r = 0,641$, $p = 0,001$), PG left ($r = 0,585$, $p = 0,001$), RPG left ($r = 0,627$, $p = 0,001$) significant positive moderate and high correlation; HGS right ($r = 0,464$, $p = 0,004$), HGS left ($r = 0,491$, $p = 0,003$), RFTG left ($r = 0,301$, $p = 0,05$), PG right ($r = 0,384$, $p = 0,017$), RPG right ($r = 0,444$, $p = 0,006$), RBS ($r = 0,394$, $p = 0,014$) a significant positive, weak and moderate correlation was found. In the correlation of female athletes; RBS ($r = 0,603$, $p = 0,002$) significant positive moderate correlation; RHGS right ($r = 0,474$, $p = 0,015$), RHGS left ($r = 0,491$, $p = 0,012$), RFTG right ($r = 0,457$,

p=,019),RFTG left (r=,441, p=,023), RPG right significant positivemoderate correlated (Table 6) (r=,444, p=,022), RPG left (r=,441, p=,023),

Table 1. Descriptive statistics of male and female athletes in sport climbing

Parameters	Male climbers n=31		Female climbers n=21	
	M	SD	M	SD
Age (years)	16,4	1,23	16,48	1,12
Height(cm)	175	5,98	164,6	6,56
Weight (kg)	61,5	6,97	53,03	6,07
BMI (kg/m2)	17,6	1,20	20,01	1,55
Experience (months)	22,0	22,52	16,36	27,80

Table 2. Competition scores of female and male climbers

	Female climbers (n=21)				Male climbers (n=31)		
	Min.-Max values	M	SD	Min.-Max values	M	SD	
Competition Scores	47,34 100	73,21	22,35	31,82 100	76,66	20,04	

Table 3.Evaluation results of participants

	Male Climbers (n=31)				Female climbers(n=21)			
	Min.	Max	M	SD	Min	Max	M	SD
VJT (watt)	5299	6682	6134	352,93	4750	6026	5223	284,4
MBT (cm)	420	660	528	91,72	300	530	409	52,00
HGS right (kg)	28,7	60	43,65	7,19	22,3	47	29,9	5,73
HGS left (kg)	27,8	58,7	41,13	7,74	21,8	41,4	28,7	5,29
LG right (kg)	8	15,5	12,20	1,75	6,5	11,5	8,85	1,48
LG left (kg)	9	15	11,66	1,54	6	12,5	9,05	1,49
FTG right(kg)	5,50	11,5	7,79	1,49	5	9,5	6,60	1,18
FTG left (kg)	5	12,5	7,50	1,55	5	10	6,25	1,22
PG right (kg)	8,50	16	10,91	1,96	7	15,5	8,91	1,75
PG left (kg)	7,50	15	10,32	1,82	6,5	13,5	8,84	1,87
BS (kg)	81,5	209	128,3	28,71	61	137,5	88,5	22,04

VJT: Vertical jump test, MBT: Medicine ball throwing, HGS: Hand grip strenght, LG: Lateral grip (key), FTG: Finger tip grip (2 points), PG: Palmar grip (C3- point pad), BS: Back strenght

Table 4. The Relationship between participants' anaerobic power and competition scores

	Male Climbers n=31		Female climbers n=21	
	Competition Scores			
Anaerobic Power (watt)	r	-,086		-0,48
	p	,322		,418

Anaerobic power measurement was obtained from the vertical jump test. The conversion of the data obtained by performing the vertical jump test

to the peak power is provided by the following formula developed by Harman et al. 1991.

Table 5. The Relationship between participants' experience and competition scores

		Male Climbers n=31	Female climbers n=21
		Competition Scores	
Experience (months)	r	,619	,479
	p	,000**	,014*

**p<0,01 *p<0,05

Table 6. The Relationship between participants' upper extremity strength parameters and competition scores

		Male Climbers n=31	Female climbers n=21
		Competition Scores	
MBT (cm)	r	,117	,028
	p	,265	,452
HGS right (kg)	r	,464	,113
	p	,004*	,313
HGS left (kg)	r	,491	,184
	p	,003*	,212
RHGS right (kg)	r	,618	,474
	p	,000**	,015*
RHGS left (kg)	r	,641	,491
	p	,000**	,012*
LG right (kg)	r	,186	,061
	p	,159	,396
LG left (kg)	r	,130	,051
	p	,243	,412
RLG right (kg)	r	,299	,226
	p	,051	,162
RLG left (kg)	r	,257	,243
	p	,081	,145
FTG right (kg)	r	,156	,191
	p	,200	,204
FTG left (kg)	r	,225	,152
	p	,111	,255
RFTG right (kg)	r	,290	,457
	p	,057	,019*
RFTG left (kg)	r	,301	,478
	p	,050*	,014*
PG right (kg)	r	,384	,282
	p	,017*	,108
PG left (kg)	r	,585	,230
	p	,000**	,157
RPG right (kg)	r	,444	,445
	p	,006*	,022*
RPG left (kg)	r	,627	,441
	p	,000**	,023*
BS (kg)	r	,243	,348
	p	,094	,061
RBS (kg)	r	,394	,603
	p	,014*	,002**

MBT: Medicine ball throwing, HGS: Hand grip strenght, RHGS: Relative hand grip strenght, LG: Lateral grip (key), RLG: Relative lateral grip, FTG: Finger tip grip (2 points), RFTG: Relative finger tip grip, PG: Palmar grip (C3- point pad), RPG: Relative palmar grip, BS: Back strength, RBS: Relative back strenght **p<0,01, *p<0,05

DISCUSSION

Based on the model of the climber with low body weight and high hand and finger strength in the literature, the relationship between a relative value and performance was examined by dividing both the upper extremity strength values and the strengths by the weight of the participants. In addition, the relationship between anaerobic power, athletic experience and medicine ball throwing values and performance score was examined.

In the study of Mermier et al. in 2000, measurements of some parameters were made to determine the sport climbing performance, and 24 male and 20 female climbers with 0,10 and 44 years of experience, aged between 18 and 49, had to climb two routes with a length of 11-30 meters. were asked and scored according to the system of holding the handles, that is, reaching the summit. The climbing performance of the person was determined by summing the results obtained from the two routes. Similar to the subject of this thesis research, in this study, the measurements taken for each participant were based on anthropometric, physiological and physical components and the effect of the measured parameters on climbing performance was investigated. The variables measured for each subject were anthropometric (height, weight, leg length, arm span, % body fat), demographic (self-reported degree of climbing, years of climbing experience, weekly training hours), and physical (knee and shoulder extension, knee flexion, hand). grip and finger strength, bent arm suspension, grip strength, hip and shoulder flexibility, and upper and lower body anaerobic strength). Considering the effects of the study on performance, the performance of components including upper and lower extremity strength, endurance, fat ratio and climbing grade was explained as 58.9%, hip flexibility as 1.8% and anthropometric characteristics as 0.3%. The above study, which includes the hand grip and finger grip strengths of the upper extremity strengths, supports the finding that the finger and hand grip strengths of the male and female participants in this study are significant.

In the study published by Laffaye et al in 2016, it was tried to determine the physical and anthropometric differences between elite, intermediate and novice athletes and to analyze the determinants of climbing ability. In the study with

41 participants, the athletes were divided into three groups according to their climbing skills and categorized as novice (<6a), skilled (6c-7b) or elite ($\geq 8a$) mountaineers according to the French scale. In addition to the anthropometric features, the measurements taken are physically; general and specific strength, jumping on the handle (arm) test, bench press test and hand and finger grip strength tests. Considering the results of this test, in which the effect of the measurements taken on the climbing skill was examined, it was concluded that the climbing ability was related to the special strength from the general strength, and that the ability could be explained mostly by skills that can be developed with training such as endurance, hand grip strength, finger strength and upper extremity strength, rather than anthropometric characteristics. Statistically significant results were obtained in hand grip strength, finger strength and arm strength. The factors affecting climbing performance were explained as 64.22%, finger and hand grip strength value, arm strength jump over the handle test score and upper extremity strength values as 46% and anthropometric characteristics as 4%. When the research findings are examined, this study is meaningful and consistent with the study of Laffaye et al.

In the study of Gurer ve Duman in 2022, the effect of regular sports climbing on upper extremity strength was investigated. Participants; The control group consisted of 12 sedentary individuals and the study group consisted of 12 experienced climbers. Experienced climbers were trained for 8 weeks and finger strength, hand grip strength and bent arm hanging strength were measured. The study was carried out in the leader climbing style. In the study, statistically significant differences were found as a result of 8-week climbing training in right and left hand grip strength, right and left finger strength and arm strength. As a result, it has been concluded that there will be a positive increase in the specified parameters in sports climbing regularly (Gurer and Duman 2022). In the above study, which includes upper extremity strength, the muscle groups that develop with regular climbing training and the muscle groups that are related to performance in this study are common. The fact that the strength measurements correlated in the findings and the strength measurements developed in Gurer's study are the same, supports the importance of upper

extremity strength for sport climbing and the findings of a significant relationship in this study.

In the study conducted by Ozen et al. in 2010, the participants consisted of 13 elite climbers and 13 non-elite climbers. The measurements included in the study consisted of some anthropometric measurements as well as right and left claw and pinch finger strength and respiratory parameters, and a comparison was made between the two groups. As a result of the study, left hand grip strengths were found to be statistically different between elite and non-elite athletes. The reason for the statistically significant difference in left hand grip strength between elite athletes and non-elite athletes is that elite athletes develop left hand grip strength with training and equal load, while non-elite athletes have a high percentage of strength in the right hand, which is generally used as the dominant hand in daily life. It is thought to have less power. While the right hand strengths were close to each other in elite and non-elite athletes, the high level of elite athletes in left-hand strengths and low levels of non-elite athletes caused a statistically significant difference. "In sport climbing, right hand and left hand muscles develop at the same rate as they are loaded at the same rate." (Ozen et al. 2011). Although the right hand fingertip strength was higher in the measurement in this study, the lack of a significant relationship with the result of the competition can be explained by the possibility that most of the male participants were right handed and the right hand fingertip strengths were close to each other, while the reason for the left hand fingertip strength to be significant was the low scores of the athletes with high scores. This may be due to the fact that the left hand fingertip strengths are higher than the athletes who score points. In this study, it was seen that the right hand fingertip strength was higher in male participants, while the left hand strength measurement correlation values of male participants were higher than the right hand, which supports the study of Ozen et al. and is consistent.

In another study evaluating energy contributions during climbing, it was stated that aerobic and anaerobic systems were used (Bertuzzi et al. 2007). One study concluded that during climbing, the heart rate is high versus the relatively low oxygen intake level, and that aerobic metabolism may play a secondary role in rock climbing. (Billat et al. 1995). Similarly, another

study observed a disproportionate increase in heart rate compared to oxygen intake during climbing, but concluded that climbing requires not only anaerobic but also aerobic metabolism (William Sheel et al. 2003). No significant relationship was found between the competition result and the competition result. When a literature review is made between anaerobic power and climbing performance, it is emphasized that anaerobic power is important on performance in general, especially isometric contractions with negative slope with difficult moves and speed-based climbing discipline. One of the reasons why no significant correlation was found in the measurement of anaerobic power may be due to the negative slope and low difficulty of the climbing wall, as it consists of routes determined according to VI / VI+ difficulty levels according to the UIAA route measurement rating system. Therefore, the fact that it does not have an effect that will cause isometric contractions and make a difference on anaerobic power may not have a statistically significant relationship.

The results of the research showed that the strength parameters were compatible with the low body weight, high finger and grip strength and endurance climber model in the literature. In the research, endurance tests were not applied and only strength values were examined. Back strength measurement, which is not included in many studies in the climbing disciplines in the literature, was made and a significant relationship was established between the results of the competition. It is a known belief that performance will increase as climbing experience increases. Based on the ratio of maximal isometric finger strength to body weight in the studies in the literature, the same ratio was applied to the force parameters measured in this study and positive relationships were determined. It was concluded that upper extremity muscles are important in climbing performance. From finger strengths, it was concluded that palmar grip is more effective than other finger strengths for climbing performance. No significant relationship was found for key grip finger strengths.

Since the relationship between strength parameters and anaerobic power and competition performance in the leader climbing discipline may cause different results with the variability of the leader climbing walls, the diversity of the route and slope, making the measurements in the

discipline of speed climbing with the same rules valid worldwide will make this research stronger. Since the height of the climbing experience will increase the relationship between the strength parameters and the result of the competition, it will be important that the athletes who are measured are at the elite level. It is important to take these measurements in Sport Climbing skill selections.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Statements

Ethical approval of the study was obtained from Giresun University, Social Sciences, Science and Engineering Research Ethics Committee with the decision numbered 50288587- 050.01.04-80503 and dated 09 March 2022 and numbered 20/23.

Author Contribution

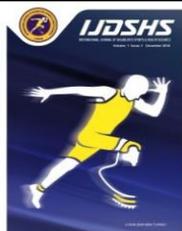
Study Design, AHB; Data Collection, MK; Statistical Analysis, MK; Manuscript Preparation, AHB, MK; Literature Search, MK. All authors have read and agreed to the published version of the manuscript.

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RESEARCH ARTICLE

Effect of Integrated Ocular Exercise Program on Selected Visual Impairments Among Chronic Smartphone Users

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Abstract

The aim of the study was to determine the effectiveness of an integrated ocular exercise program on the three selected visual impairments. The study was conducted among 100 individuals, 67 of them were females and 33 were males between the age group 18-35 years with visual impairments who fulfilled the inclusion criteria. Two groups were formed both following the conventional treatment of an ophthalmologist, with the experimental group added with an integrated ocular exercise program for four weeks. The Standard Patient Evaluation of Eye Dryness (SPEED) score for the dry eye level of group A was 14.6 ± 3.785 , and the values for group B were 16.58 ± 3.351 ($P < 0.0001$). The visual acuity post-intervention in the treatment group was 29.1 ± 15.57 and the control group was 32.5 ± 15.625 , which shows much difference ($P = < 0.001$). According to Snellen's chart, there was a much significant difference between the pre-post visual eye fatigue questionnaire ($P = 0.001$). The results showed that at the end of the 4 weeks, the designed exercise program along with the conventional method proved beneficial for the patients with selected visual impairments. An unpaired t-test was used for comparing two separate groups. The chi-square test was used for calculating binary variables and effect size. According to the results of our study, the Integrated ocular exercise program was useful among chronic smartphone users for reducing their eye discomforts like eye fatigue, dry eyes, and visual acuity. In conclusion, the Experimental group shows more improvement in the post-intervention than the control group.

Keywords

Smartphones, Ocular Exercises, Visual Impairment, Eye Fatigue, Visual Acuity

INTRODUCTION

The usage of smartphones has increased over the past decade. The development of the multipurpose smartphone and its following global acceptance have impacted the communication and informational environment. It altered the interests, principles, and desires of many users, and raised concerns about addiction and usage all over the

world (Panova et.al., 2018). A large portion of the population, especially young people, routinely uses their smartphones for a variety of objectives. They use their smartphones for a wide range of activities, including calling, texting, gaming, navigation, social networking, etc. (Salehan et. al., 2013).

During the period of lockdown, more people are using their smartphones for entertainment,

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while students are using them to study and take online classes from schools. (S. Shinde et.al., 2023) Extensive development and usage of smartphones in everyday life have an impact on communication and interaction between individuals. Among adolescents aged over 18 years, the health problems related to smartphone use are headaches and eye problems. Internet addiction has been a worldwide problem and is related to stress, sleep problems, and depressive symptoms which are also related to availability demands and being awakened at night for smartphone usage. (Machado et al., 2023). Smartphone users can perform repetitive tasks while slouching over their small screens for extended periods of time, which affects the eyes (S. Shinde et.al., 2022). Blue light is the foundation of smartphone technology. Using them for an extended amount of time increases the risk of vision damage because blue light has a shorter wavelength (Park et.al., 2017). Due to their numerous applications, smartphones have recently become widely used by the majority of people, particularly college-going students. (Torpil et. al., 2022). Smartphones are useful in many ways, but they also have disadvantages like reduced productivity, attention-grabbing social interactions, and psychological addiction. Currently, between 24.8% and 27.8% of students are smartphone addicts, and that percentage is growing (Jeonge et.al.,2015). The number of blind persons worldwide is estimated to be 36 million and the number of people with vision impairment is estimated to be 216.6 million. 90% of these people live in developing and middle-income countries (Flaxman et.al., 2017; Rono et. al., 2020). Visual impairment is caused by a variety of diseases or degenerative processes and results in considerable limitation in vision (Vilmaz et. al., 2023). On a global scale, millions of people experience dry eye, a serious tear insufficiency disorder of the ocular surface. A recent survey found that there has been a substantial increase in the number of dry eye patients (Goto et. al., 2002). Dry eye is characterized by a number of symptoms including ocular fatigue, discomfort, red eyes, and a heavy feeling in the eyes (Lemp et.al.1998). Dry eye disease (DED) is a highly frequent, multifunctional condition that affects the tear film and the ocular surface. Millions of people all around the world experience ocular pain and discomfort due to dry eye. The primary symptoms

of DED are ocular surface dryness, stinging, burning, pain, and feeling of a foreign body (Fjaervoll et.al., 2022). If visual fatigue continues in normal life, it can impact visual processing and can cause various problems such as eye discomfort, damaged corneal epithelial cells, conjunctival hyperemia, and reduced visual acuity (Park et. al., 2017).

Optometrists may recommend a variety of treatments for vision, to help with particular vision problems that cannot be treated by simply wearing glasses or contact lenses (Rouse et.al., 1987). In certain conditions eye physical therapy, where patients' performance and function are improved by correcting vision issues (Mohamed et.al., 2013). Sometimes visual disorders occur in patients who have neck pain. Neck muscles have an important role in normal mobility and stability of the cervical spine. The McKenzie method is one of the popular approaches to evaluating and treating patients with neck pain. (Avaghade et.al., 2023).

The vestibular-ocular reflex is a component of the vestibular system which helps to stabilize vision (Morimoto et.al.2011). When the ciliary muscle fails to contract and relax fully to focus and refocus the vision becomes low and vision impairments come into the picture. (Gosewade et al., 2013). Fixation, saccadic movements, smooth pursuit, as well as optokinetic and vestibular motions are all elements of ocular-motor exercises. (Minoonejad et. al., 2019).

There is a scarcity of research examining the efficacy and impact of an integrated exercise program as a physiotherapy intervention for addressing visual impairments, including dry eye, eye fatigue, and visual acuity issues, especially among individuals who are chronic smartphone users. This study focuses on visual impairments like dry eye, eye fatigue, and visual acuity in chronic smartphone users with Physiotherapy exercises. This study addressing the outcome measures to find out the impact on visual impairments.

According to recent reports, the usage of a smartphone most adversely affects the eye. However, there is a lack of information in the medical literature about how smartphones affect the eyes (Maddii et al., 2018). The present study aims to identify the immediate beneficial effects of

an integrated ocular exercise program developed and handed down by physiotherapists.

MATERIALS AND METHODS

Table 1. Demographic characteristics of the participants

Age Group	Male	Female
18-22	24	44
23-30	5	9
31-35	4	14

This experimental study has been carried out in Krishna Vishwa Vidyapeeth, karad after receiving approval from the Institutional Ethical Committee. (Protocol no. 298/2022-2023). Participants' allowance to permit the experiment was taken through signing the consent form. A total of 110 individuals fulfilled the inclusion criteria, out of which 3 individuals did not agree to participate while the other 7 terminated the treatment. The remaining 100 individuals participated actively in the study. Then 100 participants were randomly allocated into two groups, namely Group A and Grop B by simple random sampling. The study duration was a period of 6 months at Krishna Hospital in the physiotherapy outpatient department, Karad. The intervention was done for a period of 4 weeks. Patients of all genders ranging in age from 18-35 years, individuals experiencing dry eyes, eye fatigue or low vision, and eye symptoms caused only due to smartphone use were included. Patients were excluded if they are visually disabled.

Measuring methods

Selected three impairments were assessed with the specific respective scales of each. Standard Patient Evaluation of Eye Dryness (SPEED) questionnaire for dry eyes (Gulati et.al., 2006). Visual Eye fatigue questionnaire for evaluating the level of eye fatigue and a Snellen's chart to score Visual acuity (Habibi et. al., 2011; Lovie Kitchin et.al., 1988).

Table 2. Description of the ocular exercises for 1-2 weeks protocol

Sr. No.	1-2 weeks	Repetitions
1.	Palming	10 breaths× 2 sets
2.	Blinking	3 times/ day
3.	sideways viewing	10-sec hold × 10 reps
4.	front and sideways viewing	10-sec hold × 10 reps
5.	rotational viewing	5-sec hold × 10 reps
6.	up and down viewing	5-sec hold × 10 reps

Study design and population

Among all 100 subjects in this study, 50 subjects were enrolled in the treatment group and 50 in the control Group. 67 of them were females and 33 were males.

The study was started by conducting a quick assessment of smartphone addiction through a 'Smartphone Addiction Scale'. The assessment was conducted through the online platform google forms which were circulated among individuals aged between 18 to 35. Individuals with high smartphone addiction were considered for the study. A summing 100 participants consisting of males and females underwent an examination for Dry Eyes, Eye Fatigue, and Visual Acuity, and the scores were recorded. Respective scales were used for evaluation. Through voluntary participation and allowance of the participants they were divided into two groups and further experiment was carried. Group 'A' was the control group following the conventional treatment by an ophthalmologist. The 'B' group was the treatment group and was given the conventional treatment by an ophthalmologist added with the integrated ocular exercise program. After completion of the intervention, both groups were examined through the same tests they underwent prior to the exercise intervention.

An integrated ocular exercise program designed particularly for targeted impairments was implemented. The program aimed not only at eye muscle maintenance but also relaxation of the neck and shoulder. Four weeks of intervention were exhibited and exercises were advanced after the first two weeks. The protocol was as follows.

7	nose-tip gazing	10-sec hold × 10 reps
8	near and distant viewing	3 times/day
Sr. No.	3-4 weeks	Repetitions
1.	Saccadic eye movement	10-sec hold × 10 reps
2	The subject moving the target horizontally And tracking it with the eyes while keeping the head still	10-sec hold × 10 reps
3	The subject moving the head horizontally While keeping the stationary target in focus	10-sec hold × 10 reps
4	The subject moves the head and target in opposite directions horizontally while tracking the target with the eyes.	10 mins
5	Smooth Pursuit eye movements	10-sec hold × 10 reps
6	Candle gazing	10 mins
7	Candle reading	10 mins
8	Visual imagery	15 mins

To maintain eye hygiene and enhance relaxation these techniques were followed daily like cold fomentation with eyes closed, following the 20-20-20 rule. (Minoonejad et al., 2019; Kim et.al. 2016; Sheikh et. al. 2020; Swathi et.al. 2022).

Statistical analyses

Statistical analyzes of the study were performed using the “Statistical Package for Social Sciences” (SPSS) version 23.0 (Kirkpatrick et. al., 2015). Visual (histogram, probability graphs) and analytical methods (KolomogrovSmirnov/Shapiro-Wilk's test) were used to define whether the variables were normally distributed. Customarily distributed numerical variables will be shown as mean±standard deviation. An independent student t-test is used to find out the statistical difference between two arithmetic means. Chi-square was used for calculating binary variables, effect size between participant's age, and eye symptoms

caused only due to smartphone use. The results were calculated through statistical analysis using the software SPSS version 23.0.

RESULTS

Table 3, represents the Standard Patient Evaluation of Eye Dryness (SPEED) score before (Pre) and after the intervention for Group A and Group B. For Group A, which received the conventional treatment the mean SPEED score decreased from 19.2 before the intervention to 16.58 after the intervention. For Group B, which received the treatment, the mean SPEED score decreased from 19.22 before the intervention to 14.6 after the intervention. The extremely significant p-value for Group B indicates that the treatment had a substantial impact on alleviating symptoms of dry eye.

Table 3. Comparison of Pre-Post speed test score for dry eye

	\bar{X}		SD		P- value	Result
	Pre	Post	Pre	Post		
Group A Conventional	19.2	16.58	3.295	3.351	<0.001	Significant
Group B Treatment	19.22	14.6	3.099	3.785	<0.0001	Extremely significant

Table 4 depicts the eye fatigue questionnaire score, in which the eye fatigue level was more before the intervention which was decreased post-intervention. In Group A, which received the conventional intervention, the change in eye fatigue This study was carried out among 100 chronic smartphone users. According to statistical analysis, the effect of the ocular exercise program was significantly effective for selected visual impairment. There was a significant reduction in eye fatigue ($P < 0.0001$) in Group B than in Group

A. Dry eye scores according to the speed test were also significantly reduced ($P < 0.0001$) and visual acuity by Snellen's chart was significant ($p < 0.0001$) in Group B than Group A. Scores were statistically significant (p -value < 0.0002). In Group B, which received the treatment, the change in eye fatigue scores was even more significant (p -value < 0.0001). This indicates that the treatment had an extremely strong effect on reducing eye fatigue levels.

Table 4. Comparison of Pre-Post visual eye fatigue questionnaire score

	\bar{X}		SD		P-value	Result
	Pre	Post	Pre	Post		
Group A Conventional	2.82	2.02	1.044	1.134	< 0.0002	Significant
Group B Treatment	2.52	0.86	1.328	0.808	< 0.0001	Extremely significant

Table 5. shows a comparison of Pre and Post-mean values of Snellen's chart for visual acuity. For Group A, the mean visual acuity score improved from 47.2 before the intervention to 32.5 after the intervention. For Group B, the mean visual acuity score improved from 46.5 before the intervention to 29.1 after the intervention. The p-

value for the comparison between pre and post-scores for group A was found to be < 0.0002 , indicating a statistically significant improvement, and for Group B less than 0.0001, indicating an extremely significant improvement in visual acuity after the treatment.

Table 5. Comparison of Pre-Post values of snallen's chart score for visual acuity

	\bar{X}		SD		P-value	Results
	Pre	Post	Pre	Post		
Group A Conventional	47.2	32.5	36.255	15.625	0.0002	Significant
Group B Treatment	46.5	29.1	36.059	15.57	< 0.0001	Extremely significant

Table 6 shows a comparison of post-test mean values of speed score between Group A and Group B. The mean post-test speed score for

participants in Group A is 19.22 and for Group B is 15.59. The comparison between Group A and Group B is Extremely significant.

Table 6. Comparison of Pre and Post-test mean scores for the dry eye within Group A and Group B

SPEED SCORE	\bar{X} -Post (Group A)	\bar{X} -Post (Group B)	P- Value	Result
Group A vs Group B	19.22	15.59	< 0.0001	Extremely significant

Table 7 shows a comparison of post-test mean values of the eye fatigue scale between Group A and Group B. The mean post-test eye fatigue level for participants in Group A is 2.82

and Group B is 2.02. The p-value is less than 0.0001 and the comparison between Group A and Group B is Extremely significant.

Table 7. Comparison of post mean score of Eye fatigue within Group A and Group B

Eye Fatigue Level	\bar{X} -Post (Group A)	\bar{X} Post (Group B)	P- Value	Result
Group A vs Group B	2.82	2.02	<0.0001	Extremely significant

Table 8 shows a comparison of Post-test mean values of Snellen's chart for visual acuity between Group A and Group B. Both the values

were found to be statistically extremely significant ($P < 0.0001$).

Table 8. Comparison of post and post values of visual acuity within Group A and Group B

Visual Acuity	\bar{X} - Post (Group A)	\bar{X} - Post (Group B)	P- Value	Result
Group A Vs Group B	46.5	29.1	<0.0001	Extremely significant

DISCUSSION

The results from the current study indicate that after 4 weeks of ocular exercises, there was a significant reduction in the eye fatigue level, visual acuity, and dry eye. In addition, participants in the exercise group had a significant decrease in eye fatigue levels over a 4-week period, whereas those in the control group had no reduction in eye fatigue levels. These findings were similar to the previous study that reported that yoga ocular exercises reduce the eye fatigue symptoms score by increasing the efficiency of extraocular muscles (Telles et.al., 2006).

The study carried out in the year 2020, named "Effect of yoga ocular exercises on eye fatigue" included 32 undergraduate optometry students who were symptomatic based on a validated eye fatigue questionnaire were included after a baseline comprehensive eye examination. In the exercise group, there was a statistically significant reduction in eye fatigue scores, whereas the eye fatigue scores showed a significant increment in the control group after 6 weeks (Satish Kumar Gupta et.al., 2020). The reliability and validity of the visual eye fatigue questionnaire value are 0.75 indicating that the visual eye fatigue questionnaire has a moderate level of reliability and validity (Rajabi-Vardanjani et. al., 2014).

Performing blinking exercises has previously been demonstrated to lead to decreased partial blinking and an improved proportion of functional meibomian glands in dry eye patients. A.D. Kim et. Al undertook a research study with the purpose of the effects of blinking exercises on blink patterns and clinical signs and symptoms of dry

eye disease. This study revealed that it is possible that Blinking exercises can modify poor blinking patterns and improve dry eye, with modest changes in objective measures of tear film quality. Fifty-four participants with dry eye symptoms received instructions to perform a ten-second cycle of blinking exercises every 20 min during waking hours for four weeks. The findings of the study reinforce the potential role blinking plays in influencing meibomian gland function and tear film integrity (A.D. Kim et.al., 2021).

Also, a recent study was carried out on female basketball players, which was about to investigate the effect of ocular-motor exercises on dynamic visual acuity and stability. The athletes in the intervention group participated in the designed four-week program of oculomotor exercises and the control group did just their own daily routine exercises. It concluded that oculomotor exercises can be used to enhance the limit of stability and dynamic visual acuity in basketball players. (Minoonejad et. al., 2019). A reliability value of 0.95 indicates a very high level of consistency and agreement in the measurements obtained from the Snellen chart (Lovie-kitchen et.al., 1988).

A systematic review of literature on the association between visual display terminal use and dry eye was carried out in 2021 in which people with dry eye symptoms were included. This study revealed that the prevalence of definite or probable dry eye among video display terminal and office workers ranged from 26% to 70% in the included studies. Overall, VDT use was highly associated with dry eye disease and DED-related signs and symptoms.

DED has repeatedly been found to reduce work productivity and increase days spent away from the office, thereby providing a substantial indirect financial loss. In this study there is a decrease in dry eye symptoms (Stapleton et al., 2017; Sivakumar et al., 2021). A reliability value for the SPEED test is 0.88 to 0.95 indicating that the patient evaluation method is highly reliable, it produces consistent results across different assessments or time points. A validity value of 0.923 suggests that the patient evaluation method is highly valid (Ngo et al., 2013). Using a smartphone can be used for a variety of things, including communication and entertainment through texts, music, multimedia, internet access, photos, and games (S. Shinde et al., 2022). During prolonged usage of the smartphone, individuals have eye problems like dry eye, eye fatigue, and visual acuity.

The study's findings helped in improving the development of targeted ocular exercise programs that can be prescribed by physiotherapists to chronic smartphone users experiencing visual impairments. These exercises may help alleviate symptoms and improve visual function, reducing the potential long-term impact of smartphone use on the eyes. The novelty of this study lies in its focus on chronic smartphone users and the particular integrated ocular exercise program to treat their visual deficiencies. While previous studies investigated the impact of ocular exercises on eye health and fatigue, this study focuses on a specific population that is becoming increasingly afflicted by excessive smartphone use. In this study, the mentioned 20-20-20 rule was followed, which stated that every 20 minutes, look 20 feet apart for 20 seconds. This relieves the continuous screen gazing and enhances relaxation. Moreover, one of the strategies for reducing eye fatigue is taking regular breaks while using visual displays, in accordance with the study by Galinsky et al, which reported that breaks reliably minimized eye discomfort (Galinsky et al., 2007). By taking all the results into consideration, we can say that an integrated ocular exercise program was useful among chronic smartphone users for reducing their eye discomforts like eye fatigue, dry eyes, and visual acuity.

Conclusion

This study presents evidence that the Integrated ocular exercise program was useful

among chronic smartphone users for reducing their eye discomforts like eye fatigue, dry eyes, and visual acuity. The application of the exercise program along with the conventional treatment by the ophthalmologist in a systematic manner makes it a successful approach. It is recommended that the integrated ocular exercise program can be used as a preventive as well as a treatment tool under the guidance of a physiotherapist and ophthalmologist for treating eye impairments.

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Declaration of Conflicting Interests

All authors declare no conflicts of interest.

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Ethics Statement

The study protocol was approved by the Krishna Institute of Medical Sciences Ethics Committee

(Protocol no. 298/2022-2023) and written informed consent was obtained from the participants before starting the study.

Authors Contribution:

Study Design, TM, VK; Data Collection, TM, SS, VK, PP; Statistical Analysis, TM; Data Interpretation, TM, SS; Manuscript Preparation, TM, VK; Literature Search, TM. All authors have read and agreed to the published version of the manuscript.

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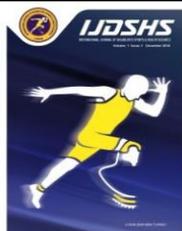
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RESEARCH ARTICLE

Physical Self-Concept Among Deaf and Hard-of-Hearing People Practicing Swimming

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Abstract

Purpose: to identify the level of physical self-concept among deaf and hard of hearing people who practice swimming, as well as identifying the differences according to the variable (management and training/sports rehabilitation). The study sample consisted of ten deaf and hard of hearing people studying physical education at Hashemite University their average age (21 year), average weight (60 k.g.) average length (157 c.m.). **Methods:** The research used a descriptive approach using the questionnaire for its suitability to the nature and objectives of the study. The researchers also conducted transactions of honesty and stability on the study tool to ensure its suitability for the study, where the data were processed statistically using (Frequency, Percentage Means, SD, t-test). **Results:** The results indicated that the level of physical self-concept among deaf and hard of hearing people practicing swimming came with average (4.65) and SD (0.27) which means high level of self-concept. The results showed no statistically significant differences according to specialization. **Conclusion:** The researchers recommend conducting more studies on other categories of people with disabilities.

Keywords

Physical Self-Concept, Deaf And Hard of Hearing, Swimming

INTRODUCTION

Sport reflects the development of society and is the spacious field through which a person can integrate into society. Sport is an effective tool in guiding individuals in maintaining their physical health and mental well-being through the development of their physical and intellectual abilities and capabilities. Sport is for all, and society should provide “the opportunity to practice various sports activities for each individual in society according to his potential and abilities” (Ahmad, 2021). Sports should not be exclusive to one segment or group in society, given their positive effects that benefit practitioners.

The practice of physical activities has become a necessity associated with preventive health care, as studies have confirmed the positive effects of physical activities on various body systems. For persons with disabilities, physical activity may be doubly important, as it is not only preventive but also rehabilitative (Goodman, 2002). Swimming is a beautiful, purposeful, and useful sport, which has remarkable health impacts. Swimming enhances muscle development, body coordination, and joint flexibility. As an activity that engages all the muscles of the body, especially the muscles of the spine, swimming often helps with body deformities, such as curvature of the back, curvature of leg bones, and rickets. It also

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regulates the breathing process, activates the circulatory system, and helps with digestion. Hence, swimming is unlike any other sport in terms of promoting the growth of the ideal body composition (Hussein, 2000).

Another benefit of swimming is that it develops courage. In descending to an environment different from the land to which they are accustomed, swimmers learn to trust in their ability and later develop a sense of pleasure and comfort during practice. Indeed, swimming has many psychological benefits. It helps increase self-confidence and develop personal and psychological traits, forming among swimmers a special positive concept of themselves as well as contributing to increasing relaxation (Abu Eid, 2004). However, given that the sport of swimming needs its practitioners to have a great degree of mental, psychological, and physical development, researcher believes that it is necessary for swimmers, especially deaf and hard of hearing swimmers, to enjoy the concept of high physicality for them to perform swimming skills with high efficiency.

Hence, the importance of the physical self-concept of deaf and hard of hearing people and its impact on their integration into society merit investigation. Researcher believes that the physical self-concept of the player can develop and improve the level of performance, as a swimmer's lack of self-confidence would hinder their performance of swimming skills to the fullest. In view of the importance of the physical self-concept of the deaf and hard of hearing in various sports in general and swimming in particular, and through our work at Hashemite University, we considered the idea of highlighting an important element affecting the psychology of deaf and hard of hearing people, namely, self-concept, which may have the largest role in improving the level of skill performance in their swimming practice.

The concept of self, as discussed by Sherrill (1998), has two meanings. The first is the traditional definition of the sum of all beliefs and intentions that a person holds. The second relates to the observational and measurable knowledge that a person holds about himself/herself. The individual's awareness of their appearance, physical ability, and role in life is of great importance in determining the self. Positive self-perception makes the individual more confident and optimistic about future expectations.

Manning (2006) believed that "the individual always seeks to form an ideal image of himself by him and others, through his actions and relationships with them, and positive consideration of the self is a need that the individual seeks." El-Shennawi, et al. (2001) proposed that self-concept is one of the important dimensions of human personality because of its great impact on the behavior and actions of the individual. Self-concept begins to develop from the first years of a child's life and is affected by many factors, such as experience, maturity, practice, perception, and heredity. Harafsha et al. (2010) pointed out that self-concept is also affected by internal factors, such as mental and physical ability, which affect the individual's self-assessment, and external factors, such as the perception of others.

We believed that the concept of a high physical self can give internal support to individuals' physical ability, influence the manifestation of abilities and capabilities during physical activity, and thus affect the level of performance. Moreover, the concept of physical self is the sport enthusiasts' appreciation of the physical characteristics and qualities that they possess and their awareness of the strengths and weaknesses of their physical abilities during the practice of sports activities. Indeed, Levy and Ebbeck (2005) argued that a positive self-concept leads to high physical efficiency and, thus, good athletic returns. The more an individual knows the limits of their abilities, the more effective they are and their ability to interact with different situations during play (Karaki & Mahmoud, 2009). Individuals with a negative self-concept tend to have poor confidence in their motor abilities and psychological compatibility (Al-Hamdani, 2018).

We reviewed previous studies related to swimming and its association with social, psychological, and physical concepts among deaf and hard of hearing people. We also reviewed previous studies and related to the study variable of physical self-concept.

Hassan (2012) studied the concepts of physical and skill self and their relation to skill performance in the game of five-a-side football. Hassan (2012) used a descriptive approach and a survey method, and their research sample included 25 students of the Department of Sports Education. One of the most important results was that the physical self, the third stage, has a positive significance and statistical significance in the five-

a-side football lesson in sport. Hassan (2004) had earlier conducted a study on physical self-esteem and its relation to the accuracy of the performance of offensive skills in volleyball. The study sample consisted of 12 volleyball team players. The results showed a positive relationship between the physical self and the accuracy of offensive skills in volleyball.

Al-Sorour (2003) conducted a study aimed at building an educational program for training teachers in the implementation of exercises that develop the self-concept of students. After applying the program, which included 126 training modules on various topics, to a number of schools in Jordan and Bahrain, Al-Sorour (2003) concluded that the self can be developed through the educational program. The program helped in the formation of a personality and in preparing the individual for life.

Owainat (2001) identified the impact of practicing sports activities, gender, sports level, and experience on self-concept among secondary school students in Tafila Governorate, Jordan. The study included 733 students practicing sports activities and 535 students who did not practice sports activities. Using the Pierce–Harris Self-Concept Scale, Owainat (2001) reported statistically significant differences between the two groups in favor of practitioners of sports activities. The study also found that the athletic sample had a higher level of self-concept compared with the rest of the sample.

Therefore, our study aimed to measure the physical self-concept of deaf and hard of hearing people practicing swimming. To the best of our knowledge, no previous studies have dealt with the topic of physical self-concept among deaf and hard of hearing people. We hoped to fill the research gap on the measurement of the self-concept of deaf and hard of hearing people. Our findings could contribute to the literature on the important topic of the relation between swimming and physical self-concept of deaf and hard of hearing people.

Researchers and psychologists have become increasingly interested in self-concept as a personality trait that expresses an individual's self-perceptions and experiences. Self-concept has been defined as "a psychological term used to express a hypothetical concept that includes all opinions, ideas, feelings and attitudes that an individual has about himself, and also includes the

Data Collection Tools

individual's beliefs, convictions, past experiences and future ambitions" (Dowidar, 1992). Moreover, the concept of physical self-concept is an important element of deaf and hard of hearing swimmers, affecting their performance and technical level. We have observed that swimmers with a high physical concept are characterized by distinctive performance, which prompted us to study this factor for deaf and hard of hearing swimmers.

Specifically, our study aimed to identify the level of physical self-concept of deaf and hard of hearing swimmers and to assess differences in the level of physical self-concept among deaf and hard of hearing people according to specialization. We addressed the following study questions: What is the level of physical self-concept among deaf and hard of hearing people practicing swimming? Are there statistically significant differences (at $\alpha \leq 0.05$) in the level of physical self-concept due to the variable of specialization?

MATERIALS AND METHODS

We used a descriptive approach to suit the nature of the study and its objectives. Our study population consisted of deaf and hard of hearing students in the Faculty of Physical Education and Sport Sciences at Hashemite University, numbering 18 male students, according to the 2023 records of the Admission and Registration Unit at the university. We then deliberately selected the study sample to include 10 male students who practiced recreation swimming 3 days a week/ 2 hours each day. One was excluded due to sports injury. Our independent variable was specialization, whereas our dependent variable was the level of physical self-concept. Table 1 indicates the distribution of the sample according to the study variables. Ethical Approval was received by the Ethics Committee at Hashemite University no. 27/4/2022/2023).

Table 1. Sample Distribution by Study Variable

Study variable	Age average	Length average	Weight average	Department	N%
Specialization	21 year	175 cm	60 kg	Management & Training	7 70
				Sport	3 30
				Rehabilitation	

We adopted the physical self-description scale (Al-Hamdani, 2018). The scale consists of 10 fields: external appearance (1-6), obesity (7-12), muscle strength (13-18), endurance (19-24), flexibility (25-30), compatibility (31-36), health (37-42), physical activity (43-48), sport proficiency (49-54), and comprehensiveness of the physical aspect (55-60).The scale contained 60 items; 40 were positive items (1,4,5,6,8,9,10,13,14,16,17,18,19,20,21,23,25,29,30,31,32,35,36,38,39,40,43,44,46,47,50,51,53,54,56,57,58,59,60) and 20 were negative items.(2,3,7,11,12,15,22,24,26,27,28,33,34,37,41,42,45,48,49,52) Participants were asked to answer the questionnaire according to the degree of applicability of the statements on a scale from 5 (“it applies to me to a very large degree”) to 1 (“it does not apply to me at all”).

Tool Validity and Reliability

We consulted with a group of (6) professors in the field of physical education and special education and asked them to review the questionnaire. After considering the questionnaire with respect to the purposes of the study, they confirmed its validity.

Next, we verified the reliability of the physical self-concept scale for deaf and hard of hearing people using the Cronbach’s alpha (0.91).The final form of the scale consisted of 60 items, and the level of physical self-concept was divided into three categories: 1–2.33, low; 2.34–3.66, average;3.67–5, high.

Statistical analysis

To process the statistics, we used arithmetic averages, standard deviation, and *t*-test.

RESULTS

Regarding the first question on the level of physical self-concept among deaf and hard of hearing people practicing swimming, we calculated the arithmetic averages and standard deviations of the responses of the study sample on the self-concept scale (Table 2). Table 2 shows that the level of self-concept among the study sample was high, with an arithmetic mean of 4.400 and a standard deviation of 0.277.

Table 2. Arithmetic averages and standard deviations of the level of physical self-concept among the study sample

Variable	Mean	SD	Level
Physical self-concept	4.400	0.277	High

Table 3 gives the arithmetic averages and standard deviations of the responses to the physical self-concept scale.

Table 3. Arithmetic averages and standard deviations of the responses to the physical self-concept scale (External Appearance, Obesity, stringth, endurance, flexebility, compatability, health, physical activity, sport proficiency, and comprehensiveness of the physical aspect)

	No.	Statement	mean	SD	Level
External Appearance	1	My external appearance is better than that of those my age.	4.24	0.55	High
	2	I’m obviously fat.	3.11	0.45	Medium
	3	I can’t easily carry heavy stuff.	4.10	0.75	High
	4	I can easily run long distances without stopping.	4.04	0.87	High
	5	My body is flexible.	4.21	0.66	High
	6	I feel confident in myself when I make some movements that need neuromuscular coordination	4.54	0.54	High
Obesity	7	I don’t have strong immunity to a lot of diseases.	3.98	0.12	High
	8	I do physical activity several times a week.	4.47	0.41	High
	9	Most of my colleagues think I’m good at sports.	4.32	0.22	High
	10	I feel good about my body.	4.31	0.81	High

	11	My face is not very acceptable.	4.12	0.74	High
	12	I have a very wide middle.	3.45	0.84	Medium
	13	I'm a physically strong person.	4.54	0.41	High
stringth	14	I can do well in any test.	4.42	0.41	High
	15	I think I don't have enough physical flexibility for most sports activities.	4.36	0.77	High
	16	I'm good at performing matching movements in swimming	4.56	0.31	High
	17	I rarely get sick.	4.12	0.71	High
endurance	18	I often do physical activities that require obvious effort.	4.31	0.87	High
	19	Most sports activities seem easy to me.	4.49	0.41	High
	20	I'm proud of my physical self.	4.41	0.66	High
	21	My body looks better than that of most of my colleagues.	4.12	0.55	High
	22	I weigh too much.	3.54	0.45	Medium
Flexability	23	I have a great degree of strength.	4.65	0.21	High
	24	When I do physical activities, I get tired quickly.	3.65	1.01	High
	25	I can easily bend my body parts and move them in different directions.	4.31	0.75	High
	26	It's hard for me to control my body when performing some agility or coordination movements.	4.32	0.65	High
	27	I feel that I have immunity to many diseases	3.74	0.12	High
	28	I feel that I have immunity to many diseases.	4.50	0.71	High
Compatability	29	I engage in physical activity several times a week.	4.45	0.67	High
	30	I'm better at sports than most of my colleagues.	4.44	0.74	High
	31	I'm happy with my physical self.	4.21	0.66	High
	32	My physical appearance looks good.	4.41	0.54	High
	33	My body is not strong and my muscles are not toned.	3.31	1.37	Medium
	34	I feel unable to practice sports activities that require physical endurance.	4.22	1.16	High
	35	I think I can do well in tests that measure body flexibility.	4.50	0.41	High
Health	36	I find that my body responds to movements that need harmony and agility.	4.46	0.52	High
	37	I get sick more than most people my age.	4.00	0.66	High
	38	I regularly do a variety of physical activities.	4.32	0.49	High
	39	I have good sports skills.	4.66	0.41	High
	40	I am completely satisfied with the nature and state of my body.	4.32	0.51	High
	41	Many believe that my physical appearance is not good.	4.08	0.67	High
Physical activity	42	Owing to my obesity, it is difficult for me to buy suitable clothes.	4.53	0.79	High
	43	I can do well in any muscular strength test.	4.52	0.67	High
	44	I think I can run long distances without feeling tired.	4.41	0.75	High
	45	My body is not flexible.	4.32	0.77	High
	46	I can easily perform movements in most sports activities.	4.41	0.31	High
Sport profeciance	47	I don't get sick as much as most of my colleagues do.	3.83	0.71	High
	48	I don't have more free time to exercise.	3.83	1.11	High
	49	I think I'm not good at sports.	4.02	0.66	High
	50	I feel good in terms of my physical abilities.	4.58	0.56	High
	51	I have a very acceptable face.	4.25	0.85	High
	52	Most of my colleagues think I am fat.	3.62	0.47	Medium

Comprehensiveness aspect	53	I'm physically stronger than most people my age.	4.98	0.90	High
	54	I have good abilities at activities that require physical endurance.	4.24	0.62	High
	55	I can easily bend, stretch, and rotate my body in various directions.	4.45	0.77	High
	56	I am agile and have the ability to get along when playing sports or any other activity.	4.65	0.66	High
	57	When I get sick, it takes a long time for me to recover.	3.82	0.71	High
	58	I do sports activities every day.	4.41	0.54	High
	59	I'm good at many sports activities.	4.50	0.52	High
	60	I feel a sense of acceptance and satisfaction regarding the nature of my body.	4.52	0.52	High
	Total		4.65	0.27	High

Table 3 shows that item 53 (“I’m physically stronger than most people my age.”) was scored the highest, followed by items 39 (“I have good sports skills.”), and item 56 (“I am agile and have the ability to get along when playing sports or any other activity.”). Meanwhile, item 2 (“I think I

look fat.”) was scored the lowest. The high score for item 53 may be explained by the self-confidence and high physical self-concept among deaf and hard of hearing people, acquired and developed through participation in swimming activities.

Table 4. Arithmetic averages, standard deviations, and *t*-test results of the physical self-concept scale according to the exact specialization variable

Variable	Specialization	mean	SD	Degrees of freedom	<i>t</i> value	Significance
Physical self-concept	Sports Management & Training	4.43	0.21	9	0.59	0.50
	Sports Rehabilitation	4.31	0.14			

DISCUSSION

We believed that through the swim practice of deaf and hard of hearing people, they gained different experiences, which directly affected their personalities, whether in the psychological, physical, or social aspects, given that sports activity, in general, and swimming, in particular, has many benefits and directly affects the physical, psychological, and social aspects of practitioners. Indeed, it also develops the physical fitness of the physically disabled swimmer in general.” Our results also coincided with those of Al-Sorour (2003), which indicated statistically significant differences in self-concept in the experimental group. Abu Eid (2004) confirmed that the individuals may be affected by the sports activities because of its competitive nature which improves their personality and their appreciation to their own selves, beside improving their experience, social spirit, communications with others and their

physical health, in addition it may have a recognized impact on individual’s self-concept.

As for item 2, the ranking may be because people engaged in swimming often have ideal athletic bodies. The high physical effort required in swimming helps swimmers stay in shape. Abu Eid (2008) had earlier pointed out the same; swimming promotes the development of muscle strength and raises the level of physical fitness among swimmers. Regarding our second research question, we calculated the arithmetic averages and standard deviations of the responses to the scale according to the specialization variable (sports management and training, sports rehabilitation). To determine the significance of the differences, we used the independent sample *t*-test (Table 4). As shown in Table 4, we found no statistically significant differences ($\alpha \leq 0.05$) in the level of physical self-concept among the respondents with respect to their specialization.

Conclusions

Our findings showed that deaf and hard of hearing swimmers had a high level of physical self-concept. Moreover, By presenting and discussing the results, we conclude that the level of physical self-concept among deaf and hard of hearing whom practicing swimming was high. As the swimming skills they learn increase their self-confidence and make them have a high self-concept among their fellow practitioners of swimming, and this is what makes them integrate into society, whether inside or outside the university. Also, the self-concept of the deaf and hard of hearing practitioners of swimming is not related to the type of specialization studied by the student, whether management, training, or sports rehabilitation.

Recommendations

Based on our findings, we formulated the following recommendations. First, in the swimming training of deaf and hard of hearing people, the focus should be on the development of physical self-concept, as it was shown to be one of the main factors in raising the level of skill performance. Second, researchers should conduct more related studies on other categories of disabled people. For instance, scholars may determine the impact of gender on the concept of the physical self. Third, studies should also pay attention to other psychological measures, such as burnout, and personality traits in deaf and hard of hearing people.

Declaration of interest

The authors report there are no competing interests to declare.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received. **Ethics Statement**

This study is approved by the Hashemite University Human Research Ethics Committee (Approval Nummer: 27/4/2022/2023).

Authors Contribution

Study Design, FA, MH; Data Collection, FA, SA, IH, MH; Statistical Analysis, FA; Data Interpretation, SA, IH; Manuscript Preparation, FA, MH; Literature Search, FA, MH, IH, SA. All authors have read and agreed to the published version of the manuscript.

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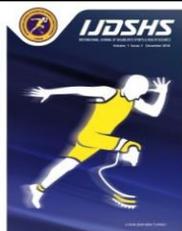
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RESEARCH ARTICLE

Investigating The Relationship Between Digital Well-Being and Cognitive and Emotional Consciousness in Sporting Consumers

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Abstract

In this study, the relationship between digital wellness of sport consumers and their cognitive and sensory conscious awareness was examined; gender, age, e-sport consumption status, and preference for using technological devices while doing sports were also examined and it was aimed to investigate whether there is a relationship between digital wellness and cognitive-sensory conscious awareness. 246 sport consumers aged 18 and above who receive services at private sports centers were chosen as the research group. The relationship between digital wellness of sport consumers and their cognitive and sensory conscious awareness was analyzed statistically using SPSS with descriptive survey method. Digital Wellness Scale developed by Öztürk (2018) was used to determine the digital wellness of sport consumers, and the Cognitive and Sensual Conscious Awareness Scale Revised, which was adapted to Turkish by Catak (2012) with validity and reliability, was used to determine their cognitive and sensual conscious awareness attitudes. Cronbach Alpha values of the scales were examined and Kolmogorow-Smirnow analysis was used to examine whether the data show normal distribution. Mann-Whitney U and Kruskal Wallis analyses were applied to investigate the significant differences in the views of sport consumers on the survey questions according to various variables. As a result of the analysis of the variables, it was found that males, e-sport consumers, those who use digital devices more frequently while doing sports higher digital wellness and cognitive-sensory conscious awareness. It was also statistically found that there was a relationship between cognitive-sensory conscious awareness and digital wellness at the 0.01 level.

Keywords

Digital Well-Being, Cognitive Sensory Conscious Awareness, Digital Well-Being in Sport Consumers

INTRODUCTION

Under the "Security" heading, it is emphasized that the factors (such as cyberbullying and hate speech) that threaten individuals' physical and psychological well-being while using digital technologies should be prevented. In this context, it is argued that citizens of the digital age need to have the knowledge and skills to use digital information for their own benefit and to protect

themselves from physical and psychological risks they may encounter while using digital technologies. Additionally, the professional training of teachers, who play an effective role in imparting the skills to use digital platforms for individual and societal well-being, gains importance. Therefore, there is a need for new research to understand the impact of digital technologies on digital well-being and subjective

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well-being (Gui, Fasoli, & Carradore, 2017; RPSH, 2017).

As a being capable of reflecting on their own mental processes, humans have the ability to evaluate not only external events and situations in the outside world but also their internal world of emotions and thoughts. The presence of a stimulus alone is not sufficient for the emergence of emotional experiences; cognitive evaluations regarding the relevant situation or objects are also necessary (Frijda, 1993). Mindfulness refers to being aware of and describing emotional experiences in detail (Catak, 2012). In addition to Mindfulness refers to a form of awareness that encompasses emotions, thoughts, bodily sensations, and external stimuli. This awareness entails being non-judgmental and non-reactive towards the experiences of the present moment. Mindfulness is associated with the capacity to recognize one's sensory experiences (such as seeing, hearing, and smelling) and internal experiences (such as emotions and thoughts). It involves being open, accepting, and attentive to the present moment's experiences. Consequently, individuals enhance their ability to perceive mental states and environmental stimuli more accurately and develop a healthier capacity to respond (Baer, Lykins ve Peters, 2012; Kabat-Zinn, 2005). Consciousness-based therapies, as defined by Hayes (2004), are classified as third-wave behavior therapies. These therapies emerged as a result of the first-generation behavior therapies, which focused on behavior change and began with laboratory studies in the 1960s. Second-wave therapies, on the other hand, include comprehensive therapies that incorporate perception and cognition alongside behavior, and are associated with the cognitive revolution of the 1970s. Cognitive and Behavioral Therapies, led by Ellis and Beck, emphasize that emotional disturbances stem from cognitive processes and their impact on emotions and behaviors. Third-wave therapies emerged in the 1990s and continue to focus on language and cognition, albeit with a different approach than Cognitive Behavioral Therapies. In third-wave therapies, the emphasis lies not on changing the content of cognition, but on developing a non-judgmental and accepting attitude towards distressing experiences caused by faulty cognitions and dysfunctional beliefs. These therapies aim to bring awareness to individuals' experiences, live in harmony with their internal

experiences, and lead a value-based life (Hayes, 2004; Herbert ve Forman, 2014).

Cognitive mindfulness refers to an individual's awareness of their own thoughts, engaging in planning before engaging in activities, organizing their thoughts during the planning process, and evaluating the congruence of their thought performance after completing the activity (Demir and Doğanay, 2009). According to Louca (2003), if cognitive mindfulness encompasses cognitive processes such as knowing, perceiving, understanding, and remembering, then cognitive mindfulness includes the individual's ability to reflect on their own perception, understanding, and remembering. Flavell (1978) also uses the concept of cognitive mindfulness as a higher-level concept.

If an individual's level of mindfulness is high during sports consumption, they can notice their current emotional state, bodily sensations, and other details related to the sports experience. This can contribute to making sports consumption more meaningful and enriching. Additionally, acceptance, which involves the ability to tolerate emotional distress, can be considered as part of digital well-being. Being able to cope with challenges or failures during sports consumption, being emotionally flexible, and displaying an accepting attitude can positively influence the sports experience and increase satisfaction in sports consumption.

Attention, momentary focus, mindfulness and acceptance are mental dimensions that form cognitive and affective mindfulness. Attention and momentary focus can be considered as part of digital well-being. The ability of an individual to focus their attention and maintain mindfulness of the present moment during digital experiences can make their interaction with digital technologies more conscious and satisfying. For example, if a digital application or platform is used during sports consumption, the individual's attention and focus are important. Digital well-being can enhance the efficiency of the sports experience and increase satisfaction associated with sports consumption.

In conclusion, attention, momentary focus, mindfulness, and acceptance are mental dimensions that contribute to cognitive and affective mindfulness. These dimensions, as part of digital well-being, play a role in enhancing the sports consumption experience. Developing these qualities and using them consciously during sports consumption can lead to more satisfying and

meaningful sports experiences. Cognitive and emotional consciousness allows sports consumers to be aware of their thoughts, emotions, and experiences. These factors can influence the sports experience and impact consumer satisfaction, motivation, and performance. Understanding the relationship between digital well-being and cognitive and emotional consciousness can help sports consumers better manage their interactions with digital technologies and enhance their sports experiences.

The use of digital technologies is rapidly increasing in today's world, and this trend is transforming and enriching the sports experience. Sports consumers actively participate in sports events, gather information, and share their experiences through digital tools such as smartphones, wearable devices, and social media. However, the impact of digital technologies on the cognitive and emotional experiences of sports consumers is still not fully understood.

Sport has become an important part of individuals' lives, particularly with the increasing digitalization of sports consumption. Alongside this process, the concept of digital well-being has emerged as a significant area of interest. Digital well-being measures individuals' experiences and the effects of using digital technologies. Consequently, examining the relationship between digital well-being and cognitive and emotional consciousness is of great importance. Cognitive consciousness refers to individuals' awareness of their thoughts, perceptions, and processes of understanding, while emotional consciousness encompasses individuals' ability to recognize and manage their emotional experiences. Sport consumption stands out as an area that can significantly impact individuals' cognitive and emotional experiences. Therefore, investigating the relationship between digital well-being, cognitive consciousness, and emotional consciousness within the context of sport consumption forms a crucial research area. The aim of this study is to examine the relationship between digital well-being and cognitive and emotional consciousness among sport consumers.

MATERIALS AND METHODS

Model of the Research

This research was conducted within the scope of a quantitative study using the

correlational survey model. The correlational survey model aims to measure the relationship between two or more variables. In this study, the goal was to examine the simultaneous variation of multiple variables (Karasar, 2014).

In this research, a non-experimental exploratory correlational design was used. This design is employed to examine the degree of relationship between variables included in the study. Non-experimental exploratory correlational design is a method that investigates the degree of existing relationships. Its purpose is to identify the causes of a situation or event and the variables that influence these causes (Büyüköztürk et al., 2008).

Convenience sampling is a sampling technique where easily accessible participants are used to collect data. In this method, data is collected from individuals who are convenient to reach, without relying on probability-based selection. This method enables researchers to quickly and conveniently access participants but often comes with limitations regarding the representativeness of the sample (Dawson and Trapp, 2001). Ethics committee approval of the study was obtained by the decision of the ethics committee of Yalova University, dated 08.05.2023 and numbered 2023/93.

Data Collection Tools

Descriptive statistical method was used in the research. The "Digital Well-being Scale" developed by Öztürk (2018) was employed to measure the digital well-being of sports consumers, and the "Revised Cognitive and Emotional Mindfulness Scale," translated into Turkish by Catak (2012) with established validity and reliability, was used to determine cognitive and emotional mindful awareness attitudes.

The research hypotheses are as follows:

H1: There is a significant difference between e-sport consumption and cognitive-emotional awareness.

H2: There is a significant difference between e-sport consumption and digital wellness.

H3: There is a significant difference between the use of technological devices during sports and cognitive-emotional awareness.

H4: There is a significant difference between the use of technological devices during sports and digital wellness.

H5: There is a significant relationship between digital wellness and cognitive-emotional awareness.

Statistical Analysis

For data analysis, SPSS 25 IBM Corp., released in 2017, was used. The Shapiro-Wilk test normal distribution, the differences between groups were evaluated using the Kruskal-Wallis test. A significance level of $p < 0.05$ was adopted for statistical significance.

RESULTS

According to the research article titled "Investigating The Relationship Between Digital Well-Being and Cognitive and Emotional Consciousness in Sporting Consumers," Mann-Whitney U and Kruskal Wallis analyses were employed to examine significant differences in the perspectives of sport consumers based on various variables. The findings of the study indicated that male individuals, e-sport consumers, and those

method was employed to assess the normality of the data distribution. As the data did not follow a

test. Additionally, the differences between paired groups were assessed using the Mann Whitney U who frequently utilize digital devices while engaging in sports demonstrated higher levels of digital well-being and cognitive-sensory conscious awareness.

Additionally, the statistical analysis revealed a significant relationship between cognitive-sensory conscious awareness and digital well-being at a significance level of 0.01. These results suggest that individuals who engage in e-sports, use digital devices more frequently during sports activities, and identify as male tend to exhibit greater digital well-being and cognitive-sensory conscious awareness.

Table 1. Analysis of the hypotheses regarding the digital well-being and cognitive-emotional conscious awareness of sports consumers based on the consumption status of e-sports

Test Statistics ^a		
	DWMEAN	CECMEAN
Mann-Whitney U	3372.000	2947.500
Wilcoxon W	16252.000	15827.500
Z	-6.729	-7.457
Asymp. Sig. (2-tailed)	.000	.000
A. Grouping Variable: E-Sports Consumption		

Based on these statistical findings, it can be concluded that there are significant differences in both the digital well-being and cognitive-emotional conscious awareness of sports consumers, depending on their consumption status of e-sports. Further interpretation and analysis of these results would be necessary to understand the specific nature and implications of these differences.

In this context, based on the results of the conducted analysis, the hypotheses H1: There is a significant difference between e-sports consumption and cognitive-emotional awareness' and H2: There is a significant difference between e-sports consumption and digital well-being' have been accepted. According to these hypotheses, individuals who consume e-sports obtain higher scores in digital well-being and cognitive-emotional awareness compared to those who do not consume e-sports. The results obtained from this research group demonstrate that e-sports

consumption has a positive impact on individuals' levels of digital well-being and cognitive-emotional awareness.

In light of the findings, e-sports games can be associated with higher scores in digital well-being and cognitive-emotional awareness compared to those who do not engage in e-sports. This can be attributed to several reasons. Firstly, e-sports require specific skills such as strategic thinking, problem-solving, reaction speed, hand-eye coordination, and teamwork. Engaging in activities that challenge and develop these cognitive abilities can positively impact overall cognitive functions. Moreover, e-sports provide opportunities for players to set goals, overcome challenges, and experience a sense of achievement. Succeeding in the game can enhance players' self-confidence and contribute to positive emotional well-being. The sense of achievement fosters increased motivation, boosts self-esteem, and has a general positive effect on emotional welfare.

Furthermore, the social aspect of e-sports, often involving multiplayer online games, promotes

Positive social connections can contribute to well-being and emotional awareness. The shared goal and collaboration with others can strengthen social bonds, leading to increased emotional satisfaction. Additionally, e-sports require engagement with digital platforms and technologies. Developing competence in using digital tools and technologies can contribute to individuals' sense of mastery and well-being in the digital world. It is important to note that these

social interaction and connection with other players.

findings highlight the potential positive associations between e-sports consumption and well-being outcomes. However, it is essential to consider individual differences and potential negative consequences such as excessive gaming, social isolation, and neglect of other important aspects of life. Further research is needed to fully understand the complex relationship between e-sports and well-being, taking into account both the positive and negative aspects of engagement.

Table 2. Analysis of the hypotheses regarding digital well-being and cognitive-emotional awareness based on the use of digital devices during sports

Test Statistics ^a		
	DWMEAN	CECMEAN
Mann-Whitney U	2380.000	1599.000
Wilcoxon W	3976.000	3195.000
Z	.000	-3.419
Asymp. Sig. (2-tailed)	.000	.001

A. Grouping Variable: Use of Digital Devices While Sports

Based on these results, it can be inferred that there are statistically significant differences between the groups in terms of both digital well-being and cognitive-emotional awareness. The group classified as "Use of Digital Devices While Sports" appears to have higher mean scores in both variables compared to the other group. The results confirm H3, indicating that there are statistically significant differences between the group labeled as "Use of Digital Devices While Sports" and the other group in terms of cognitive-emotional awareness. The group that incorporates technological devices during sports demonstrates higher mean scores in cognitive-emotional awareness compared to the other group. This implies that the use of technological devices during sports may contribute to an enhanced

cognitive-emotional awareness. The results support H4, as there are statistically significant differences between the group classified as "Use of Digital Devices While Sports" and the other group in terms of digital wellness. The group that engages with technological devices during sports displays higher mean scores in digital wellness compared to the other group. This suggests that utilizing technological devices during sports may be associated with increased levels of digital well-being.

In summary, both hypotheses H3 and H4 are supported by the results, indicating that the use of technological devices during sports is related to higher levels of cognitive-emotional awareness and digital wellness.

Table 3. Correlation Analysis

Correlations				
		DMEAN	M-MEAN	
Spearman's rho	DWMEAN	Correlation Coefficient	1.000	.792**
		Sig. (2-tailed)	.	.000
		N	246	246
	CECMEAN	Correlation Coefficient	.792**	1.000
		Sig. (2-tailed)	.000	.
		N	246	246

** . Correlation is significant at the 0.01 level (2-tailed).

Based on the statistical analysis, the results support the acceptance of hypothesis H5, which states that there is a significant relationship between digital wellness and cognitive-emotional awareness. The findings indicate that individuals who participate in e-sports, use digital devices more frequently during sports activities, and identify as male tend to experience higher levels of digital well-being and cognitive-sensory consciousness awareness.

These results suggest that engaging in e-sports and using digital devices during sports activities may have a positive impact on both digital wellness and cognitive-emotional awareness. The correlation between these variables indicates that individuals who are more involved in e-sports and digital technology during physical activities are more likely to experience enhanced well-being and increased awareness of their cognitive and emotional states.

DISCUSSION

This study is believed to contribute to the field due to its distinctive approach in examining the relationship between cognitive-emotional mindfulness and digital well-being, which sets it apart from existing research in the literature. Moreover, the study successfully revealed a significant correlation between cognitive-emotional mindfulness and digital well-being, as well as demonstrated that cognitive-emotional mindfulness predicts cognitive flexibility. These findings are expected to offer valuable insights to the field and make a meaningful contribution to the understanding of the interplay between cognitive-emotional mindfulness, digital well-being, and cognitive flexibility. The importance of the relationship between digital well-being and cognitive and emotional consciousness in sporting consumers can be evaluated from several perspectives.

Firstly, there is an increasing interest in the concept of mindfulness in today's world, and one of the main reasons for this interest is its 2500-year history (Kang ve Whittingham 2010). Research in the field of mindful awareness highlights the need to investigate the mechanisms of its effects by examining mindful awareness itself (Baer, 2011). Therefore, significant impacts of mindfulness-based approaches are observed in various fields (Aktepe and Tolan, 2020). The study conducted by

Jimenez et al. (2010) examined the effects of mindfulness-based practices on emotion regulation and their role in psychological well-being. The findings of the study indicated that high levels of mindfulness were associated with higher levels of positive emotions, emotion regulation, and self-acceptance. This suggests that mindfulness-based practices can contribute to improving emotion regulation and supporting psychological well-being.

An increase in mindfulness may contribute to the enhancement of emotional intelligence and psychological well-being (Deniz et al., 2017; Leary et al., 2007). This, in turn, can positively impact sporting consumers' emotional experiences by enabling them to better understand and manage their emotions, leading to a positive effect on their overall mood and emotional balance.

Furthermore, emotional awareness goes beyond being just a skill; it is a psychological need of individuals (Dizen et al., 2005). Individuals with high emotional awareness can observe their emotional experiences more objectively and manage their emotional responses better. This enables them to provide a more impartial perspective during the decision-making process, leading to better evaluations (Stanton et al., 2000). Secondly, it has been observed that mindfulness training leads to an increase in positive emotions, improved coping skills, and the development of a sense of purpose in life (Fredrickson et al., 2008). The concept of digital well-being pertains to the positive feelings and effects individuals experience while using digital technologies. In this context, mindfulness training holds the potential to enhance digital well-being in sporting consumers. By cultivating mindfulness, sporting consumers can use digital technologies in a more balanced and conscious manner, avoiding negative effects and enhancing their digital experiences positively.

Lastly, the significance of digital well-being for sporting consumers lies in understanding the impact of technology on their sporting experiences. In today's world, digital technologies encompass various factors that influence the process of sports consumption. These factors include access to sports events, tracking sports performance, interacting with other sporting consumers, and sharing sporting experiences. Digital well-being can support sporting consumers in using these technologies in a healthy manner

and making their sporting experiences more satisfying.

The impact of increased levels of mindfulness on positive affective states can be interpreted in relation to digital well-being in sporting consumers. Research conducted by Carlson (2012) indicates that mindfulness training has the potential to induce positive changes in individuals' emotional states. In this context, mindfulness training tailored for sporting consumers can contribute to enhancing digital well-being by fostering an improvement in their emotional states.

Mindfulness refers to the ability to focus on present experiences and evaluate them without judgment. During sports consumption, the use of digital technologies can influence the experiences and interactions of sporting consumers, subsequently affecting their emotional states. Through mindfulness, sporting consumers can develop a deeper awareness of their digital experiences, better understand their emotional reactions, and manage them in a positive manner. This can contribute to an increase in positive affective states and strengthen digital well-being among sporting consumers. Furthermore, mindfulness allows individuals to adopt a neutral and accepting attitude towards their present experiences. In the context of sports consumption, encountering negative experiences or challenges associated with the use of digital technologies is possible. Mindfulness can assist sporting consumers in responding to these challenges with less reactivity and approaching them with a more positive perspective.

As a result, this can enhance digital well-being and contribute to an increase in positive affective states. The relationship between increased levels of mindfulness and enhanced positive affective states can be interpreted in relation to digital well-being among sporting consumers. Mindfulness training tailored for sporting consumers can contribute to the development of digital well-being by promoting improvements in their emotional states. This highlights the significance and potential impact of mindfulness training in enhancing the digital well-being and overall psychological well-being of sporting consumers. In conclusion, the relationship between mindfulness and digital well-being in sporting consumers involves the elevation of emotional intelligence, the increase in positive

emotions, the development of coping skills, and the healthy use of digital technologies. Therefore, the importance of mindfulness training to enhance digital well-being in sporting consumers should not be underestimated. Research in this area provides valuable insights to improve the sporting consumption experience and support the psychological well-being of sporting consumers.

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Ethics of Research

Ethics committee approval of the study was obtained by the decision of the ethics committee of Yalova University, dated 08.05.2023 and numbered 2023/93.

Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this research.

Author Contributions

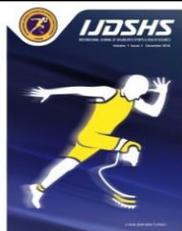
Study Design, DÖ; Data Collection, OK; Statistical Analysis, DÖ, OK; Data Interpretation, DÖ; Manuscript Preparation, DÖ; Literature Search, DÖ, OK. All authors have read and agreed to the published version of the manuscript.

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RESEARCH ARTICLE

Determination of the Relationship between Attitude towards Food Supplements and Physical Health Perception

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Abstract

In this age when the importance of human and public health is increasing, inactivity, which is seen as one of the most important problems, and the increase in obesity rates threaten public health. Therefore, the importance of physical activity and nutrition is increasing and new researches are being conducted in this field. The aim of this study is to analyse the relationship between physical health perception and attitude towards the usage of food supplements. Relational survey method was used in this study designed to determine this relationship between variables. 287 academic staff (85= female, 202= male) participated in the study. The physical health statements of the PROMIS global health scale and the scale adapted to the use of food supplements after a literature review were used. As a result, significant relationships were determined between attitude towards the use of food supplements and physical health perception. It was determined that academicians generally considered themselves healthy and were open-minded about the use of food supplements ($F=8.150$ $p=0.000$), physical health perception differed according to their field of study ($F=4.912$; $p=0.002$), and those who exercised regularly had a higher physical health perception ($F=8,339$; $p>0.05$). The study revealed important results in terms of guiding individual, public health and government policies. It is recommended for new researchers to examine the concepts related to rest, sleep behaviours and nutritional knowledge.

Keywords

Academic staff, Body Mass Index, Dietary habits, Food supplements, Perceived physical health

INTRODUCTION

While concerns about poor health and obesity are increasing in today's societies (Hardman and Stensel, 2009), it can be stated that individual steps and public projects for health protection confirm this concern. Diet and physical activity are the focal components of managing the risk of cardiovascular disease (Kinnear, et al. 2020). In the 20th century, life expectancy increased thanks to advances in public health (Merrick, 2016). Maintaining and improving the overall health of people and societies is seen as an important and rapidly increasing challenge.

General health risks include cardiovascular diseases, diabetes and cancer (Levine et al. 2005; Stensel et al. 2021). Against inactivity, which has become an important problem all over the world, it is known that projects to combat obesity and develop movement habits are supported to protect and improve public health. It is recognised that against inactivity, which has become an important problem of whole world, projects to struggle against obesity and to develop movement habits are supported in order to protect and improve public health. An individual who wants to lead a healthy life should also develop regular physical activity, quality sleep and nutrition habits. It is

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thought that improving one's overall health can be related to one's own development. Therefore, well-educated people will be more aware and can develop behaviors to protect and improve their personal health. Nutrition behaviors, which are important for human and public health, may change over time. People may turn to food supplements to access clean and healthy food and to protect their personal health. Based on nutritional habits, the relationship between perceived physical health and attitudes towards food supplements gains importance.

Perceived physical health

Perceived health is a subjective evaluation expressed by the person himself/herself. Subjective health assessment does not have a medical diagnostic basis and includes the evaluation of feelings of physical pain or discomfort as well as feelings such as well-being and satisfaction with life (Szwarcwald et al. 2005). The most common method preferred in the measurement of perceived health is the individual's personal opinion about his/her own health. It has been stated that this method, which includes subjective evaluations, is an important component of survival (Idler and Benyamini, 1997). Studies on perceived health behaviors have shown that there are poor eating habits (Tremblay, et al. 2003), objective and subjective obesity assessment (Stranges et al. 2006) and low physical exercise frequency (Kaleta et al. 2006). In a study on physical health and nutrition, it was reported that adolescents who engaged in more physical activity had better health status (García Mayor et al. 2021) and adherence to the Mediterranean diet was reported to be higher (Moral-García et al. 2020). In accordance with these results, it can be stated that personal health perception is important for one's own life.

Dietary Habits

Nutrition, one of the basic needs of human beings, is also important for public health. It is possible to protect and improve individual and social health with a balanced and healthy diet. Especially in children, it has been stated that the presence of negative factors related to eating habits may increase inactivity and lead to significant health problems (Ayas and Göral, 2023). Nutritional knowledge and habits acquired during youth (Altınok and Güvenç, 2022) are important in shaping a healthy life and (Rosi et al. 2020) in gaining nutritional habits. It has been determined

that socio-economic level and educational status affect the level of nutritional knowledge (Saribay and Kirbas, 2019). Nutritional knowledge will positively affect nutritional skills (Velardo, 2015), and thus, food preferences and nutritional behaviors of people with high levels of nutritional knowledge will be shaped. Food choice is one of the leading factors affecting people's eating habits. Food choice is motivated by physiological, social and economic factors, including taste, convenience, nutritional knowledge and beliefs, and involves individual and community differences (Birkenhead and Slater, 2015; Velardo, 2015). Therefore, it can be stated that eating habits have important for human life.

Food supplements

Interest and demand for food supplements to meet the need for a healthy diet is increasing worldwide. In studies on the habits of food supplement use, it was reported that participants used food supplements at least 21% in Spain (Pérez-Rodrigo et al. 2021), 37.7% in China (Zhao et al. 2020), 26% in Saudi Arabia (Zaki et al. 2020), and 36% in Turkey before the COVID-19 outbreak (Macit, 2020). Food supplements are needed to overcome the deficiencies caused by nutritional barriers such as population growth, access to healthy food and economic factors. Food supplements are defined as the consumption of nutrients that cannot be taken in a balanced and sufficient level in pill, tablet, capsule and liquid forms (Kılıç Kanak et al. 2021). Food supplements can be defined as non-food substitutes that are taken to supplement the nutrients that the body is thought to need for reasons such as taking substances that the body cannot synthesize itself, consumption barriers due to allergies or intolerances, personal beliefs such as veganism or vegetarianism, and reducing the risk of disease. Human beings consume food supplements for a variety of reasons, such as to compensate for or balance nutritional deficiencies (O'Dea, 2003; Petroczi et al. 2011), cosmetic reasons (Castillo and Comstock, 2007), wellness (Nichter and Thompson, 2006), or sexual performance (Reay et al. 2005). As stated in the literature, it can be stated that people generally turn to food supplements in order to maintain a healthy and productive life. In addition, the easy availability and uncontrolled use of food supplements (Samar, 2021) can be seen as one of the factors that put public health at risk. It can be stated that individual

attitudes towards food supplements and uncontrolled use are also important. In research on athletes, the belief that athletes have an advantage (doping effect) in competitions and ease of access to food supplements (Rudarli Nalçakan, et al. 2020; Yazar, et al. 2022).

Based on the variables subject to the research, perceived health, eating habits and food supplements gain importance in terms of human and public health. Due to the importance of dietary habits and physical activity and the use of food supplements, the main focus of this research can be expressed as the identification of the relations between these behaviours.

MATERIALS AND METHODS

In this research, the relational survey method, which "aims to determine the existence and/or degree of co-variance between two or more variables" (Büyüköztürk, et al. 2013; Fraenkel and Wallen, 2006; Karasar, 2016), was used. The measurement tool prepared for data collection in the context of the study was applied face-to-face to the participants. The data of the study participants who agreed to participate in the study were evaluated.

Participants

The research was conducted with academic staff (n=882) working in a public university. The research sample is limited to the opinions of 287 (85=female, 202=male) participants (85=female, 202=male) who volunteered to participate in the research and were randomly selected from the population. All academic units were tried to be reached by not considering differences such as title and seniority among academic staff. The sample size in the research is expected to reach at least 10 times the total number of statements or at least 200 sample size (Büyüköztürk, 2002). However, according to Yazıcıoğlu and Erdoğan (2014) the sampling error of ± 0.05 was determined as 278 at a significance level of $p=0.05$ in determining the sample for such studies conducted in social sciences. Convenience sampling method was used for data collection. In the study, all conditions stated in the literature on sampling were met (n=287). The questionnaire prepared by the researcher was applied face-to-face, incorrect and incomplete questionnaires were excluded from the scope of the study, and the data were coded, transferred to the SPSS v26 package program and

analyzed. Approval was obtained from Hitit University Non-Interventional Ethics Committee (2023/09) for the implementation of the study. Detailed demographic characteristics of the employees participating in the study are given in Table 1.

Measurements

In the study, the physical health statements of the "PROMIS global health scale" developed by Hays et al. (2009) and whose reliability study was conducted again in (Hays et al. 2017) were used. The first of the scale statements is a personal health assessment derived from responses to the question "How would you rate your health in general? For comparable scaling with other health items, responses were coded as 5=very healthy, 4=in good health, 3=healthy, 2=neither good nor bad health, 1=not healthy. The second statement asks "Compared to other people your age, how would you rate your health in general? For comparable scaling, this question was coded as 5=my health is much better than most people my age, 4=my health is better than most people my age, 3=my health is about the same as most people my age, 2=my health is worse than most people my age, and 1=my health is much worse than most people my age". The third statement is "How often does your health get in the way of what you want to do? (1=very often to 5=never). Finally, the responses to the statement "How satisfied are you with your current health status? (1=not satisfied at all, 2=dissatisfied, 3=somewhat satisfied, 4=satisfied and 5=very satisfied) were coded. Participants' responses were summed and divided by the number of valid responses. Scores ranged from 1 to 5 (poor to good physical health) and the internal consistency was .78.

A literature review was conducted to determine attitudes towards food supplements. In the literature review, it was determined that the focus was generally on concepts such as nutrition knowledge, feelings and behaviors towards nutrition, good or bad nutrition, and type of nutrition (Özkan Pehlivanoglu et al. 2020; Tekkurşun Demir and Cicioğlu, 2019; Ulaş Kadioğlu, 2019; Yolcuoğlu and Kızıltan, 2021). The food supplements subject to the research define the industrial products of a market with high economic value. For this reason, it is thought that researchers are not inclined to conduct studies on food supplements. The scale created as a result of examining the scales examining knowledge,

feelings and behaviors, that is, attitudes towards nutrition, was adapted to the use of food supplements. According to experts, the scale has high reliability if the internal consistency coefficient is between 0.80 and 1 (Alpar, 2006; Büyüköztürk, 2014; Tavşancıl, 2014). The structural reliability and validity analyses of the scale are included in the findings. The scale was prepared as a Likert-type rating as "*Strongly disagree*", "*Disagree*", "*No idea*", "*Agree*", "*Strongly agree*".

RESULTS

In this part of the study, findings related to the demographic characteristics of the participants, reliability and frequency analyses, t-test and Anova test results are presented. Cronbach's Alpha reliability values of the scales used in the study were calculated as ,771 for the cognitive dimension of the food supplement use scale, ,717 for the affective dimension, ,695 for the behavioural dimension, ,737 for the whole scale and ,779 for the physical health perception scale.

Table 1. Demographic characteristics of participants

Variables		f	%
Gender	Female	85	29,6
	Male	202	70,4
Marital Status	Married	172	59,9
	Single	115	40,1
Age	25-34 age	82	28,6
	35-44 age	109	38,0
	45 years and over	96	33,4
Body Mass Index	Normal weight	128	44,6
	Overweight	111	38,7
	Obese	48	16,7
Scientific Area	Medicine/Health Sciences	36	12,5
	Science	53	18,5
	Social Sciences	144	50,2
	Engineering and Natural Sciences Sciences	54	18,8
Food Supplement Use	Yes	83	28,9
	No	204	71,1
Making Regular Exercise	Yes	87	30,3
	No	200	69,7
Total		287	100

It is seen that the majority of the participants are male (70.4%) in terms of gender. In terms of age, it can be stated that 82 participants are between 25-34 years old, 109 participants are between 35-44 years old, and 96 participants are 45 years old and above. In terms of marital status, 59.9% of the participants are married and 40.1% are single (Table 1). When the participants are analysed in terms of their fields of study, it is seen

that the majority of them work in social sciences (50.2%) and science (18.5%) and engineering-natural sciences (18.8%). In terms of Body Mass Index, 44.6% of the participants were normal weight, 38.7% were overweight and 16.7% were obese. The majority of the participants stated that they did not use food supplements (71.1%) and did not exercise regularly (69.7%) (Table 1).

Table 2. Analysis of regular exercise participation in physical health and food supplement use

	Making Regular Exercise	N	Mean	Sd.	F	p
Physical Health Perception	Yes	87	3,38	,68	8,339	,004
	No	200	3,18	,53		
Food Supplement Use	Yes	87	3,45	,35	3,026	,083
	No	200	3,37	,30		

$p < 0,05$

The results of the analysis showed that the physical health perception of those who exercise regularly differed ($F=8,339$; $\bar{X}=3,38$), while no significant difference was found in the use of food

supplements ($p > 0,05$). Based on the table, it was determined that regular exercisers ($\bar{X}=3,38$) perceived their physical health status better than non-exercisers ($\bar{X}=3,18$) (Table 2).

Table 3. Analysis of physical health and food supplement use on body mass index

	BMI	N	Mean	Sd.	F	p	Post-Hock
Cognitive Dimension	Normal weight	128	3.50	.57	8.150	.000	1>3 2>3
	Overweight	111	3.35	.67			
	Obese	48	3.06	.81			
	Total	287	3,37	,67			
Affective Dimension	Normal weight	128	3.01	.57	3.553	.030	2<5 3<5 4<5
	Overweight	111	3.06	.67			
	Obese	48	2.75	.81			
	Total	287	2,99	,68			
Behavioural Dimension	Normal weight	128	3.75	.57	.034	.967	No difference
	Overweight	111	3.75	.67			
	Obese	48	3.78	.81			
	Total	287	3,76	,72			
Physical Health Perception	Normal weight	128	3,24	,53	8.150	.000	1>3 2>3
	Overweight	111	3,31	,59			
	Obese	48	3,09	,70			
	Total	287	3,24	,59			

As a result of the analyses conducted to reveal whether the perception of food supplement use differs according to the body mass index of academicians, it was found that the perception of food supplement use of academicians in the normal weight ($\bar{X}=3.50$) and overweight group ($\bar{X}=3.35$) differed in the cognitive dimension compared to those who were obese ($\bar{X}=3.06$) ($F=8.150$ $p=0.000$). When the results of the body mass index and physical health perception of the academicians constituting the research sample were examined, it was determined that the physical health perception of the academicians in the obese ($\bar{X}=3,09$) category differed compared to those in the normal weight ($\bar{X}=3,24$) and overweight group ($\bar{X}=3,31$) (Table 3).

As a result of the analyses conducted to reveal whether the perceptions of food supplement use differ according to the age variable of academicians; while there was no difference in the affective dimension, it was found that the perceptions of food supplement use of academicians aged 25-34 ($\bar{X}=3.50$) differed in the cognitive dimension compared to academicians aged 45 and over ($\bar{X}=3.21$; $F=4,492$ $p=0.012$). In the behavioural dimension, it was found that academics aged 45 years and over ($\bar{X}=3.89$) had a different perception of food supplement use compared to academics aged 25-34 years ($\bar{X}=3.60$; $F=3,517$ $p=0.031$) (Table 4).

Table 5. Analysis of physical health and food supplement use on scientific area

	Scientific Area	N	Mean	Sd.	F	p	Post-Hock	
Perception of food supplement	Cognitive Dimension	Medicine/Health Sciences	36	3,55	,70	1,234	,298	No difference
		Sciences	53	3,29	,56			
		Social Sciences	144	3,37	,69			
		Engineering Sciences	54	3,31	,69			
		Total	287	3,37	,67			
	Affective Dimension	Medicine/Health Sciences	36	3,15	,75	1,020	,384	No difference
		Sciences	53	2,89	,55			
		Social Sciences	144	2,99	,68			
		Engineering Sciences	54	2,97	,76			
		Total	287	2,99	,68			
	Behavioural Dimension	Medicine/Health Sciences	36	3,56	,82	1,805	,146	No difference
		Sciences	53	3,66	,60			
Social Sciences		144	3,84	,69				
Engineering Sciences		54	3,76	,84				
Total		287	3,76	,72				
Physical Health Perception	Medicine/Health Sciences	36	3,36	,50	4,912	,002	1>2 3>2 4>2	
	Sciences	53	2,99	,53				
	Social Sciences	144	3,26	,63				
	Engineering Sciences	54	3,37	,50				
	Total	287	3,24	,59				

As a result of the analyses conducted to determine the difference between the perceptions of academicians' fields of study on physical health and use of food supplements, it was determined that academicians in the fields of medicine/health sciences ($\bar{X}=3.36$), social sciences ($\bar{X}=3.26$) and engineering ($\bar{X}=3.37$) perceived their physical health status better than academicians in the field of science ($\bar{X}=2.99$) ($F= 4.912$; $p=0.002$).

DISCUSSION

The aim of this study is to define the relation between physical health perception and attitude towards the use of food supplements. Human physical health is related to nutrition, rest and movement. In order to maintain health, the body needs to ensure that its needs are adequately met, healthy and adequate nutrition, exercise and rest are needed. In this context, studies on food supplements generally focus on dietary habits. Considering the increase in the use of food supplements, it is important to reveal how physical health affects individuals. The demographic data show that the majority of the participants were

male (70.4%), 82 participants were between the ages of 25-34, 109 participants were between the ages of 35-44, 96 participants were 45 years and over, 59.9% were married and 40.1% were single. It was determined that the majority of the participants worked in the field of social sciences (50.2%), 28.9% used food supplements and 30.3% exercised regularly (Table 1).

The results of the study showed that academicians who exercised regularly perceived their physical health status as better and felt themselves healthier (Table 2). It is known that one of the most important factors of physical health is physical activity. One of the requirements of a positive life in terms of individual and community health is proper nutrition and physical activity (Kaya et al. 2018). A study conducted on students reveals that physical health perception is affected by demographic, economic, social, psychological and competence factors (Vingilis et al. 1998). In a study focusing on the relationship between nutrition and physical activity with 1155 adult participants in Spain, the importance of the Mediterranean diet and physical activity was emphasised (Pérez-Rodrigo et al. 2021).

According to these findings, physical inactivity is associated with the development of obesity (Levine et al. 2005). It can be claimed that the positive relationship between exercise and health in these studies coincides with the results of the research. It was determined that academicians who were normal weight and overweight in terms of body mass index found their physical health better, had knowledge about food supplements and followed the discourses on the use of food supplements (Table 3). It is known that low food and nutrition literacy status is a barrier to healthy eating (Ulaş Kadioğlu, 2019). It can be noted that academicians generally consider themselves healthy and are open-minded about the usage of food supplements and are interested in the arguments that they have knowledge on this subject. The finding that nutrition knowledge directly affects nutrition behaviour (Yolcuoğlu and Kızıltan, 2021) supports the results of the research. The academic staff aged 25-34 years were more active in the cognitive and behavioural dimensions of their attitudes towards the use of food supplements compared to those aged 45 years and over (Table 4). Mechanic and Hansell (1987) argued that young people's perception of physical health is shaped by the general sense of functioning measured by family quality, and that achievement and self-esteem are related to this perception.

The results of the study indicated that young people have more positive attitudes towards food supplements with the intention of becoming or staying healthier. This findings may partly explain why epidemiological studies on self-assessment of health have shown that young people do not rate their own health much higher than older individuals, despite the lower prevalence of chronic health problems among young people (Mulder, 1996). This finding is consistent with other studies that suggest that chronic health conditions actually have a limited impact. In a comparative analysis of the chronic health problems, Wolman et al. (1994) emphasised the importance of body image. In another study, body image was found to be a strong determinant of emotional well-being (Vingilis et al. 1998). These results support the positive attitude of young people towards food supplements.

It was determined that academic staff working in social sciences, health sciences and engineering found themselves physically healthier

(Table 5). It is thought that academicians do a meaningful job open to development as people who contribute to science production and aim to improve life through research. It has been determined that academicians who perform the job of knowledge production professionally have a meaningful and purposeful life perception and role-identity clarity, which mediates their positive effects on mental and physical health (Thoits, 2012). In addition, it has been revealed that individuals' physical health perceptions are significantly related to economic and social status in terms of psychological, behavioural and competence factors (Weston et al. 1989). Therefore, our findings that the physical health perceptions of academics who have a meaningful job such as producing science are generally high are supported by the literature. As a conclusion, significant relationships were determined between attitudes towards the usage of food supplements and physical health perception. It is thought that the fact that the use of food supplements is important especially in the cognitive and behavioural dimension may be due to the fact that the research sample is scientist

Limitations

Although the results of this study conducted on academic staff make important contributions to the literature, it has some limitations. The most important limitation is that there is no accepted method that can be used to measure food and nutrition literacy in our country (Ulaş Kadioğlu, 2019). Another is that the data were collected using a cross-sectional design. For this reason, it eliminates the possibility of collecting only the perceptions of the participants, who are only academicians, at a moment in time and consequently predicting behaviour over time. In addition, the fact that the main mass of the study consists only of academics and that it was conducted at a university creates an obstacle to the generalisability of the results. Another constraint of the study is that the participants correctly understood the statements in the questionnaire form. In this study, it was carried out with two variables in order to limit the number of statements in the questionnaire form.

Recommendations

According to the results of the research, it is believed that nutritional intelligence has a direct effect on nutritional behaviour and it is of great importance to increase social awareness by taking

into account the importance of educational programmes in terms of individual and public health (Yolcuoğlu and Kızıltan, 2021), and for this purpose, it is thought that educational programmes should be carried out systematically.

In future studies, revealing the effects of physical activity level, rest and sleep behaviours or health-related tests on other variables may allow better interpretation of the results of the research. In an age of increasing concern about obesity and decreasing physical activity, studies on individual health will continue to be a central issue for public health and therefore for governments. This study builds on this understanding and provides a fertile ground for future enquiry.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

This study is approved by the Hitit University Non-Interventional Ethics Committee (Protocol number: 2023/09).

Author Contributions

Study Design, Data Collection, Statistical Analysis, Data Interpretation, Article Preparation, Literature Review processes were carried out by the Author. The author has read and accepted the published version of the article.

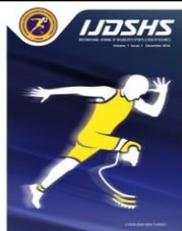
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RESEARCH ARTICLE

Enhancing Classroom Learning Outcomes: The Power of Immediate Feedback Strategy

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Abstract

The study investigates the effects of using immediate feedback as a teaching strategy. Additionally, the impacts of immediate feedback and gender on students' classroom learning outcomes were examined. The study was designed as a quasi-experimental, pretest-posttest, experimental, and control group. The sample consisted of 225 junior secondary school level 2 (JSS 2) students. Students were chosen from two intact coeducational classes and split into experimental and control groups. All relevant data was collected using a study tool called the Science, Technology, English Language & Mathematics Achievement Test-Questionnaire (STEMAT-Q), which was developed, validated, and used. Data collected were analysed using the mean, standard deviation, Student's t-test, and analysis of covariance (ANCOVA). The study's findings demonstrate that an immediate feedback technique significantly affects the learning outcomes of students. However, for treated male and female students, the interaction effects of the immediate feedback technique and gender on classroom learning outcomes were not significant. Immediate feedback is particularly successful at addressing student confusion, correcting errors, identifying learning gaps, bridging gender differences in student learning outcomes, and inspiring students to learn well. Based on the above findings, the researcher recommends the provision of immediate feedback for students during the learning process or class discussion or activities to enhance their learning skills and help them retain key concepts, ideas, and principles.

Keywords

Immediate Feedback, Treatment, Gender, Interaction Effects, Achievement Test, Learning Outcome

INTRODUCTION

We define feedback as comments and suggestions given to students during class or after they have finished a task or project. Students discover their opinions or beliefs about the situation through this feedback. After the assignment is finished, this kind of feedback must be provided. Assessing students learning ability is a way of measuring student achievement and a means of improving teaching and learning processes. Thus, the regular assessment carried out by teachers in the classroom is designed to

eliminate the detrimental and discouraging effects of an examination given at the end of teaching and learning processes. According to several researchers, mastery learning involves using strategies including feedback and remedial instruction (Afemikhe, 1985; Ughamadu, 1990; Odulaja, 1993; Ajogbeje, 2012; Ndukwu & Ndukwu, 2017). Godson and Okey (1978) reported that the use of modified formative tests in the assessment of learning difficulties or disabilities improve students' skills and learning retention. Tests are designed to diagnose a student's strengths and disabilities, improve learning and teaching,

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mathematical and other academic skills. The theoretical framework of this study focuses on the immediate feedback model developed by the researcher. The model is used to examine the effects of instruction with immediate feedback on student learning. Carroll (1963) proposed a concept of individualized mastery strategy in which students are usually divided into subjects according to their intelligence and aptitudes. And it was determined that the majority of such learning will lead to the student mastering the subject if it satisfies their particular demands in terms of the sort of education provided and the time allotted. This model focuses on meeting students' learning needs rather than timing and assessment. Bloom (1968) proposed a modification of this strategy, proposing a group-based diagnostic formative assessment strategy that included feedback and treatment. In other words, at the conclusion of each lesson, pupils are evaluated using ungraded diagnostic or formative tests. The strategy focuses on the continuous monitoring and evaluation of students' learning needs during and after school. Again, time constraints are one of the biggest barriers to adopting this model. Based on these problems, Ajogbeje (2023) proposed an immediate feedback model that includes immediate feedback and appropriate correction or revision of the learning process, without establishing proficiency or competence. This model is shown in Figure I below.

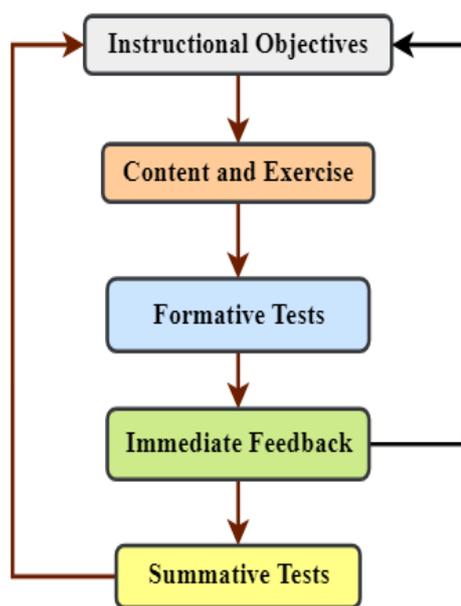


Figure 1. Ajogbeje (2023) Immediate Feedback Model

Immediate feedback and corrective instructions are used to identify group dynamics that are strong and weak and to diagnose individual learning difficulties in an effort to enhance teaching and learning. The aim is to consider immediate feedback as a variable in instructional design related to cognitive performance and several emotional traits. The researcher believes that students' poor performance in science, basic technology and mathematical subjects may result in teachers piling up problems over time and ultimately cause their students to lose all knowledge of science, basic technology and mathematical subjects. When student learning is regularly assessed and immediate feedback is given throughout the teaching and learning process, students are more likely to recognize learning gaps.

Literature Review

A literature review that included reviews of related studies showed that many researchers are trying to find different ways and solutions to students' poor performance in science, basic technology and mathematical subjects. Onuigbo & Eze (2010) highlighted the use of e-learning, problem-solving learning techniques, project methods, role-playing, games, information and communication technologies, and the presentation of facts and narratives. Ajogbeje (2012), Akkuzu (2014), and Ndukwu & Ndukwu (2017) argue that feedback is an information learners receive after completing tasks that demonstrate the validity and effectiveness of learning strategies. Many instructors or classroom teachers only provide students with feedback at the completion of the term. Positive feedback-based teaching strategies can enhance learning results (Hattie, 2009). At all educational levels, feedback is a crucial tool for fostering learning and performance (Hattie, 2013). Feedback is helpful for language, math, science, and basic technology subjects, according to evidence from prior studies (Higgins & Nicholl, 2003), and it is a crucial component of a successful education (Onuigbo & Eze, 2010).

According to this study, feedback is a procedure where teachers allow students know about their skills and assess their performance in order to advance them. Information provided by classroom teachers, classmates, book read, parents and guardians, previous experiences, and others can be referred to as feedback. It helps both teachers and students to reassess previously

learned topics. Feedback can be categorized by form (delayed or immediate), modality (written or verbal), and information provided (positive or negative) (Duane, 2005). Numerous studies on the following forms of feedback have been done, according to studies by Onuigbo and Eze (2010), Ajogbeje and Alonge (2012), Hattie (2013), Akkuzu (2014), and Ndukwu and Ndukwu (2017). These studies include modifications, progress, formats, and modalities of feedback. Although studies have shown that feedback can actually help improve some aspects of human behavior, the researchers in the aforementioned research studies took the time to carefully consider the advantages and disadvantages of various feedback strategies. As a result, the researcher discovered that there are very few studies that look at the use of immediate feedback strategies.

Feedback and Classroom Learning Outcome

Assessment involves using a variety of assessment methods to guide and improve student learning and achievement. Most students take formative and diagnostic tests at various stages of their learning, and decisions and guidance on how to continue their education are based on the results of these tests (Ajogbeje, 2012 and Klopter, 1971). Feedback is "information provided by an agent about an aspect of performance or understanding". It is a response to student action to engage, inform, and extend knowledge by bridging "the gap between current understanding, performance, and purpose." It is associated with knowledge and information about learning outcomes (Ajogbeje, 2012) and motivating learners (Bridgeman, 1974). Providing feedback to learners has both a (1) motivational effect (Gronlund & Linn, 1990; Ajogbeje, 2012) and a (2) knowledge correction effect, according to earlier and more contemporary studies (Bardwell, 1981; Erinosh, 1988; Gronlund & Linn, 1990; Ajogbeje, 2012). Granlund and Linn (1990) suggested that assessment of student motivation can be helpful in providing information about student progress. Bardwell (1981) also stated that feedback is the information that classroom teachers give to students about their performance in an assignment or examination, and when this information is given, students begin to understand their own abilities. Erinosh (1988) stated that after students succeeded in an examination or a task, they liked the subject or the task and found ways to be successful in the examination. In other words, these students rated themselves as

motivated and competent in upcoming assignments and exams. However, Erinosh (1988) also reported that negative feedback on task or test performance can lead to one or two effects. First, students sit down and use feedback to check their accuracy and performance on assignments and upcoming exams. Second, failure on subsequent assignments and tests can be negatively impacted by dissatisfaction, feelings of inadequacy, loss of interest, and poor performance.

In this regard, Kulharvy (1977) suggested that feedback fails to perform its facilitative role under two conditions: first, the initial student response if the feedback is helpful; and second, if the subject being studied is too challenging or difficult for the student. In the absence of these conditions, he continued, the research can draw the conclusion that providing feedback on students' performance based on the aforementioned two assumptions helps identifying and correcting errors as well as making clear the right responses. Scannel and Tracy (1975) argued that incomplete or inadequate knowledge of performance on the task prior to a test or task can lead to lower learning or failure and poor content retention. Erinosh (1988) also claimed that students who do not have information about their performance on tests or assignments will create stress in students because they cannot evaluate their performance and competence on the given task or examination.

Kirkland (1971) believes that how students perceive the test affects test-taking behavior. He added that when students accept their assigned test scores as representative of their performance, they will be more willing to accept their test scores and respond appropriately. Therefore, the researcher believes that test scores that do not match or reflect students' thoughts or expectations about themselves may negatively affect classroom learning. In other words, the most important aspect of feedback is its corrective function, and this strategy will be more appropriate and effective if students receive immediate feedback after an incorrect answer. Therefore, the researcher hope to use the feedback as a corrective influence on students and improve their learning. We have seen that feedback increases student confidence, motivation to learn, and ultimately student achievement. And there are different forms of feedback and it can be provided on an ad hoc, irregular or continuous basis. Feedback can also be added to the end of a learning module, listed in a

question, or once a year in a performance appraisal form. But what is the best way for students to get feedback?

Immediate Feedback and Classroom Learning Outcome

The practice of explaining to pupils why they failed, where they failed, and what they did incorrectly while they continue to study is a form of immediate feedback. A lot of work has been done in classrooms to provide immediate feedback and learning outcomes in the classroom (Epstein et al., 2002; Metcalfe, Kornell, and Finn, 2009). Kerr, Kelly, and Heffernan (2013) reported that giving feedback immediately after completing a task results in better learning outcomes than giving the same feedback the next day. According to Kulik & Kulik (1988), immediate feedback is more useful than delayed or traditional feedback. They also reported that immediate feedback from students during learning activities results in better learning outcomes. Additionally, they claimed that receiving immediate feedback from students during learning activities improves learning outcomes than expecting the same feedback the next day (Keher, Kim, & Heffernan, 2013). Unfortunately, many Nigerian teachers do not use or do not know how to use immediate feedback in the classroom. Such teachers usually do not give immediate feedback to their students. Sadly, a lot of Nigerian educators either do not use or are unable to use immediate feedback in the classroom. These instructors typically do not provide their students with immediate feedback. Woolfolk (2010) found that feedback is effective when given while the classroom lesson activities is in progress.

Immediate feedback is a strategy used to make teaching and learning more effective by encouraging students to work hard and succeed in school. According to Rozek (2014), immediate feedback can aid learning. Regardless of gender, the researcher is interested in discovering whether immediate feedback can enhance learning outcomes. Ajogbeje (2012) and Denzin (2008) considered gender as one of the factors affecting student performance. Onuigbo and Eze (2010) report that the results of their research study show gender imbalance and mathematics bias in Nigeria. Boys have been shown to outperform girls in mathematics. Conversely, a study by Jeff (2015) found that females outperformed males in mathematics. The discussion about gender findings

led the researcher to investigate what happens when immediate feedback strategies are used in classroom teaching and learning. What all these reported results mean is that feedback is effective to the extent that students perceive the results as representing their goals. Feedback from tests contribute to learning when students try to do well, and these students tend to take responsibility for their own success or failure rather than blaming environmental factors. If you don't have a goal in mind, information about scores alone will not be effective in improving performance. Most of the studies reviewed showed that the type of feedback students receive about their performance in these studies is targeted.

Effective Feedback and Classroom Learning Outcome

Feedback is an information provided by classroom teachers or instructors about their students' performance or technical knowledge. It is a response to the students' action or response aiming to inform, communicate and grow by reducing the doubts between present understanding and intentions. Immediate feedback helps increase students' knowledge by correcting errors, maintaining competence, and dispelling misconceptions about the subject. The more and more classroom teachers provide feedback to students, the better their results. Additionally, when teachers or instructors give immediate feedback during a lesson or as a follow-up, students are more likely to pause, interact and engage in conversation, and alter their behavior. Thus, by providing immediate feedback before regular feedback, students learn more about how to do better through practice.

The form of feedback might be verbal, written, or pointed out. Feedback from assessments and instruction is meant to boost rather than lower student performance. Negative criticism or feedback can undermine students' efforts and performance. Teachers have a specific obligation to encourage student learning and offer feedback in order to prevent pupils from feeling overwhelmed after class. However, other studies have disputed similar findings (Breitwieser et al., 2022; Engelmann et al., 2021). After three weeks of study, some research suggests that using prompts can increase learning performance on themes from the domain of educational psychology (Christoph and Maria 2019). In a second session three weeks later, Engelmann et al.

(2021) found no evidence of a lasting benefit from meta-cognitive cues. The positive effects of prompts on learning achievement are highly variable and may improve with repetition, as reported by Breitwieser et al. (2022). Our classes are diverse and some learners want to know where they stand in their studies, some want to advance to the next level, while others need to be careful not to interrupt learning and make it worse (Dinham, 2002, 2007a; 2007b).

Effective feedback encourages learners to evaluate their own learning and learning practices so they can improve their learning outcomes. Additionally, it updates students on their progress toward achieving the success criteria. Feedback is a two-way process that fosters learning progress for the learners and helps the teacher identify where the learners are on the learning continuum when a classroom instructor has strong professional connections with learners based on mutual respect. According to Hattie, (1999; 2023), Dinham (2002, 2007a; 2007b) and Wiggins (2012) an effective feedback expected to be provided by classroom teachers or instructors should include the following:

- Does not give praise, reward, or punishment but schedules regular time to discuss feedback with students on an individual or small group basis.
- Concentrates on the quality of the learner's work product and/or processes and tries to give feedback as close to the learning and assessment task as possible.
- Motivates and challenges the learner to further develop their knowledge and skills, and equally encourages them to ask questions about their feedback.
- It focuses on the caliber of the work and is detailed in identifying what the student has done well and what has been misunderstood or not understood.
- It is closely related to the success criteria and learning intentions and might be spoken, a gesture or written.
- Let the students know that your main goal is to make sure they comprehend how their learning is being assessed.
- Confirm that the student comprehends the material being covered;
- Inquire of the student what they believe they need to improve on;

- Be clear and detailed in your criticism, including examples whenever available.
- Share your thoughts on potential future steps for development.
- Encourage dialogue by inviting students to discuss their work with you or their peers.
- Be trustworthy, sincere, and truthful. Every time a student completes an assignment, repeat.

From the studies reviewed, one can see that the motivation for assessment and feedback during practice is to improve student outcomes, not to limit current outcomes. Unfortunately, students may not always have appropriate internal feedback and may instead produce maladaptive internal feedback in multi-session learning, which consists of at least two similar learning sessions with a time lag in which the learning environment is the same but the learning materials are different. For instance, students may overestimate their learning outcomes due to faulty self-evaluation (Chou and Zou 2020) and hence stop studying before they have actually mastered the material.

A good feedback system is very important for students. Bad comments can limit a student's effort and success. Teachers have a special responsibility to support students' skills and provide commentary so that students are not burdened outside the classroom. In the previous studies, children in the samples were divided into treatment groups using criteria like ability, pretest scores, and prior grades, in most of the studies. Thereafter, students are given a task to perform, and rather than receiving a true grade for it, their performance is randomly evaluated. Some gave students random scores according to treatment group (Bridgeman, 1974). Others use words like "excellent", "good", and "tried" (Means and Means, 1971; Bridgman, 1974). The performance of the experimental groups is then compared to that of the control groups using posttest results. Some students receive grades that they feel do not reflect their abilities. This can reduce confidence in subsequent tests, which can affect motivation and, consequently, performance.

Finally, the implications for the effects of feedback on post-task performance are inconclusive. It may be necessary to broaden the perspective of the investigation being conducted. Other aspects of the learning environment can affect the effectiveness of feedback. The question

therefore arises of how these effects affect learning outcomes and how they can be combined with other social and psychological factors to improve students' skills. It's a matter of how you decide to use it. As a result, the researcher examines solutions for immediate feedback in this work. In order to inform what and how to do during teaching and learning, students use this procedure to point out errors and make prompt assessment changes. As a result, the purpose of this study is to investigate how immediate feedback affects students' learning outcomes. The study specifically aimed to ascertain: 1. The impact of immediate feedback on students' learning outcomes. 2. The impact of gender on students' academic performance 3. The impact of gender and immediate feedback strategies on students' learning outcomes. The study sought to answer the following questions and test the following hypotheses.

Research Questions

The following research questions were raised to guide the investigation:

1. How do students exposed to immediate feedback and those subjected to conventional feedback differ in terms of their mean learning outcome scores?
2. How do student gender differences in mean learning outcome scores compare?
3. How do gender and immediate feedback strategies interact to affect students' mean learning outcomes?

Research Hypotheses

The study was designed to test the validity or otherwise of the following hypotheses at 0.05 level of significance:

- 1) Treatment has no significant impact on pupils' learning outcomes.
- 2) The gender of students has no significant impact on their learning achievements.
- 3) Treatment and gender had no significant interaction effects on students' learning outcomes.

MATERIALS AND METHODS

All secondary schools in Ondo State made up the study's sample population. With experimental and control groups, a quasi-experimental, non-equivalent pretest-posttest control group design was adopted. The 225 students who made up the sample for this study came from two co-educational secondary schools

in Akure South Local Government Area, Ondo State, and were chosen using the purposive sampling technique. The two chosen schools were split into an experimental group (the group that received immediate feedback) and a control group. The following are the treatment packages provided for the experimental and control groups:

Instructional Strategies I

In response to class-related questions or assessments, instructional strategy 1 instructs students on each topic. While instruction is still going on and before moving on to the next topic or unit, immediate feedback is given. Students are given the opportunity to talk about their performance and offer potential course corrections.

Instructional Strategies II

Each lesson concludes with an in-class test. Before the start of the next lesson, students receive feedback on their test results. During the teaching and learning process, there was no feedback, no corrections, and no discussion of the outcomes.

Experimental Procedures

Before starting the study, the researcher went to the principals of the schools that were chosen and requested their cooperation and permission to use the classroom teachers. The goals, interests, and intentions of the researcher were also reviewed, as was how to collaborate with school administration to seamlessly incorporate the research activities into the academic program. The basic science, basic technology, English language, and math instructors, who later worked as the researcher's research assistants, were introduced to the researcher by the principals in their spare time. The Hawthorne effect, in which participants react to the knowledge that they were a part of the experiment, is eliminated when research assistants are chosen as the treatment group rather than the control group. Selected research assistants were informed about the objectives of the research study by the researcher, cooperation was sought, and the starting time was decided. The research assistants were personally trained on what to do and how to do it before the research work started. The experiment lasted for 6 weeks, of which 1 week was used for the pretest and research assistant training, 4 weeks for treatment, and the last week for the posttest.

Since the experiment is being conducted at the beginning of a new academic session, the students' prior understanding of the subject matter is minimal at best. Because there are no set

guidelines for the amount of time allotted to teaching each topic in the group, ability disparities within the group are also taken into consideration. The researcher works with research assistants to develop efficient teaching strategies, test questions, and evaluation techniques rather than participating directly in the data collection process. Pretests, treatment sessions, and posttests take place during regular class times. The experimental group's lesson plan was used by the treatment group to teach English language and math five times per week, as well as basic science and basic technology three times per week for four weeks. The control group's lesson plan was also used by the control group to teach English language and math five times per week, as well as basic science and basic technology three times per week for four weeks. Under the researcher's direction, research assistants performed the evaluation.

Each group takes a 40-minute class every day and five times a week English language and mathematics and three times a week for basic science and technology, depending on the school schedule. The researcher kept an eye on how research assistants used lesson plans and the reduction of cheating by students during exams. The control group's instruction contained the feedback delivered at the conclusion of the topic, but the experimental plan included immediate feedback.

The students were given the Science, Technology, English and Maths Achievement. Test (STEMAT-Q) developed by the researcher as a pretest, or before beginning treatment. Following the pretest, the researcher reshuffled the STEMAT-Q items that would be used in the posttest. STEMAT-Q was utilized by the researcher to gather all the necessary information for the study. It is made up of 40 objective questions that were designed by the researcher with assistance from four JSS II teachers using material from the students' textbooks on basic science, basic technology, English language, and mathematics. The STEMAT-Q is made up of two parts. Part B contains 40 achievement test items on topics from basic science = 10 items, basic Technology = 10 items, English language = 10 items, and mathematics = 10 items. Part A refers to the respondent's biodata. With the assistance of four STEM teachers, experts in STEM education, and a test and measurement expert for face validity, the STEMAT-Q instrument was validated. The

content coverage, appropriateness, and instructional technique of the instrument were to be corrected and validated by the experts in accordance with the topic, purpose, research question, and hypotheses. The instrument for this study was modified in response to their recommendations. A pilot test was carried out at two public secondary schools in the Akure North Local Government Area of Ondo State to assess the reliability of the research instrument. In two schools, fifty (50) JSS II STEM students each received a copy of the STEMAT-Q, and the data collected was used to calculate the instrument's reliability coefficient of 0.79 using Kuder-Richardson (KR20).

To assess the appropriateness and non-discrimination of the STEMAT-Q items, a difficulty index analysis was also computed. After confirming face validity, the training program's usability was evaluated. The lesson plans developed by the researcher were used by the four JSS II STEM teachers who were chosen for the pilot test to instruct and assess JSS II pupils. To assess the reliability, applicability, and suitability of the training plan, field training was carried out. Lesson plans frequently feature helpful advice from teachers. The lesson plan's alignment with the research's goals was further ensured via field testing. The study focuses on the effects of using immediate feedback as a teaching strategy and does not include any direct intervention, manipulation, or collection of personal data from human subjects participants. The research instrument was reviewed and approved by the Centre for Research and Development (CERAD) Ethics Assessment Committee of Bamidele Olumilua University of Education, Science, and Technology.

Statistical Analysis

To evaluate the null hypotheses generated at the 0.05 significance level, the Student's t-test and analysis of covariance (ANCOVA) were utilized. The mean and standard deviation were used to answer the study questions.

RESULTS

Part 1: Impact of Immediate Feedback on Pupils' Learning Outcomes.

The participants' pre-treatment (pretest) and post-treatment (posttest) mean scores and standard deviations are displayed in Table 1.

Table 1. The mean and standard deviation of the treatment groups' posttest results

Variable	Pretest			Posttest	
	N	Mean	SD	Mean	SD
Feedback Treatment					
Experimental Group	144	20.68	13.07	42.78	20.22
Control Group	81	20.52	10.19	37.32	11.68

The results in Table 1 show that both groups achieved higher posttest scores. With a mean score of 42.78 compared to 37.32, the immediate

feedback group outperformed the control group. A t-test statistic was computed as stated in Table 2 to assess whether there was a significant difference in scores between treatment groups.

Table 2. The mean posttest scores for the experimental and control groups

Group	N	Mean (μ)	SD (σ)	df	t_{cal}	t_{tab}
Experimental Group	144	42.78	20.22	224	10.23	1.96
Control Group	81	37.32	11.68			

*P < 0.05

Part II: Impact of Gender Differences on Pupils' Learning Outcomes.

Students' pre-treatment (pretest) and post-treatment (posttest) mean scores and standard

deviations were calculated for male and female in the treatment group, as shown in Table 3.

Table 3. The mean and standard deviation of posttest results for both male and female students

Variable	Pretest			Posttest	
Gender	N	Mean	SD	Mean	SD
Male	63	32.57	11.05	44.15	18.27
Female	81	31.15	10.69	43.23	17.86

The findings in Table 3 show how male and female students perform academically differently. Male students' pretest mean score was 32.57, with a standard deviation of 11.05; their posttest mean score was 44.15, with a standard deviation of 18.27. The pretest mean score for female students was 31.15, with a standard deviation of 10.69, and

the posttest mean score was 43.23, with a standard deviation of 17.86. Students' posttest mean scores were higher than their pretest mean scores for both genders, with male students having slightly higher mean improvements than female students. The t-test was computed as stated in Table 4 to assess whether there is a significant difference between the mean scores of male and female students.

Table 4. Mean posttest results for male and female students

Group	N	Mean (μ)	SD (σ)	df	t_{cal}	t_{tab}
Immediate Feedback Group	63	44.15	18.27	143	1.702	1.96
Control Group	81	43.23	17.86			

*P < 0.05

Table 4 reveals that the difference in student performance is not statistically significant. Table 4 also shows that the treatment was particularly successful for male students, who performed better academically in the experimental group.

Part III: Treatment and Gender Interaction Effects on Students' Learning Outcomes.

As shown in Table 5, mean scores and standard deviations for the interaction between gender and immediate feedback strategies on students' learning outcomes were computed.

Table 5. Gender and immediate feedback interaction effect on students learning outcomes

Variable	Gender	N	Pretest		Posttest	
			Mean	SD	Mean	SD
Experimental Group	Male	63	21.09	9.44	48.64	19.04
	Female	81	21.02	10.04	45.24	20.09
Control Group	Male	36	20.03	11.07	31.12	11.15
	Female	45	15.72	8.98	30.62	13.88

The findings in Table 6 reveal the interaction effect of gender and immediate feedback strategies on students' academic achievement. The interaction effect for treatment-gender $F(1, 221) = 0.672, P < 0.05$ was not statistically significant.

Given that the association value (0.438) used as a decision criterion is greater than 0.05, the null hypothesis is not rejected, and it is therefore concluded that there is no interaction between gender and immediate feedback on student learning outcomes.

Table 6. Posttest scores' analysis of covariance (ANCOVA) by gender and treatment

Source	Sum of Squares	df	Mean Square	F-cal.	Sig.
Corrected Model	1192,578	4	298.145	4.454*	.002
Intercepts	904.450	1	904.450	13.511*	.000
Pretest	1095.825	1	1095.825	16.340*	.000
Treatment	58.001	1	58.001	0.866	.420
Gender	41.008	1	41.008	0.613	.538
Treatment x Gender	45.406	1	45.406	0.672	.438
Error	14794.331	221	66.943		
Corrected Total	12235.795	225			

DISCUSSION

As can be seen from Table 2, the calculated t-test is greater than the t-test obtained from the table (i.e., $t_{cal} > t_{tab}$), which shows that the difference in students' performances is good for the experimental group. In other words, the result shows that the treatment had a positive effect on the academic outcomes of the experimental group. It can be concluded that giving immediate feedback to students in the teaching and learning processes improves learning outcomes. According to the study's findings, using immediate feedback techniques can significantly affect students' academic performance. In comparison to the control group, which received instruction in basic science, basic technology, English language, and math using the traditional feedback technique, the experimental group greatly outperformed it. This result is in line with the findings of Onuigbo & Eze (2010), Ajogbeje & Alonge (2012), Metcalfe, Kornell, & Finn (2009), Ndukwu & Ndukwu (2017) and Hathila, Baria, Damor, & Mahajan (2023). Onuigbo and Eze (2010) reported that the use of feedback when teaching students with maths difficulties improves their maths performance. Ajogbeje and Alonge (2012) also reported that feedback with remediation has an impact on

students' achievement. While Metcalfe, Kornell, and Finn (2009) argue that immediate feedback leads to better performance than delayed feedback. According to Ndukwu & Ndukwu (2017), teaching low achievers using an immediate feedback technique has a considerable impact on their proficiency in mathematics. Hathila, Baria, Damor & Mahajan (2023) also reported an improvement in students' knowledge, understanding, and confidence as it helps in identifying gaps and loopholes in learning processes. According to the study's findings, students might improve their academic performance, increase their motivation, self-control, and self-efficacy, and close the gap between their present performance and their intended performance by receiving rapid feedback (Aubin, 2023). Wiggins (2012) says: **“Less teaching plus more feedback is the key to achieving greater learning.”**

Table 4 also shows that the treatment was particularly successful for male students, who performed better academically in the experimental group. Thus, it can be said that giving students immediate feedback during teaching and learning has no impact on either the learning of male or female students. The study's findings also demonstrate that the performance scores of both

male and female students in the experimental group were identical to those of the control group. This shows that gender is a nonsignificant variable for students learning outcomes while using immediate feedback. The results are consistent with those reported by Achor, Imoko and Ajai (2010). In their studies, Abdu-Raheem (2012), Mirjam, Heikamp, and Trommsdorff (2013), and Ndukwu & Ndukwu (2017) found the achievement scores of male and female pupils to be equal. According to Ndukwu & Ndukwu (2017), male and female low achievers exposed to the immediate feedback technique did not significantly differ in their achievement scores. However, this result contradicts the findings of Muthukrishny (2010) and Amongne (2015), which reported significant results in preferring male students among male and female students. This study shows that gender and immediate feedback strategies do not have a significant effect on student achievement. This indicates that immediate feedback (treatment) and no other factors are what lead to pupil learning achievement.

This result is in line with Eze (2003) findings, which claimed that there is no relationship between feedback and gender that affects students' progress. This research suggests that immediate feedback is beneficial to both genders, indicating that prompt feedback can reduce the achievement gap between male and female students. According to Ndukwu & Ndukwu (2017), the interaction effect of gender and immediate feedback on low-achieving pupils' math achievement was not significant

Conclusion

Offering immediate feedback to students has allowed for improvement in students' knowledge, expertise, and self-confidence because it enables in identifying gaps and shortcomings in learning process (Hathila, Baria, Damor & Mahajan, 2023). The findings of this study suggest that immediate feedback can help students close the performance gap between their present and desired goal levels by encouraging self-motivation, self-regulation, and self-efficiency (Aubin, 2023). Furthermore, it is very powerful and effective in the clarification of students' doubts, correction of errors or mistakes, identification of mastery learning gaps, bridging the gender differences in students' learning outcomes and motivating students to learn properly. Notwithstanding the usefulness of feedback, complaint from college students is that

they do not receive immediate feedback in their learning process. Therefore this study recommends that classroom teachers should allow and encourage their students to lead and participate actively in teaching and learning in the classroom using active learning techniques, project-based learning, self-assessment, and self-discovery. Therefore, the teacher acts a learning facilitator and consultant in the classroom.

The curriculum for pre-service teachers should include immediate feedback as a learning strategy, and prospective teachers should be shown how to use immediate feedback strategies in the classroom by teacher training institutions, such as colleges of education and technology and faculties of education in universities. The stakeholders in the educational sectors should arrange for in-service training programs, workshops, and seminars on how to apply immediate feedback mechanisms in teaching and learning processes for in-service teachers. School curriculum planners and lesson planners should have student activities and teacher activities share steps by steps with immediate feedback. This will enable students to succeed, study regularly and achieve better results. Lastly, teachers in the classroom need to be prepared and eager to help their students, following Norris and Schuhl's (2016) advice to use assessment questions when students are stuck and advance questions when students are ready to go beyond the standards.

Acknowledgement

I would like to extend my gratitude to the principals, research assistants, teachers, and students from the schools used for this study for granting me access to their students and classrooms as well as their willingness to share their time, effort, and insights with me. Without their cooperation and assistance, this research work would not have been possible. I would also like to thank everyone who helped conduct this research.

Conflict of Interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethics Statement

This study does not require ethical approval since it focuses on the effects of using immediate feedback as a teaching strategy and does not involve any direct intervention, manipulation, or

collection of personal data from human subjects. However, the research instrument was reviewed and approved by the Centre for Research and Development (CERAD) Ethics Assessment Committee of Bamidele Olumilua University of Education, Science, and Technology.

Author Contribution

The author conceived the idea, developed the materials, carried out the data collection, and wrote the manuscript. The author also read and approved the final manuscript.

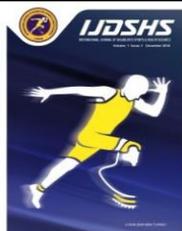
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RESEARCH ARTICLE

Attitude, Knowledge and Practice Towards Oral Hygiene Among Dental Students and Associated Groups of Institution During COVID-19

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Abstract

Objective: The improvement of both one's oral and general health depends in large part on one's knowledge of oral health. The primary goal of the Indian dental health profession is to increase knowledge and public awareness of oral hygiene practices. The goal of the study is to understand how dentistry students and related individuals feel about maintaining their oral health in the current COVID environment. **Methodology:** A total of 460 dental students and 46 associated groups of VDC participated in this cross-sectional survey. The mean age was 21 years, with 91 men (19.3%) and 369 women (80.7%). Questionnaire of 12 were prepared by the author on attitude, knowledge & practice regarding oral health & COVID-19 and distributed to obtain information from the participants through Google forms. **Results:** Both the student body and the institute's affiliated groups have a responsible approach regarding oral health and understand its significance during pandemics. Associate members (75%) and first- and fourth-year students (90%), respectively, had the lowest and greatest percentages of respondents to the poll. Statistical significance for the questions on importance of oral hygiene and the requirement for awareness programs were seen with p values 0.007 and 0.028 respectively. There was no statistical significance for knowledge and practice related responses. A level of significance set at 0.005. **Conclusion:** All of the students and affiliated groups were made to feel safer, healthier, and more responsible thanks to the institution's stringent infection control procedures and orientation programmes about the value of dental hygiene during COVID-19.

Keywords

Associate Groups, Covid-19, Dental Students, Oral Hygiene.

INTRODUCTION

According to the World Health Organization (WHO), oral health is an important indicator of

overall health, well-being and quality of life. It covers a range of diseases and conditions, including tooth decay, periodontal (gum) disease, tooth loss, oral cancer, dental trauma, noma, and

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birth defects such as cleft lip and palate (WHO, 2022). Oral health is an important part of systemic health (Küçükyıldız and İşiner Kaya, 2018), and many studies show that there is a relationship between oral diseases and systemic chronic diseases (Bui et al., 2019).

Additionally, Sampson et al. He stated that improving oral hygiene in Covid 19 patients can reduce the risk of developing Covid 19 complications. Knowledge, beliefs, values, attitudes, skills, finances, materials, time, family members, friends, co-workers, opinion leaders, and even healthcare professionals themselves are among the factors that can influence all of these health behaviors (Park's, 2021). One of the ways to determine the importance and perspective people attach to oral health is to evaluate their knowledge, attitudes and behaviors.

Periodontal disease is one among the other oral diseases affecting the large population groups all over the world. Prevalence of periodontal disease in India is at steady rise due to poor oral health awareness among the people (Avasthi et al., 2022; Kukreja et al., 2021).

Dental issues are currently one of the largest issues in both industrialised and underdeveloped nations. Oral hygiene is the practise of maintaining a tidy, clean oral cavity, which will aid in preventing the development of microbial plaque on the teeth and subsequently aid in preventing the onset and advancement of any disease. In order to maintain personal oral hygiene and oral health, one needs be aware of oral hygiene practises (Raza et al., 2020; Bharath et al., 2022)

Although there have been studies on the relationship between dental and medical students' oral health, there have been very few studies on dental students' awareness of this relationship and the linked group of persons employed by the school. (Alawia et al., 2021; Almulhim et al., 2021). For dental health professionals, the current COVID-19 scenario and the necessity of oral hygiene awareness and practise are their top concerns. During this pandemic, it is also important to raise awareness and understanding among the affiliated group members of the institution (Batra et al., 2021)

This study is therefore initiated in VDC with a prime focus to determine the attitude, knowledge, and awareness levels during COVID 19 pandemic among the dental students and

associated groups working in VDC, Bhimavaram, West Godavari District, Andhra Pradesh, India.

MATERIALS AND METHODS

Between January 2022 and June 2022, an observational study was conducted in the Department of Periodontics and Implantology at Vishnu Dental College. The Institutional Review Board approved it on 20-9-2021 with reference number VDC/RP/2021/81. The research was carried out by following the Helsinki Declaration of 1975, as updated in 2013. This cross-sectional observation study investigated the importance of infection control protocols and orientation programs followed at the institution level based on the World Health Organization and Dental Council of India guidelines and assessed the attitude, knowledge, and practice of oral hygiene among the dental students and associated members in the present COVID situation.

The study's goals are to: a) understand the dental students' attitudes, knowledge, practice, and maintenance of oral health in the current COVID situation; and b) understand the associated group members of the dental institution's attitudes, knowledge, practice and maintenance of oral health in the current COVID situation. c) To assess the impact of institution-level infection control procedures and education campaigns regarding the value of oral hygiene during COVID-19.

Demographic Data

A total of 460 dental students and 46 associated groups of VDC participated in this cross-sectional survey. The mean age was 21 years, with 91 men (19.3%) and 369 women (80.7%). Questionnaire prepared and distributed to obtain information from the participants through Google forms. 12 questions on attitude, knowledge and awareness regarding oral health during COVID-19 were prepared and responses for the same were recorded.

Inclusion criteria

1. All the BDS & PG students those who had taken admission into VDC will be included in the study.
2. All the associated groups like Receptionists, nurses, assistants and those who are working for VDC will be included in the study.

Exclusion criteria

1. All the non-dental professional students in Vishnu Campus

2. The students and associated groups from VDC who are not willing to participate.

RESULTS

The parameters assessed were the type of stricter infection control protocols followed and type of orientation programs conducted about the importance of oral hygiene programmed during COVID-19 at the institution level and how far these measures helped all the students and

associated groups in the institute to be safer, healthier and responsible during COVID pandemic will be assessed. Out of 506 participants, 1st, 2nd, 3rd, and 4th BDS students responded were 18%, 17%, 16%, and 18% respectively. The interns and associated group members (Receptionists, Nurses, Office staff and Assistants) were 16% and 15%. Out of 506 participants, 80.7% were female and 19.3% were males. (Table. 1)

Table 1. Demographic characteristics of participants

Characteristics	Students N(%)	Associated groups N(%)
Age	21±2	35±7
Gender		
Male	91 (19.3%)	9 (19.6%)
Female	369 (80.7%)	37 (80.4%)
Education		
1 BDS	100 (21.7%)	Receptionists 10 (21.7%)
2 BDS	86 (18.7%)	Nurses 16 (34.8%)
3 BDS	91 (19.8%)	Office staff 6 (13.04%)
4 BDS	92 (20%)	Assistants 14 (30.43%)
Interns	91 (19.8%)	
Infected with Covid-19 disease		
Yes	162 (35%)	28 (60%)
No	298 (65%)	18 (40%)

Responses related to the attitude

99% of participants agreed that maintaining good dental hygiene is just as important as taking other precautions in daily life. When questioned about the types of daily oral hygiene practises? For the purpose of maintaining of oral hygiene throughout the critical moments of COVID, 21.8% (111) individuals used only a toothbrush, 35.9% (183) people used a toothbrush and mouth wash, 5.7% (29) participants used a toothbrush and floss, and 36.7% (187) participants combined a toothbrush, mouth wash, and floss.

When asked about their opinion on oral hygiene maintenance at present COVID-19 situation? 93.3% (476) participants responded that maintaining oral hygiene is as important as maintaining general health. 48.8% (249) participants contacted dental surgeon or dental health care professional for appropriate information on maintaining oral hygiene especially in this situation. Whereas 51.1% (261) responded that they had not contacted any health

professionals on maintaining oral hygiene. When asked about the need to educate people about oral hygiene measures to follow during the times of pandemic, 99.2% (506) participants responded that they all need to educate about the types of measures to be followed during COVID critical times. (Table. 2)

Responses related to the knowledge

Out of 506 participants, 98% of individuals responded that there is a necessary need to change tooth brush after recovery from COVID-19. When asked about the scarcity of oral hygiene equipment in the present COVID-19 situation: 43.3% (221) reported the unavailability of oral hygiene equipment during critical times of COVID. Both the dental students and associate personnel of dental institute were aware of the symptoms associated with COVID-19 infection. Among the symptoms, most of them said that they knew fever, cough, sore throat and diarrhea and running nose in descending order will be will be associated with COVID-19 infection.(Table. 2)

Responses related to the oral hygiene practice

Out of 506 participants, 99% of individuals were aware of the fact that poor dental health is linked to many serious diseases and conditions. The measures followed by the dental students and associated persons to prevent transmission from known or suspected COVID-19 patients were: frequent hand cleaning (480), quarantine and social distancing (467), wearing face mask (455.5), routine cleaning and disinfecting surfaces (442.5), protective clothing (430), and avoiding unnecessary transporting (420). (Table. 2)

When asked about the type of dental problem they faced during the present pandemic situation: most of the participants responded the following problems in decreasing order: 16.1% (82) complained about the cavities, 6.5% (33) faced gum problems, 4.1% (21) complained of tooth pain, 2.9% (15) complained of bad breath. Others in few percentages also complained of repair in braces, sensitivity, food accumulation and impaction. 66.7% (340) participants had not faced

any dental problems among both students and supporting staff groups.88.2% of individuals felt that online awareness programs are required for maintaining oral hygiene in the current position (Table. 2).

The Nurses, receptionist, office staff and assistant’s attitude, knowledge and awareness were high among nurses and least among assistants in decreasing order. Out of 460 students, 162 were infected with COVID-19 and 298 were not infected. Whereas out of 46 associated groups, 28 were infected and 18 were not infected during COVID-19 health crisis (Table. 1) Among interns, 4th, 3rd, 2nd, and 1st year dental students, interns, 4th and 3rd year students attitude, knowledge and awareness towards oral hygiene during COVID-19 were high compared to 2nd and 1st year students (Table. 2) Among the students and associated groups, the students attitude, knowledge and awareness towards oral hygiene during COVID-19 were high when compared to the associated groups (Table. 2).

Table 2. Responses related to the attitude, knowledge and awareness towards oral hygiene during COVID-19.

Groups	Response	Attitude			Knowledge			Practice		
		Yes (%)	No (%)	May be (%)	Yes (%)	No (%)	May be (%)	Yes (%)	No (%)	May be (%)
Group 1 (BDS)	1 (100)	100 (100%)	0 (0%)	0 (0%)	98 (98%)	2 (2%)	0 (0%)	98 (98%)	2 (2%)	0 (0)
	2 (86)	84 (98%)	2 (2%)	0 (0%)	84 (98%)	2 (2%)	0 (0%)	84 (98%)	2 (2%)	0 (0)
	3 (91)	89 (98%)	2 (2%)	0 (0%)	91 (100%)	0 (0%)	0 (0%)	91 (100%)	0 (0%)	0 (0)
	4 (92)	92 (100%)	0 (0%)	0 (0%)	92 (100%)	0 (0%)	0 (0%)	92 (100%)	0 (0%)	0 (0)
	Interns (91)	91 (100%)	0 (0%)	0 (0%)	91 (100%)	0 (0%)	0 (0%)	91 (100%)	0 (0%)	0 (0)
Group 2	Receptionists (10)	5 (50%)	4 (40%)	1 (10%)	7 (70%)	3 (30%)	0 (0%)	4 (40%)	3 (30%)	3 (30)
	Nurses (16)	11 (69%)	2 (13%)	3 (18%)	12 (74%)	2 (13%)	2 (13%)	14 (87%)	0 (0%)	2 (13)
	Office staff (6)	1 (17%)	3 (50%)	2 (33%)	1 (17%)	2 (33%)	3 (50%)	0 (0%)	3 (50%)	3 (50)
	Assistants (14)	2 (15%)	9 (64%)	3 (21%)	3 (21%)	8 (58%)	3 (21%)	1 (7%)	12 (86%)	1 (7)

*BDS- Bachelor of Dental Surgery

Gender wise comparison done for attitude, knowledge and practice related responses towards oral hygiene during COVID-19. Responses to all the 12 survey questions were tabulated in Table-3, Table-4 and Table-5.

Conducting educational programmes resulted in a complete awareness of hygiene maintenance

and its relevance to general health among dental students and associated group members. The impact of educational program can well be demonstrated by the number of students and associated groups infected with COVID-19 after the educational programs conducted by the institution.

Table 3. Gender wise comparison of attitude towards oral hygiene during COVID-19.

Question	Gender	Responses N(%)	P value
In your opinion, Do you think in the present COVID-19 situation maintaining oral hygiene is as important as general hygiene?	Female (403)	May be- 23 (5.7%) No- 3 (0.7%) Yes- 377 (93.5%)	0.007
	Male (103)	May be- 3 (2.9%) No- 5 (4.9%) Yes- 95 (92.2%)	
In your opinion, Did you contact any dental surgeon or dental health care professional for appropriate information on maintaining oral hygiene especially in this situation?	Female (403)	May be- 32 (7.9%) No- 175 (43.4%) Yes- 196 (48.6%)	0.834
	Male (103)	May be- 10 (9.7%) No- 43 (41.7%) Yes- 50 (48.5%)	
Do you think is it necessary to educate People about oral hygiene?	Female (403)	May be- 1 (0.2%) No- 1 (0.2%) Yes- 401 (99.5%)	0.335
	Male (103)	May be- 1 (1%) No- 1 (1%) Yes- 101 (98.1%)	
Do you feel any scarcity of oral hygiene equipment in the present COVID 19 situation?	Female (403)	May be- 98 (24.3%) No- 135 (33.5%) Yes- 170 (42.2%)	0.064
	Male (103)	May be- 14 (13.6%) No- 40 (38.8%) Yes- 49 (47.6%)	
Do you want to insist on the importance of maintaining oral hygiene to your Friends and family members?	Female (403)	May be- 4 (1%) No- 4 (1%) Yes- 395 (98%)	0.200
	Male (103)	May be- 0 (0%) No- 3 (2.9%) Yes- 100 (97.1%)	
Do you feel that online awareness programmes are required on maintaining oral hygiene measures in the present situation?	Female (403)	May be- 125 (31%) No- 7 (1.7%) Yes- 271 (67.2%)	0.028
	Male (103)	May be- 24 (23.3%) No- 6 (5.8%) Yes- 73 (70.9%)	

Table 4. Gender wise comparison of knowledge towards oral hygiene during COVID-19.

Question	Gender	Responses N(%)	P value
In your opinion, do you feel oral hygiene practices are as important as general measures in day-to-day life?	Female (403)	No- 2 (0.5%); May be- 1 (0.2%); Yes- 400 (93.3%)	0.296
	Male (103)	No- 2 (1.9%); May be- 0 (0%); Yes- 101 (98.1%)	
In your opinion, are you aware of the fact that poor dental health is linked to many serious diseases and conditions?	Female (403)	May be- 14 (3.5%) No- 2 (0.5%) Yes- 387 (96%)	0.685
	Male (103)	May be- 5 (4.9%) No- 1 (1%) Yes- 97 (94.2%)	
What is the dental problem you are facing in the present situation?	Female (403)	Cavities- 63 (15.6%) Gum problems- 29 (7.2%) Others- 42 (10.5%)	0.388
	Male (103)	None- 269 (66.7%) Cavities- 19 (18.4%) Gum problems- 9 (8.7%) Others- 5 (6.9%) None- 68 (66%)	

Table 5. Gender wise comparison of practice towards oral hygiene during COVID-19.

Question	Gender	Responses (No./%)	P value
In your opinion, What kind of oral hygiene measures do you follow on a daily basis?	Female (403)	Tooth brushing- 86 (21.3%) Tooth brushing & Mouth wash- 154 (38%) Tooth brushing & Flossing- 20 (5%) All of the above- 144 (35.7%)	0.145
	Male (103)	Tooth brushing- 25 (24.3%) Tooth brushing & Mouth wash- 28 (27.2%) Tooth brushing & Flossing- 9 (8.7%) All of the above- 41 (39.8%)	
Do you have a habit of Brushing twice a day?	Female (403)	No- 169 (41.9%) Yes- 234 (58.1%)	0.082
	Male (103)	No- 53 (51.5%) Yes- 50 (48.5%)	
What is the source of information you are using to update about oral hygiene measures in the present situation?	Female (403)	Social media- 75 (18.6%) Google- 117 (29.0%) WHO website- 47 (11.7%) Don't follow- 34 (8.4%) Dentists- 130 (32.3%)	0.061
	Male (103)	Social media- 29 (28.2%) Google- 22 (21.4%) WHO website- 6 (5.8%) Don't follow- 12 (11.7%) Dentists- 34 (33.0%)	

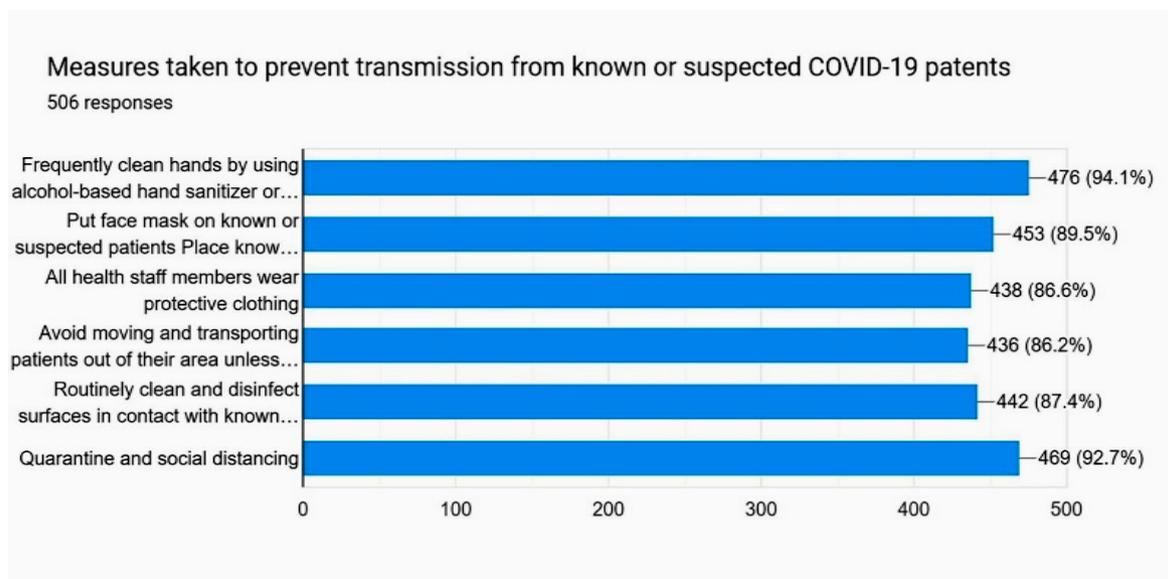


Figure 1. Explains the impact of educational programs on attitude, knowledge and practice related responses towards oral hygiene during COVID-19

The number and percentages of students and associated group members infected with COVID-19 even after following the guidelines were 162 (35%) and 28 (60%) respectively.

DISCUSSION

The present investigation evaluated the attitudes, knowledge, and awareness levels of dentistry students and related individuals towards the COVID-19 epidemic. It was conducted during the early stages of the epidemic. The bulk of participants in this study (80.7%) were female dentists, with men accounting for 19.3% (Bennardo et al., 2020). The approaching COVID-19 pandemic is a once-in-a-lifetime event that will be defined by a deluge of social, economic, and health difficulties. To address the aforementioned issues and develop fair expectations about the disease's future course, impacted communities must have a sufficient awareness of COVID-19 (Jafari et al., 2021).

It is impossible to exaggerate the significance of preventative oral health knowledge, behaviour, and practise. In order to assess preventative oral health knowledge, practise, and behaviour among the residents of Bhimavaram, Andhra Pradesh, during Covid-19, attempts were made in this study (Sezgin et al., 2020). Bipin et al., 2020 did a research to learn about the general population's understanding and practice of oral hygiene, as well as the adult population's oral health maintenance in the current COVID condition. Obtaining dental treatment has been

challenging in the present COVID situation, as the epidemic worsens by the day. At home, cleanliness is essential. About 200 persons in total were invited to participate in the study. Twenty questions on the survey were intended to gauge respondents' attitudes towards and awareness of oral hygiene in the current COVID context. The findings revealed that while [81%] of the research population believed dental care is more important than other medical treatments, [50.8%] of this particular age group felt oral hygiene was just as important as general measures. These findings are consistent with the current research (Maheshwaran et al., 2020).

We were motivated to conduct this study because Nitika et al., 2012 study on dental health awareness, attitude, oral health-related behaviors, and habits among Rajasthan's adult population provided the knowledge we needed to evaluate preventive oral health awareness and oral hygiene practices in patients using the outpatient clinic at Vyas Dental College and Hospital (VDCH), Jodhpur. The study, which involved the random selection of 500 patients between the ages of 15 and 50, discovered the urgent need for extensive educational campaigns to promote excellent oral health and teach knowledge about sound oral hygiene practices (Jain et al., 2012)

Srivastava et al., performed a research to analyze DHCPs' knowledge, attitudes, and practices (KAP) on COVID-19. A total of 318 people freely responded to the poll. The majority of DHCPs had modest expertise (51.6%), a good attitude (92.1%),

and sufficient practice standards (86.5%). They did, however, exhibit a good attitude and an adequate level of practice since they followed rules set by numerous international and national health bodies. The same motivation for following the instructions aided the dental students and associates of this institute in practicing oral hygiene during the COVID-19 epidemic. (Srivastava et al., 2020)

Surprisingly, with the exception of the impoverished socioeconomically deprived people, oral health standards in India are improving. Furthermore, during the COVID-19 pandemic, two-thirds of patients had never seen a dentist.

Conclusion

During the COVID epidemic, however, all professionals must continue to take preventative measures. When compared to the dental institution's affiliated personnel, conducting educational programmes resulted in a complete awareness of hygiene maintenance and its relevance to general health among dental students.

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Conflict of interest

The authors declare no conflict of interest. No financial support was received.

Ethics Statement

The institutional review board approved with reference number VDC/RP/2021/81 dated 20-09-2021. The research was carried out by following the Helsinki Declaration of 1975, as updated in 2013.

Author Contributions

Study Design, MKP and PKK; Data Collection, KST and GSP; Statistical Analysis, MKP, SGNVS; Data Interpretation, KST and PKK; Manuscript Preparation, MKP, GSP and RKS; Literature Search, SGNVS, RKS, PKK and KST. All authors have read and agreed to the published version of the manuscript.

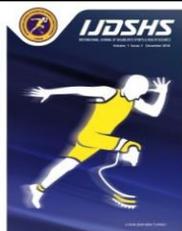
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RESEARCH ARTICLE

The Effect of Using Visual Aids on Learning Some Swimming Skills Among Hearing-Impaired Individuals By

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Abstract

Purpose: Finding out the impact of an educational program in swimming using visual aids at the skill level in swimming among hearing-impaired students, the study sample included 8 students from Faculty of Physical Education and Sport Sciences whom (height 175.6/cm, Weight 77.5 /kg, Age 21.2/Year). **Methods:** the experimental approach / one experimental group, the researchers used visual aids such as displaying a model in front of the study sample in addition to displaying a video that includes teaching basic skills in swimming using illustrations. The researchers also used an educational program aimed to teach the sample members basic skills in swimming freestyle, the duration of the program is 24 educational units by 3 units per week and the time of one unit is 75 minutes, data were processed statistically using statistical packages spss to conduct the following treatments (arithmetic mean, standard deviation, correlation coefficient, and test (T) to find differences between the arithmetic averages of the pre- and post-measurements) **Results:** the P values in this study was (0.00*) in all tests, which means there are statistically significant differences between the pre- and post-tests of the skill level in swimming among the sample of the study in favor of post-test. **Conclusion:** using of visual aids to teach hearing impaired persons to swim because of its great impact on the speed of learning and mastering basic skills in swimming.

Keywords

Swimming, Visual Aids, Hearing Impairment

INTRODUCTION

Sport is no longer limited to the normal in civilized societies, but it has become necessary for disabled individuals to practice sports activity, whether in its form of entertainment, competitive or therapeutic. Sport for all, which means providing the opportunity to practice various sports activities for each individual in society according to his potential and abilities Sport is not exclusive to a segment or category in society alone, because of its positive effects that benefit the public to its practitioners, including the hearing impaired (Nawasra, 2006).

The hearing impaired is defined as "an individual who suffers from total or partial hearing loss of more than 90 decibels, which prevents him from being able to successfully process language information through the hearing device alone, whether with or without hearing aids (Al-Qaryouti, 2006).

The researchers believe that one of the most important difficulties facing the hearing impaired is the problem of adaptation resulting from their sense of inferiority and helplessness due to injury, which leads to an imbalance in their personality and a lack of emotional and emotional balance, as

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these imbalances lead to great psychological and integrating into the society, and constitutes an obstacle to them and limits the ability to communicate with others, This may change their view of themselves and overcome them with a look of persecution, pessimism, shyness and loss of self-confidence and thus push them to isolation.

Believing in the need to integrate people with special needs and work to adapt them into society, the disabled must receive care in various fields, especially in the sports field, because of the many psychological, physical, and social benefits of sport in the rehabilitation and integration of the disabled into society. The American Red Cross (2001) states that "swimming is one of the most important sports activities programs that help the adaptation and integration of the disabled into society, which enhances his self-confidence and improves his self-concept. Also, practicing swimming and activities in the aquatic environment helps to develop the social and emotional aspects of people with disabilities, which provides an opportunity to develop communication skills and learn many motor skills (Abu Eid, 2004). Swimming is a beautiful, purposeful and useful sport, which has a great impact on the safety and health of the human being, the development of his muscles, the consistency of his body and the flexibility of his joints, swimming regulates the breathing process, activates the circulatory system, helps digestion and involves all the muscles of the body, and often helps in removing body deformities such as back curvature, leg bone curvature and rickets, hence swimming is a complete sport that is not equivalent to a sport for the growth of ideal body formation (Abu Eid, 2008).

Abu Al-Lail (2006) pointed out that the hard impaired category is one of the categories of hearing disabilities who can practice all physical and sports activities practiced by non-disabled people with the same rules of play without modification. The researchers believe that the use of aids in education has a direct impact on the learner, whether through verbal explanation, model performance, the use of models and images, or the presentation of videos, all of which lead to accelerating learning and saving effort. In order for the disabled person to absorb the movement intended to be applied, and in order for

pressure that causes them difficulties in adapting the learning process to take place easily, some educational aids must be used in order to clarify the movement and communicate the idea to them so that it is realized and applied, this is because the use of aid tools to the improvement and stabilization of motor skills. This is mentioned by Al-Jaafara (2017) aimed that teaching with aid tools increase the tendency to learn for participant , and help increase the effectiveness of teaching methods, especially in motor activities, as its raising and increasing attention in learners..

Shatnawi and Abu Zama, (2008) study which aimed to find out the impact of visual feedback on learning some basic skills in swimming, the study sample are a group of students of the Faculty of Physical Education at Mutah University, the sample was divided into two groups: traditional group given swimming skills in the traditional way and an experimental group given swimming skills in a way visual feedback, the results of the study indicated that there are statistically significant differences between the two groups and in favor of the group that uses visual feedback.

Also, Al-Hutaibat and Bani Atta (2007) conducted a study aimed to identify the impact of both immediate and deferred feedback on learning to swim butterfly. The study sample consisted of 20 students from the Faculty of Sports at Mutah University. The sample was divided into two equal groups, one of which is the immediate feedback group and the other uses deferred feedback, an educational program for butterfly swimming was applied for 8 weeks, and the results of the study indicated that there are statistically significant differences between the two groups and in favor of the group that uses the accompanying feedback. Issa (2005) also conducted a study aimed to know the effect of accompanying and deferred feedback on learning the skill of backstroke swimming. The study sample consisted of a group of second-year students in the Faculty of Physical Education from the University of the seventh of April, and the results of the study indicated that there were no statistically significant differences between the two methods, whether giving immediate feedback or even giving deferred feedback in learning the skill of swimming crawling on the back.

The researchers reviewed the theoretical literature on the subject of the use of teaching withaid tools and their impact on learning various skills, which indicated that the teaching with aid tools contribute to facilitating the possibility of learning difficult and complex movements such as different swimming skills, and this means works to provoke learners and provoke their tendencies and desires to improve their performance, in addition to that the use of other senses during the educational process helps greatly in order to adapt and interact with the surrounding environment and society, And this is confirmed by (Shirrell, 2004) that the use of the remaining senses of the disabled is mainly one of the foundations on which they rely to gain experience and knowledge and contribute to the formation of ideas, concepts and meanings in order to interact and communicate with the environment Also, through participation in sports activities, including swimming, opportunities for communication between the hearing impaired and others increase, as (Abu Eid, 2008) point out that individuals who practice sports activities appropriate to them regularly and relatively intensively according to their ability and could be vital energies. They overcome the negative effects of disability, and create a positive view of society, hence the idea of this study, which is the use of some visual aid tools such as video and providing a model in addition to the use of drawings and models in teaching swimming skills

to the hearing-impaired sample members in the Faculty of Physical Education and Sport Sciences.

The aim of this study is to investigate the effect of the swimming training program in which visual aids are used on the swimming skill levels of the hearing impaired students. Study Hypothesis there are statistically significant differences in the skill level in swimming between the pre- and post-tests among the members of the study sample and in favor of the post-tests.

MATERIALS AND METHODS

Study Methodology

The researchers used the experimental method which suit the nature and objective of the study.

Study population

Hearing-impaired students in the Faculty of Physical Education and Sport Sciences at the Hashemite University, numbering (8) students.

Ethical approval taken for the research and approved by the Hashemite University Human Research Ethics Committee (Approval Nummer: (28/ 4 / 2022 / 2023)

Study sample

The sample was selected in a deliberate way, and they represent the total population of the study and their number (8) males with special needs disabled and table (1) indicates the characteristics of the sample

Table 1. Arithmetic averages, standard deviations, range and torsion of sample subjects in growth variables (n=8)

Growth variables/unit of measure	X	SD	Range	Convolution
Height (cm)	175.6	4.32	17	0.11
Weight (kg)	77.5	5.44	21	1.07
Age/Year	21.2	1.23	3	-0.34

By reviewing Table (1), we note that the sample is homogeneous in terms of torsion, where the torsion values for the length variable of the sample were (0.11), for the weight variable, the value was (1.07), and for the age variable, the torsion reached (-0.34), and these values all range between (+3 and -3), which indicates that the sample is homogeneous.

Data collection tools

First

An educational swimming program was designed to teach the sample members basic skills in swimming and mastery of freestyle swimming, after the researchers saw the specialized references and studies such as the study of Jarrar (2005), Abu Eid (2004), Rizk (2004), Elayyan (2000) and Hussein (2000). The program was presented to a group of arbitrators to determine the suitability of the program for the sample members in terms of content and time and considering the gradation in the exercises.

The program was adopted in its final form after making amendments and suggestions submitted by the arbitrators. Where the researchers benefited from it in building and designing the proposed educational program for basic skills in swimming, where they designed the program in proportion to the members of the study sample in terms of the nature of the exercises and skills that suit the nature of their disability and gradation from simple skills to the vehicle and reliance on visual feedback to the group using videos. In addition to presenting a model in front of students, and using safety factors during the presence of the sample in the pool, where they formed a set of scientific foundations that were adopted during the design of the educational program, such as:

- The content of the program should work to achieve the objectives of this study.
- The content of the program should be commensurate with the nature of the disability among the members of the study sample.
- The exercises and skills should be commensurate with the age group of the members of the study sample.
- The program should consider the individual differences between the members of the sample.
- Gradation in skills and exercises from easy to difficult.
- Gradation from simple to complex.
- Considering the factors of safety during the entry and exit between changing rooms and swimming pool.
- Providing the factor of suspense, diversification, and competition among the members of the sample

to banish boredom and monotony during the period of application of the program.

- The use of aid tools of assistance such as ropes, buoyancy boards and rescue pipes.

The program included in its final form three meetings a week on Sundays, Tuesdays and Thursdays, and the meeting time was 75 minutes, and the duration of the program's application was eight weeks. The program contained a set of educational units that aim to teach basic skills in swimming and mastering freestyle swimming such as (buoyancy of all kinds, slipping on the abdomen and on the back, in addition to hand movements and standing in the water, in addition to a set of small games in the water.

. In addition to displaying special videos to teach some swimming skills that are displayed to the sample during the program period as visual feedback.

Second: The skill level tests were used in swimming, after reviewing many studies such as Shatnawi and Abu Zama (2008), Hutaibat and Bani Atta (2007), Abu Eid (2004) and Elayyan (2000).

To ensure the sincerity of the tests, the researchers presented them to a group of experts and arbitrators in the field of swimming and physical education modified and unanimously agreed on the appropriateness of the tests for the study sample, where the researchers then applied and re-applied the tests to ensure the stability of the tests, and the results were as in the following table 2.

Table 2. Stability values for swimming skill level tests

No	Tests	Pearson's correlation coefficient
1	Hold breath /sec	0.87
2	Breathing timing/number	0.85
3	Slipping on the abdomen/m	0.90
4	Slip on the back/m	0.88
5	Freestyle swimming /m	0.90

By reviewing the previous table, we notice that the stability values ranged between (0.85 and 0.90) which indicates that the tests have a high degree of stability.

Exploratory study

Ethical approvals were taken from all members of the sample to join the study experiment. The researchers conducted an exploratory study so that some of the educational

units included in the program were applied to a hearing impaired person other than the study sample in order to ensure the appropriateness of the proposed exercises and the best way to deal with the hearing impaired in the aquatic environment in addition to identifying the difficulties that may be an obstacle during the application of the program. In the Hashemite

University swimming pool during the period 26/2/2023 until 28/2/2023.

The exploratory study included a set of exercises that the researchers will apply in the proposed program.

The survey aimed to:

4. Identify the appropriateness of the proposed exercises for the study sample.
5. Ensure the time required to apply the exercises.
6. Identify the difficulties facing the sample during the period of application of the program and try to overcome them.

Limitations of the study

1. Identify the best way to deal with hearing impaired in the water environment.
2. Ensure the validity of the tools used in the study.
3. Ensure the availability of safety factors inside the pool.

Place: Hashemite University Swimming Pool.

Time: between 5/3/2023 to 27/4/2023

Statistics

Arithmetic means, standard deviation, Pearson's correlation coefficient, and T test were used to find differences between the arithmetic averages of the pre- and post-measurements.

RESULTS

Table 3. Arithmetic mean and standard deviation in the pre-measurement of the skill level tests in swimming among the hearing impaired

No	Tests	X	SD
1	Hold breath /sec	21	1.6
2	Breathing timing/number	17	2.4
3	Slipping on the abdomen/m	1.8	0.18
4	Slip on the back/m	1.7	0.16
5	Freestyle swimming /m	2.7	0.02

The researchers calculated arithmetic averages, standard deviations in the dimensional

measurement of the skill level tests in swimming, where the results indicated as in Table (4)

Table 4. Arithmetic mean and standard deviation in the dimensional measurement of the skill level tests in swimming among hearing impaired

No	Tests	X	SD
1	Hold breath /sec	45	2.7
2	Breathing timing/number	28	2.3
3	Slipping on the abdomen/m	4.55	0.14
4	Slip on the back/m	3.95	0.11
5	Freestyle swimming /m	16	0.88

To verify the results of this hypothesis, the researchers calculated arithmetic mean, standard

deviation, and value (T) between pre- and post-tests, and Table (5) shows the results.

Table 5. Arithmetic mean, standard deviation and T value of participants between pre- and post-tests

Tests		X	SD	value (T)	P value
Hold breath /sec	Pre -tests	21	1.5	37.4	0.00 *
	post-tests	45	2.7		
Breathing timing/number	Pre -tests	17	1.4	38	0.00 *
	post-tests	28	2.3		
Slipping on the abdomen/m	Pre -tests	1.8	0.16	35.5	0.01 *
	post-tests	4.55	0.16		
Slip on the back/m	Pre -tests	1.7	0.15	41.7	0.00 *
	post-tests	3.95	0.14		
Freestyle swimming /m	Pre -tests	2.7	0.1	87	0.00 *
	post-tests	16	0.55		

As shown in previous table the values of (T) were a function at the level of significance $\alpha \leq 0.05$ between pre- and post-tests among the sample and in favor of post-tests

DISCUSSION

After statically treatment made by researchers the results shows as in table 5 , that the values of (T) were a function at the level of significance $\alpha \leq 0.05$ between pre- and post-tests among the sample and in favor of post-tests which indicates that the hypothesis of the study has been achieved, and this is evident through the results of the tests, which indicated a clear progress among hearing-impaired swimmers in all the skills provided to them.

The researchers attribute this progress to the natural result of performing exercise, skill and gaining practical experience during practice swimming, in addition to the skill of sensation and getting used to the water in the pool, which leads to a clear improvement in the skill level by using educational videos, drawings and illustrations and presenting a model in front of the hearing impaired as Shirrell (2004) mentions. The provision of visual feedback raises motivation in individuals to learn, as well as the correct responses are emphasized and away from the wrong performance by repeating the video presentation in front of the swimmers with disabilities more than once, as it works to increase the element of suspense and motivation and thus consolidate the movements in the minds of the participants. Al-Khouli (2000) pointed out that the practice of physical activity may reflect on the life of the individual and develop his vital organs and give activity and vitality to his health, and this has agreed with the study of Abu Eid (2004) which indicated a positive improvement in the skill level of the members of the study sample, as well as Marei (2004), which indicated a physical and psychological improvement for the members of the study sample after participating in a training program for swimming. Also, Rasmi (2011) which indicated a positive effect of the recreational swimming program on the psychological and physical aspects of the disabled. It also agrees with what Joanna (2001) pointed out that the practice of water activities works to develop many physical, psychological, and social aspects of the study sample.

Conclusions

The use of the proposed educational program in swimming has a positive impact on the learning of the study sample members' basic skills in swimming. The use of the proposed educational program using visual aid tools has a positive impact on the development of the skill level in swimming. There is a difference between the pre- and post-tests of the study sample in the tests of the skill level in swimming and in favor of the post-tests.

Recommendations

Researchers recommend using the proposed educational program to teach hearing impaired people basic skills in swimming. Researchers recommend the use of visual aid tools to teach basic skills in swimming to teach the hearing impaired.

Declaration of interest

The authors report there are no competing interests to declare.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

This study is approved by the Hashemite University Human Research Ethics Committee (Approval Number: (28/ 4 / 2022 / 2023)

Authors Contribution

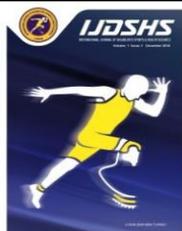
Study Design, FA, MH; Data Collection, FA, SA, IH, MH; Statistical Analysis, FA; Data Interpretation, SA, IH; Manuscript Preparation, FA, MH; Literature Search, FA, MH, IH, SA. All authors have read and agreed to the published version of the manuscript.

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RESEARCH ARTICLE

Extent of Knowledge and Application the Basics of Biomechanics Among Paralympic Games Coaches

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Abstract

This study aimed to identify the extent to which the bio-mechanical principles of human movement are known and applied in training the skill aspects of Paralympic coaches where the sample of the study consisted of 35 Paralympic coaches from several countries, all of whom are males. The average age of 42 ± 3.4 years. Their average training age was 7.5 ± 2.6 years. In order to achieve the study's objectives, the researchers designed a cognitive test that its validity, reliability, difficulty index were confirmed, and composed of 51 questions distributed to 6 axes. They also designed a questionnaire that its validity and reliability were confirmed and consistent and made up of (38) A paragraph distributed to (6) axes. The study results showed a low level of knowledge and low degree of application of the basics of biomechanics among Paralympic coaches. According to the results of our study, The responsible authorities of the Paralympic Committees should provide their coaches with special courses in biomechanical analysis and enhance their capabilities in this field, given its practical importance.. Academic agencies that issue training certificates in the field of sports training for persons with disabilities should focus on the field of biomechanical analysis and its related matters in their teaching programs.

Keywords

Paralympics, Biomechanics, Application, Coaches, Knowledge Range

INTRODUCTION

Since the 1940s, persons with disabilities have used sport as a therapeutic tool to overcome health complications, prevent secondary disabilities and survive. Then after several fluctuations, especially after the large number of physically disabled people due to World War I and World War II, the sport of the disabled began to develop until the appearance of the Paralympics corresponding to the Olympic Games, where it debuted in 1960 in Rome (Mauerberg-deCastro et al.,2016) When focusing this, we find that all matters related to the disabled

in rehabilitative therapeutic terms are conducive to high-level sports competitions associated with achievement. also related to biomechanical aspects, whether for treatment, motor rehabilitation or physical and skillful sports training. The rehabilitation and physiotherapy for persons with disabilities is based on the biomechanical aspects and thus their athletic training is based on these biomechanical aspects (Maly, 2009).

Biomechanics is a quantitative and qualitative study to perform sports. It is the physics of sport in which physical laws applied to sports movements and skills in order to achieve a

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deeper, better and more accurate understanding of the sports movement through modeling of skill performance based on a range of mechanical elements for all athletes (Watkins, 2014). Biomechanical analysis is an important factor for the development of the skill performance of athletes in all sports, especially among athletes with injuries or physical and sensory disabilities. Understanding and applying biomechanical work to provide scientific and practical data to coaches that help them to develop the sporting plans of their players and commensurate with them in terms of the nature of their disability and their specialized sport, which helps them adapt to the correct skill form and apply it with the least time and effort and in the best possible way (Lopes et al., 2023).

Motor analysis based on biometric principles increases the awareness of athletic coaches of the mechanical performance specifications, helping them to develop the required skill development plans of their players with disabilities (Trowell et al., 2020) so that this disability requires a full mechanical understanding of it in terms of its impact on the mechanics of movement in general and the skills associated with sport in particular. Also understand the mechanical nature of the remaining motor capacity after disability and thus build the skill performance in a mechanical manner commensurate with this ability and with the type of motor mechanical loss because of disability. The biometric principles of sports movements provide continuous information to coaches to evaluate skill performance first and thus progressively develop it based on the strengths and weaknesses that characterize the player. The coach works to modify weaknesses and enhance strengths through targeted training programmes that take into account aspects and biomechanical variables such as strength, speed and other variables and the relationship between these variables in order to the best possible skill performance according to biomechanical models that are consistent with the type and severity of disability and the requirements of the sport practiced by the disabled person (O'Riordan and Frossard, 2006).

By examining the Biomechanics analysis, we find that he studies linear and angular dynamics and statics through two groups. First, the kinematic variables that describe movement

externally, such as speed, acceleration, displacement, joint angles, angular speeds, peripheral speeds and other variables, And the Kinetic variables that show the amount of internal work and internal forces such as strength, speed, work, torque, work, joints momentum and other dynamic variables 139-4. The athletic coach must know and apply all this to optimize the skill performance, which consists of the result of movements based on Biomechanical variables. Each skill performance has a biomechanics shape with certain values that control the success of this performance if not (Özkaya et al., 2016). Thus, in the current era, coaches must know and apply biometric principles and develop their quantitative and qualitative motor analysis capabilities according to them and use the tools and equipment needed for such analysis to identify many variables of their players' skill performance such as their inertia, freedom of their movements, their ability to move, coordinate movements, and the appropriate Kinetic rhythm (Higgs et al., 1990).

Players trained according to the principles and rules of biometrics have achieved better results than others compared to those who have not been trained according to these principles and rules, especially in the field of continuity of development and progress in the skill performance of (Dutt, 2018). Therefore, biomechanical motor analysis is important, necessary and useful for all athletes at all ages and levels whether local or international for the normal people or disabled, as it gives the coach a unique opportunity to develop the skill of his players more in terms of motor efficiency (Chawla, 2017). In fact, the need to apply biomechanical aspects to disabled athletes is more important than applying these aspects to normal people, especially with the differences in anthropometric measurements of disabled players, as a result of the disability that imposes different forms of performance in terms of mechanical terms, which means the importance of identifying the special mechanical variables for each sports skill in disabled sports (İSLAMOĞLU., et al, 2023). So When we talking about Paralympic sports of a highly competitive nature, we find them to be diverse and multiple and characterized by their skillful form and nature from the sport of the normal people. Each game has a professional medical classification to which the player is

subject according to his or her abilities and type of disability, giving him a degree that determines his or her sensory or motor ability after disability. This means that each player has a degree and severity of disability and ability to move remaining after the disability, this requires the coach to know the biomechanical aspects that the player possesses according to the remaining capabilities and capabilities he has to avoid losing any performance aspect that the player can perform in order to increase competitiveness and the opportunity to achieve success and win (Reina et al., 2019). So from the foregoing, if the need for the coaches of normal players to know and apply the biomechanical principles when developing their athletic performance is urgent and necessary and is an important requirement that distinguishes the modern trainer, that need seems more pronounced in the coach of the Paralympics, the average person has preceded anatomically and functionally identifying his biometric variables based on the nature of the usual human movement. As for the person who is anatomically disabled, and because of the sensory or motor defect, he has an impact on the nature of the motor mechanics in his movements. Therefore, there is an increased need for his trainers to know and apply the appropriate biomechanical bases for his situation and try to develop them for his skill performance.

This study therefore addressed the answer to the following questions:

1. How well do Paralympic coaches know the principles and biometric laws of human movement?
2. How far do Paralympic coaches apply the biometric principles and laws of human movement when developing skilled training plans?

MATERIALS AND METHODS

Study Design

This study used the descriptive curriculum of all its scientific procedures and tools to achieve its objectives.

Study sample

The study respondents consisted of 35 Paralympian trainers from several countries, all of whom were males. The average age was 42 ± 3.4 years, while their average training age was 7.5 ± 2.6 years.

This study was approved by the Scientific Research Ethics Committee of the College of Pharmacy at Mutah University - Jordan (approval code: 295/2023-SREC-7/ May. 29,2023)

Study Tools

Researchers used a test in addition to a questionnaire to measure the knowledge and application of the biometric principles of human movement in Paralympic coaches and below detailed the study tools:

Cognitive Test

The test consisted of 51 multiple-choice questions, with each question having 4 answer options, with a time of 60 minutes. The test questions were divided into six axes:

- 1- Concepts related to biomechanics (9 questions)
- 2- Divisions of Sports Skill Movements as Described in Biomechanics (11 questions)
- 3- Newton's Laws of Motion (8 questions)
- 4- Mechanical aspects of sports movements (9 questions)
- 5- Human kinetic levers (7 questions)
- 6- Applied biomechanical analysis procedures (7 questions),

These questions measure Paralympic coaches' knowledge of the biomechanical principles and laws of human movement. To ensure the validity of the test, it was presented to (10) arbitrators who specialize in kinesiology, biomechanical analysis, and measurement and evaluation in sports training. They indicated the comprehensiveness and gradation of the questions, and that they actually measure the extent of Paralympic coaches' knowledge of the biomechanical foundations and laws of human movement, the lowest average acceptance rate for questions was 78%, while the highest acceptance rate for questions was 96%, which are acceptable percentages. The specialists also agreed that the time allotted for the test is sufficient. As for the reliability of the cognitive test, it was calculated by applying the test and re-applying it after two weeks on (10) coaches are not included in the study respondents. After calculating the internal consistency through the Cronbach alpha test, the results showed the reliability coefficients for the study test is 0.912 for stability and 0.84 for for reliability.

Difficulty and Discrimination Coefficient of the Test

The difficulty and ease coefficient was calculated as the difficulty and ease rate ranged from 0.32 to 0.71. The discrimination coefficient was 0.31. Therefore, 3 questions were excluded. Their transactions came outside the established ratios. The test settled on 40 cognitive questions. The following ratios have been adopted by researchers to determine the level of knowledge

1. Concepts related to biomechanics (7 paragraphs)
2. Divisions of Sports Skill Movements as Described in Biomechanics (7 paragraphs)
3. Newton's Laws of Motion (6 paragraphs)
4. Mechanical aspects of sports movements (6 paragraphs)
5. Human kinetic levers (6 paragraphs)
6. Applied biomechanical analysis procedures (6 paragraphs), which is based on the five-point Likert scale.

The answers were identified as follows:

Radically Agreed - 5 Marks

Mildly Agreed - 4 Marks

Agree - 3 Marks

Slightly Agreed - Two Marks

Very Slightly Agreed - One Mark

The scale did not contain any negative paragraphs requiring reversal of grades.

In order to ensure the validity of the test, it was presented to (11) specialists and academics in kinesiology, sports training science, training for persons with disabilities, measurement and sports evaluation, where they made some amendments to the texts of some paragraphs, and the agreement of the specialists was approved by 75% for the approval of the paragraph and the field. The percentages of agreement ranged On fields and paragraphs, with a minimum score of 78% and a maximum score of 97%.

As for the reliability of the cognitive test, it was calculated by applying the test and re-applying it after two weeks on (13) coaches are not included in the study respondents. After calculating the internal consistency through the Cronbach alpha test, the results showed that the cognitive test obtained a stability coefficient with a value of 0.80.

The researchers adopted the following percentages to judge the extent to which Paralympic Games coaches applied the principles

of Paralympic coaches in the biometric principles of human movement:

≥ 0.75 , high level

0.60 - .074 average level

≤ 0.59 , low level

Study Questionnaire

The study questionnaire, which determines the extent to which Paralympic coaches apply the principles and biometric rules of human movement when developing skilled training plans, is based on 38 paragraphs spread over (6) areas. and biomechanical rules of human movement when developing skill training plans:

1- If the arithmetic mean (1-1.8) is a very low degree of application

2- If the arithmetic mean (1.81-2.6) is a low degree of application

3- If the arithmetic mean is (2.61-3.4), the degree of application is medium

4- If the arithmetic mean (3.41-4.2) is a high degree of application

5- If the arithmetic mean is greater than or equal to (4.21), a very large application score.

Statistical Analysis

In this study all analyses were performed by using the Statistical Package for the Social Sciences (SPSS) software version 15, The following statistical treatments were used: internal consistency coefficient Cronbach's Alpha, means and standard deviations, frequency, percentage, and median.

RESULTS

The following are the results of the study according to the questions posed

First

As a result of the first question: How well do Paralympic coaches know the principles and biometric laws of human movement?

The table 1 indicates the percentages of the Paralympic Games coaches' knowledge of the biomechanical principles and rules of human movement in the biomechanics-related concepts axis, where the average correct answers were 14 out of 35 answers, while the percentage of correct answers for the axis as a whole was 39.66%.

Table 1. Percentages of the extent to which Paralympic Games coaches know the basics and laws of biomechanics of human movement in the axis of concepts related to biomechanics.

No.	The question	The integer (N)	Percentage for each question %	The average number of correct answers \bar{x}	The total percentile of the axis %
1	What is the ultimate goal of biomechanics?	16	0.45	14	39.66%
2	What does the kinetic refer to?	14	0.40		
3	What is kinematics?	14	0.40		
4	What does quantitative kinetic analysis mean?	12	0.34		
5	Which of the following refers to qualitative kinetic analysis?	14	0.40		
6	What does angular kinematic analysis relate to?	12	0.34		
7	What is linear analysis?	14	0.40		
8	Which of the following is static work?	15	0.42		
9	Which of the following does not indicate dynamic motion?	15	0.42		

The table 2 indicates the percentages of the extent to which the Paralympic Games coaches know the principles and biomechanical rules of human movement in the axis of the divisions of sports skill movements according to

biomechanics, where the average of correct answers was 13.90 out of 35 answers, while the percentage of correct answers for the axis as a whole was 39.36%.

Table 2. Percentages of the extent to which Paralympic Games coaches know the basics and biomechanical laws of human movement in the axis of sports skill movement divisions according to biomechanics.

No.	The question	The integer (N)	Percentage for each question %	The average number of correct answers \bar{x}	The total percentile of the axis %
1	What does variable speed mean?	18	0.51	13.90	39.36%
2	What is positive acceleration?	16	0.45		
3	Which of the following is a kinetic example of a general motion?	11	0.13		
4	What does linear motion refer to?	13	0.37		
5	Which of the following indicates a difference between curvilinear motion and circular motion?	12	0.34		
6	What is the difference between a closed skill and an open skill?	15	0.42		
7	What is the center of gravity of a stationary body?	18	0.51		
8	Which of the following is a movement performed on the longitudinal axis of the body?	11	0.31		
9	Which of the axes is perpendicular to the frontal plane?	13	0.37		
10	Which of the following movements is performed on the deep axis of the body?	12	0.34		
11	At what point do all the axes and physical levels meet?	14	0.40		

The table 3 indicates the percentages of the Paralympic Games coaches' knowledge of the biomechanical principles and rules of human movement in the Newton's Laws of Movement

axis, where the average correct answers were 13.37 out of 35 answers, while the percentage of correct answers for the axis as a whole was 37.75%.

Table 3. Percentages of Paralympic Games coaches' knowledge of the biomechanical principles and rules of human motion in the axis of Newton's laws of motion.

No.	The question	The integer (N)	Percentage for each question %	The average number of correct answers \bar{x}	The total percentile of the axis %
1	What does force equal to?	17	0.48	13.37	37.75%
2	What is acceleration?	16	0.45		
3	Does controlling training tool blocks help development?	10	0.28		
4	What is inertia totally related to?	11	0.31		
5	Inertia is useful in all of the following movements, except ?	11	0.31		
6	Which of the following is an example of action and reaction in athletic movements?	14	0.40		
7	What does speed equal to?	19	0.54		
8	Does increasing power by stabilizing mass and increasing acceleration lead to performance improvement?	9	0.25		

The table 4 indicates the percentages of the extent to which Paralympic Games coaches know the principles and biomechanical rules of human movement in the axis of mechanical

manifestations of sports movements, where the average of correct answers was 12 out of 35 answers, while the percentage of correct answers for the axis as a whole was 33.77%.

Table 4. Percentages of Paralympic Games coaches' knowledge of the principles and biomechanical rules of human movement in the field of mechanical manifestations of sports movements.

No.	The question	The integer (N)	Percentage for each question %	The average number of correct answers \bar{x}	The total percentile of the axis %
1	What does Kinetic rhythm refer to?	19	0.54	12	33.77%
2	Can the freedom of movement be inferred through?	14	0.40		
3	What shape appears on the motion athletic movements chart as a result of a proper change in the directions of movement in the joints?	8	0.22		
4	What is the purpose resulting from the occurrence of kinetic transfer?	9	0.25		
5	Which of the following is a transfer of motion from the foot to the torso?	16	0.45		
6	What is the ratio of torso mass to body mass?	9	0.25		
7	Does proper kinetic absorption begin with the joints?	11	0.31		
8	What does dynamic movement mean?	10	0.28		
9	What does collision mean?	12	0.34		

The table 5 indicates the percentages of the Paralympic Games coaches' knowledge of the biomechanical principles and laws of human movement in the leversaxes, as the average of

correct answers was 11.14 out of 35 answers, while the percentage of correct answers for the axes as a whole was 31.28%.

Table 5. Percentages of Paralympic Games coaches' knowledge of the biomechanical principles and laws of human movement in the leversaxes

No.Question	The integer (N)	Percentage for each question %	Average number of correct answers \bar{x}	Total percentage of the axes %
1 Which of the following is not an anatomical lever that does not provide effort?	10	28.0	11.14	31.28%
2 The PUSH UP exercise is an example of leverthat?	8	22.0		
3 Which of the following is a point of resistance in levers?	9	25.0		
4 What is the point of power in levers?	13	37.0		
5 The more the resistance line in the lever it becomes?	15	42.0		
6 Equal to the lines of resistance and power in the levers occurs in the movements that need?	12	34.0		
7 Examples of levers that provide effort?	11	31.0		

The table 6 indicates the percentages of the Paralympic Games coaches' knowledge of the biomechanical principles and laws of human movement in the axes of movement analysis

procedures, where the average of correct answers was 10.14 out of 35 answers, while the percentage of correct answers for the axes as a whole was 28.42%.

Table 6. Percentages of Paralympic Games coaches' knowledge of the biomechanical principles and laws of human movement in the axes of applied biomechanical analysis procedures

No.	Question	The integer (N)	Percentage for each question %	Average number of correct answers \bar{x}	Total percentage of the axes %
1	Is drawing scale used in mechanical motion analysis for purposes?	8	22.0	10.14	28.42%
2	Cameras are placed to portray the movement to be analyzed according to ?	8	22.0		
3	The distance between the camera and performance relates inherently with?	10	28.0		
4	Body joints identification points must be in colors that distinguish them?	9	25.0		
5	The number of cameras used in photography increases as it is?	14	40.0		
6	Which of the following is a program designed to analyze sports movements?	9	25.0		
7	The faster the athletic performance, the cameras must be distinguished by?	13	37.0		

The table 7 indicates the averages of the correct answers and the total percentages for each of the axes of the Paralympic Games coaches' knowledge test of the biomechanical principles and laws of human movement, the results show that the highest axis was the axis of concepts related to biomechanics with an average of 39.66%, while the axis of applied biomechanical analysis principles came as the lowest axis with

an average of 28.42%. While the results also indicated that the total range of knowledge according to the axes of the Paralympic Games coaches of the biomechanical principles and laws of human movement was low, with an average of correct answers reaching 12.42 out of 35, with a percentage of 35.04%, which is classified as low according to the levels that were chosen to judge the results of this question.

Table 7. The arithmetic average of the correct answers and the total percentage of the Paralympic Games' knowledge test of the biomechanical principles and laws of human movement according to the test axes

No. Axes	Average of correct answers	Total percentage of axes	Axis knowledge level	Average of the total number of correct answers for the axes	Total percentage of axes	Axis overall knowledge level
	\bar{x}	%		\bar{x}	%	
1 Concepts related to biomechanics.	14	39.66%	low	12.42	35.04%	low
2 Divisions of athletic skill movements from the point of view of biomechanics	13.90	39.66%	low			
3 Newton's Laws Of Motion	13.37	37.75%	low			
4 Mechanical manifestations of athletic movements	12	33.77%	low			
5 The levers	11.14	31.28%	low			
6 Applied biomechanical analysis procedures	10.14	28.42%	low			

The result of the second question: To what extent do Paralympic Games coaches apply the biomechanical principles and laws of human movement when developing skill training plans?

Second

The table 8 shows the arithmetic averages and standard deviations for the field of concepts related to biomechanics, where the paragraph “the final mechanical goal of the skill training plans

for players to reach the motor efficiency” came in the first rank with an arithmetic average of 3.88 and a large degree of application, while the paragraph “Work on applying power, resolve and work equations when calculating training intensity in skill plans” came in the last rank with an arithmetic average of 2.14 and a low degree of application, while the level of application of the field as a whole came with an arithmetic average of 2.62 and a medium degree of application

Table 8. Arithmetic averages, standard deviations, and the degree of applied of the field of concepts related to biomechanics

No. Rank	Paragraph	\bar{x}	SD	Application Degree
1 1	The final mechanical goal of skill training plans is to reach players efficiency of the movement	3.88	2.17	Great
2 7	Work on applying power, resolve and work equations when calculating training intensity in skill plans	2.14	1.94	Low
3 3	Put skillful plans based on a clear perception related to the speed and acceleration of performance and the angles of motor work	3.64	2.03	Great
4 6	Interested in collecting raw data on mechanical	2.39	1.45	Low

		players' performance variables to use as feedback?			
5	4	Realize that each skillful motor performance has mechanical variables that are more influential than others?	3.21	1.16	Medium
6	5	Realize that calculating variables such as speed and acceleration differs between linear and circular work?	2.89	1.32	Medium
7	2	Distinguish between static and dynamic movements when developing skill exercises	3.41	1.56	Medium
Field of concepts related to biomechanics			2.62	1.09	Medium

The table 9 shows the arithmetic averages and standard deviations for the field of athletic skill movement divisions from the point of view of biomechanics, where the paragraph "Taking into account when developing skill training plans the difference in speeds when performing" came in the first rank with an arithmetic average of 4.22 and a large degree of application, while the

paragraph "Taking into account the nature of closed and open skills when developing my skills training program" came in the last rank with an arithmetic average of 1.74 and a low degree of application, while the level of application of the field as a whole came with an arithmetic average of 2.44 and a medium degree of application.

Table 9. Arithmetic averages, standard deviations, and the application degree of the field of athletic skill movement divisions from the point of view of biomechanics

No.	Rank	Paragraph	\bar{x}	SD	Application Degree
1	1	When developing skill training plans, take into account the difference in performance speeds	4.22	2.56	Great
2	2	Work on putting exercises with different speeds	3.02	1.77	Medium
3	6	When developing training plans, I put exercises that take into account the forms of engineering movements	1.77	23.0	Low
4	3	Distinguish between the speeds of my players by moving straight, curved or circular	2.74	1.44	Medium
5	5	Aware of the axes and levels on which most of the skills that I am training are based	1.78	63.0	Low
6	7	Taking into account the nature of closed and open skills when developing my skills training program	1.74	78.0	Low
7	4	Aware of how the body's center of gravity shifts in most of the exercises I include in my training plans	1.82	1.09	Low
Field of divisions of athletic skill movements from the point of view of biomechanics			2.44	1.32	Medium

The table 10 shows the arithmetic averages and standard deviations for the field of Newton's laws of motion, where the paragraph "Benefit from the law of motor reflex response when developing technical plans" came in the first rank, with an arithmetic average of 2.94 and with a medium degree of application, while the paragraph "Putting my training plans to work on

modifying some of the mechanical variables associated with skillful performance using Movement laws" came in the last rank, with an arithmetic average of 1.82 and a low degree of application, while the level of application of the field as a whole came with an arithmetic average of 2.17 and a low degree of application.

Table 10. Arithmetic averages, standard deviations, and the degree of application of Newton's laws of motion

No.	Rank	Paragraph	\bar{x}	SD	Application Degree
1	4	Taking into account the laws of power calculation when developing training plans	1.89	72.0	Low
2	2	Taking into account the issue of the player's body mass and its relationship to his inertia when making plans	2.66	1.05	Medium
3	5	Use the methods of controlling mass, acceleration, or both as the primary control for power	1.84	1.02	Low
4	3	Use the law of inertia when developing training programs	1.90	97.0	Low
5	1	Benefit from the law of motor reflex response when developing technical plans	2.94	1.25	Medium
6	6	Putting my training plans to work on modifying some of the mechanical variables associated with skillful performance using Movement laws	1.82	51.0	Low
Newton's Laws of Motion field			2.17	1.06	Low

The table 11 shows the arithmetic averages and standard deviations for the field of mechanical manifestations of athletic movements, where the paragraph “Work during the training plans to take into account the distribution of performance power ideally on the parts of the movement” came in the first rank, with an arithmetic average of 3.74, and with a great degree of application. With an arithmetic average

of 2.51, with a great degree of application, while the paragraph “In developing my skill training program, I make sure that the point of the body's center of gravity is in the most appropriate place for performance” came in the last rank, with an arithmetic average of 2.51 and a low degree of application, while the level of application of the field as a whole came with an arithmetic average of 2.92 and a medium degree of application.

Table 11. Arithmetic average, standard deviations, and the degree of application to the field of mechanical manifestations of athletic movements

No.	Rank	Paragraph	\bar{x}	SD	Application Degree
1	3	Putting the motor rhythm for all the skills that I work on training	2.74	1.33	Medium
2	4	Make sure to draw a dynamic flow chart for all the skills that I put in training plans	2.54	1.20	Low
3	1	Work during the training plans to take into account the distribution of performance power ideally on the parts of the movement	3.74	1.89	Great
4	5	Clearly, I put the directions of motor transfer in the training plans	2.69	1.32	Medium
5	2	Putting part of my schematic program to train a special skill in how to finish the skill perfectly	3.34	2.87	Medium
6	6	In developing my skill training program, I make sure that the point of the body's center of gravity is in the most appropriate place for performance	2.51	1.02	Low
Field of mechanical manifestations of athletic movements			2.92	2.11	Medium

The table 12 shows the arithmetic averages and standard deviations for the field of levers, where the paragraph “I realize power and resistance points in the exercises that I put in my training plan” came in the first rank, with an arithmetic average of 2.41 and a low degree of application, while the paragraph came “Use

anatomical levers as a mechanical basis when developing skill training plans” in the last place with an arithmetic average 1.71, with a low degree of application, while the level of application of the field as a whole came with an arithmetic average of 1.90, with a low degree of application

Table 12. Arithmetic average, standard deviations, and degree of application for the field of levers

No.	Rank	Paragraph	\bar{x}	SD	Application Degree
1	5	I distinguish the motor levers and their types for most of the exercises that I put in my skill training plan	1.77	2.30	Very low
2	3	I have the ability to vary the difficulty of the movements performed by changing the lever on which the exercise works	1.90	1.65	Low
3	1	I realize power and resistance points of the exercises that I put in my training plan	2.41	1.95	Low
4	4	I distinguish the line of resistance and the line of power in the exercises that I put for the players	1.82	1.02	Low
5	6	Use anatomical levers as a mechanical basis when developing skill training plans	1.71	36.0	Very low
6	2	Distinguish clearly the changes that occur as a result of the difference in power and resistance	2.01	1.32	Low
Field of levers			1.90	1.01	Low

The table13 shows the arithmetic averages and standard deviations for the field of applied biomechanical analysis procedures, where the paragraph “Know where to place the cameras to get the best viewing angles for the players' performance” came in the first rank, with an arithmetic average of 2.55 and a low degree of

application, while the paragraph “Use the drawing scale to determine the distances across the screen relative to reality” came in the last place With an arithmetic average of 1.55, with a low degree of application, while the level of application of the field as a whole came with an arithmetic average of 1.87, with a low degree of application.

Table 13. Arithmetic averages, standard deviations, and degree of application for the field of applied biomechanical analysis procedures

No.	Rank	Paragraph	\bar{x}	SD	Application Degree
1	4	Work on photographing the performance of the tactical and skillful players for the purposes of biomechanical analysis	1.70	98.0	Very low
2	1	Know where to place the cameras to get the best viewing angles for the players' performance	2.55	1.20	Low
3	2	I am good at determining the ideal distances between the performance analysis cameras and the location of the actual performance of the players	2.03	1.33	Low
4	5	Use the flowchart drawing of the players to judge a player's skillful performance	1.66	69.0	Very low
5	6	Use the drawing scale to determine the distances across the screen relative to reality	1.55	1.03	Very low
6	3	I am good at using at least one mechanical analysis software, and I use that in my training work	1.77	1.32	Very low
Field of applied biomechanical analysis procedures			1.87	1.04	Low

The table 14 shows the arithmetic average and standard deviations of the fields of application of the Paralympic Games trainers to the principles and laws of biomechanics of human movement when developing skill training plans. Where the field of mechanical manifestations of athletic movements came in the first rank with an arithmetic average of 2.92 and a medium degree of application, while the field of applied

biomechanical analysis procedures came in the last place with an arithmetic average of 1.87 and a low degree of application, while the total level of the Paralympic Games trainers' application of the biomechanical principles and laws of human movement when developing skill training plans came with an arithmetic average of 2.32, with a low overall application degree.

Table 14. Arithmetic average, standard deviations, order of fields, and the degree of application of the Paralympic Games trainers to the principles and biomechanical laws of human movement when developing skill training plans according to the fields of study?

NoRank	Field	\bar{x}	SD	application degree	overall arithmetic average of fields \bar{x}	overall standard deviation of fields SD	Overall application degree
1 2	Concepts related to biomechanics	2.62	1.09	Medium	2.32	1.55	Low
2 3	Divisions of athletic skill movements from the point of view of biomechanics	2.44	1.32	Medium			
3 4	Newton's laws of motion	2.17	1.06	Low			
4 1	Mechanical manifestations of athletic movements	2.92	2.11	Medium			
5 5	levers	1.90	1.01	Low			
6 6	Applied biomechanical analysis procedures	1.87	1.04	Low			

From the above, the answer to the study questions is as follows:

1- The result of the first question: To what extent do Paralympic Games coaches know the basics and biomechanical laws of human movement?

Low

2- To what extent do Paralympic Games coaches apply the biomechanical principles and laws of human movement when developing skill training plans?

Low

DISCUSSION

According to the results of the study, it is clear that the Paralympic Games coaches who are represented by the study respondent do not have sufficient knowledge nor sufficient ability to apply the principles and biomechanical laws of human movement when developing skill training plans, where the results were low, whether for the extent of their knowledge or their application of these principles. Returning to the results, we find that the knowledge of the trainers about biomechanics in all aspects was low. This can be explained by the fact that the trainers may not have received an academic education related to the subject of their profession, such as being former players and becoming coaches as a result of their previous

experiences. They would not have given the mechanical side an important space when they received the courses for training their various games, although the biomechanical analysis is an important aspect and cannot be separated from sports training because of its benefits related to the perfect skillful performance that is free from motor errors, as it makes the performance acquire a streamlined and economical nature in The effort exerted in addition to avoiding injuries, which increases the chances of success for athletes (Perrin, 2021).

The need for athletes from healthy people to be trained according to the rules of kinesiology and biomechanical analysis due to the imbalances of movement that are associated with their disability, which generally affect the directions of movement, its performance line, the power needed by each part of the movement, as well as the general shape of the movement, and all these variables are related to the mechanics of movement different from the disabled person. This means that the mechanical and kinetic requirements are different for normal people, especially when performing skillful movements in competitive sports activity. Indeed, they differ from one disabled person to another and in the same sport, depending on the functional medical

classification and the degree of disability of the player, which gives additional importance to the extent to which trainers know the rules of biomechanical analysis and use them not only when developing Skill training plans, but when evaluating performance, kinesiology in general can be used as a tool for measuring and adjusting at one time (Romanov and Medjedovic, 2022).

As for when returning to the results of the second question related to the extent to which the trainers apply the principles and biomechanical laws of human movement when they develop the skill training plans, we find that it is low and this is consistent with their low knowledge in this field. Certainly, knowing something helps to apply it, but in another look at the fields that measure the extent of application, we find some field such as the field of concepts related to biomechanics, the divisions of sports skill movements from the point of view of biomechanics and mechanical manifestations and athletic movements have come in medium levels of application, which the researchers attribute to the fact that trainers may apply some of the principles of biomechanical analysis in their plans acquired through expertise and experience without knowing that it is part of biomechanics or kinesiology and therefore we find that all knowledge axes are low, but the fields of application appear to have medium degrees of application. The experiences give the trainers additional capabilities that they may not have received during the courses (Silva and Fonseca, 2019) which means that the trainer, as a result of his acquisition of training experiences, realized some mechanical variables without knowing that they are related to this side.

Conclusion

The trainers of the Paralympic Games for the sport of persons with disabilities show a cognitive and practical weakness in the biomechanical principles and laws of human movement when developing skill training plans, which is something that those in charge of these games must take into account by providing their coaches with special courses in biomechanical analysis and raising their capabilities in this field in view of its applied importance. It should also be noted that the academic institutions that issue training certificates in the field of athletic training for persons with disabilities should focus on the field of biomechanical analysis and related fields such as kinesiology in their teaching programs.

Conflict of interest : The authors confirm that there are no conflicts of interest associated with this study, and that it was self-funded by the authors.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

This study was approved by the Scientific Research Ethics Committee of the College of Pharmacy at Mutah University - Jordan (approval code: 295/2023-SREC-7/ May. 29,2023).

Author Contributions

Study Design, Literature Search Data Collection and Statistical Analysis (Ibtehal Alkhawaldeh), Data Interpretation, Manuscript Preparation and Application of study procedures (Ibtehal Alkhawaldeh and Mohamad Alzughialat)

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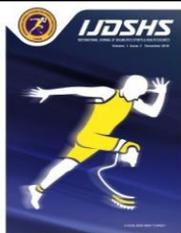
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RESEARCH ARTICLE

Investigation of Perceived Walkability of Neighborhood Environment According to Physical Activity Level and Body Composition of Adults during the COVID-19 Pandemic

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Abstract

This research examined the relationship between physical activity status and perceived walkability in the neighborhood environment during the Covid-19 pandemic. A total of 88 volunteer adults, 45 females and 43 males, aged 18-65 participated in the study. An online IPAQ-Short Form and Neighborhood Environment Walkability Scale were administered to the participants. In addition, daily step counts were determined to determine objective physical activity levels. The collected data were analyzed by correlation and t test in SPSS program. According to analysis of step counts, there was a significant difference between the physical activity groups ($p < 0.05$). Only the aesthetics of neighborhood environment subscale scores were significantly different between those with high intensity physical activity compared to those with low and moderate intensity physical activity ($p < 0.05$). According to the analysis results, mean step count and mean IPAQ scores were identified to have positive moderate level of correlation ($r = 0.27$, $p = 0.01$). There were no statistically significant differences between the mean walkability perception of the neighborhood environment subscale scores according to body composition ($p > 0.05$). As a result, in this process, the status of adults' perceptions of the neighborhood environment regarding physical activity was examined; During the Covid-19 pandemic, features of the built environment did not increase physical activity and walking, and their effects were not as expected. In conclusion; the most important reasons for this are the measures taken by the administrators to protect people, the conditions affecting the pandemic such as the threat and uncertainty that the pandemic poses on people.

Keywords

COVID-19, Environment, Health, Physical activity, Perception, Walkability

INTRODUCTION

The COVID-19 pandemic was one of the most dramatic experiences of humanity in recent years in both health and social terms. In addition to the direct effects of coronavirus on human health, human life was deeply affected due to isolation precautions and psychological factors linked to the disease (Ozen et al., 2020; Demirci et al., 2022). Due to the rapid spread of the pandemic and high transmissivity, precautions were taken around the world in general and societies faced great changes. Precautions like

social distancing, quarantines, masking and movement restrictions affected the daily lives of people and disrupted normal routines. In the first period of the struggle against the coronavirus, convalescent plasma and antiviral medications (e.g., remdesivir) were adopted as partial treatment methods, while later traditional and mRNA vaccinations provided significant advances in the treatment of COVID-19 patients (Scavone et al., 2020; Byambasuren et al., 2023). Many countries adopted social isolation and hygiene behavior strategies as the most effective method to limit spread of the virus and to reduce

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morbidity and mortality. In this period, perceptions of close surroundings and physical activity became important to sustain the health and welfare of individuals.

Public health advice (decisions to remain at home, closure of parks, gyms and fitness centers to prevent spread of the virus) have the potential to reduce daily physical activity. In this context, daily regular physical activity and exercise assist in the struggle against some diseases by strengthening the immune system, and preventing obesity, diabetes and hypertension and serious heart diseases that make people more susceptible to COVID-19 (Civil et al., 2021; Siordia, 2020). Exercise affects the immune system and improves morbidity and mortality due to infection (Lowder et al., 2005; Warren et al., 2015; Kohut et al., 2009). When situations like remaining at home and reduced physical activity are combined with a sedentary lifestyle, uncontrolled weight gain is an unavoidable outcome. Research in Italy including 41 child and adolescent obesity patients identified that participants did less exercise and increased unhealthy snack consumption as a result of remaining at home (Pietrobelli et al., 2020). A study in the United Kingdom concluded that adults with obesity had reduced belief in limited numbers of behaviors to prevent typical weight gain (e.g., physical activity) compared to before stay-at-home orders (Robinson et al., 2020). The importance of investigating behavior related to weight and understanding obstacles to weight management during the COVID-19 crisis was emphasized by the association of high BMI with increased risk of hospitalization and death due to coronavirus (Garg et al., 2020; Klang et al., 2020). Additionally, health reports by the World Health Organization (WHO) and other national health authorities showed a striking increase in the prevalence of obesity and other diseases related to physical immobility (USDHHS, 2000; WHO, 2010; Unuvar, 2004).

The COVID-19 pandemic caused people to remain at home more and to complete most of their daily activities in their close surroundings. Homes became safe harbors and the close environment played an important role in the struggle with the pandemic. In this process, people's perceptions of their close surroundings changed and their interest in their homes, neighborhoods and natural areas increased. According to research by Saelens et al. (2003), the

quality and attractiveness of walkable areas near homes may affect people's level of physical activity. People tend to discover walking paths, cycle lanes and open areas in the close environment near their homes. According to Yin (2013), the activities and functions between the start and end points of walks affect the walkability, with path components listed as accessibility, socialization, security and image. The start and end points of a journey with the purpose of walking and the features of the route linking these two points make the space walkable. Running and walking comprise significant proportions among types of physical activity; for this reason, walking activities play an important role in determining the total amount of daily movement (Tremblay et al., 2001). Contrary to this, some factors preventing walking in cities include few areas where it is safe to be active, lack of access to physical activity equipment, distance to areas like parks and gyms, cost of physical activity and time limitations (Ferreira et al., 2007; Cavill et al., 2006; Motl et al., 2007). When all these negative aspects are resolved, physically active journey choices emerge and provide the opportunity for individuals to participate in physical activity. WHO (2021) stated that physical activity includes all movements in the daily routine including during leisure, when going places, for transport or as part of a person's job. Individuals going to work by bicycle have lower probability of mortality due to any cause; people walking to work have lower risk of cancer and individuals using active modes instead of vehicles have lower body mass index (BMI). Additionally, recent research showed that regular and continuous participation in physical activity was associated (Mutz et al., 2021; Brown et al., 2015; Anokye et al., 2012; Vagetti et al., 2014; Krzepota et al., 2018; Ho et al., 2019) with positive mental outcomes in terms of (Schuch et al., 2018) mental health (Whitelaw et al., 2010) and happiness (Dolan et al., 2014). In light of this information, the aim of our study was to investigate the perceived walkability of the neighborhood environment according to physical activity levels and body composition of adults during the COVID-19 pandemic.

MATERIALS AND METHODS

Procedure

Within the scope of this study, data obtained from September-December in 2021 during the COVID-19 pandemic were analyzed. In this research to investigate the close environment perceptions of adults according to physical activity level and body composition. The study was approved by the Scientific Research Ethics Committee of Çanakkale Onsekiz Mart University with the decision of 04/01/2021 and number 01/03

Participants

A total of 100 volunteer participants aged 18-65 years were reached. However, only 88 people fully completed the survey or gave consent with the consent form. Surveys were prepared with Google Forms and sent to individuals as the study was completed during the pandemic and due to the risk of transmission. People who did not complete the consent form were not included in the study. Height and weight information was obtained to determine obesity among participants and BMI was calculated. After calculations, the BMI classification table of the WHO was used (WHO, 2000). BMI is used to predict body weight according to height and does not provide information about the distribution of fat in the body.

Data Collection

IPAQ-Short-Form

This scale measuring the intensity of physical activity comprises nine questions. Questions provide information about physical activity, walking upstairs, walking, shopping and sitting during the last seven days. From this data, total weekly physical activity levels (MET/hr/wk) are classified as low, moderate and high. Individuals not doing physical activity have low physical activity of ≤ 600 MET-min/wk, while it is necessary to achieve $\geq 600-3000$ MET-min/wk total physical activity for high intensity or moderate intensity of physical activity (Craig et al., 2003).

Total physical activity points: The MET-min score (MET-min/wk) for participants for the last 7 days was calculated using the formulas below for high intensity and moderate intensity physical activity and walking based on duration in minutes and number of days of that activity.

Standard MET values were created for these physical activities.

- Walking score (MET-min/wk) = $3.3 * \text{walking duration} * \text{number of days of walking}$
- Moderate intensity activity score (MET-min/wk) = $4.0 * \text{duration of moderate intensity activity} * \text{number of days of moderate intensity activity}$
- High intensity activity score (MET-min/wk) = $8.0 * \text{high intensity activity duration} * \text{number of days of high intensity activity}$
- Total physical activity score (MET-min/wk) = walking score + moderate intensity activity score + high intensity activity score

Step Count

To determine the objective physical activity levels and daily step counts of participants, daily step count data were requested by communicating with individuals. Individuals determined their daily step count using smart watches, smart wrist bands or mobile telephone applications.

Neighborhood Environment Walkability Scale (NEWS)

The NEWS was first developed by Cerin et al. (2006) in USA to measure perceptions of walkability neighborhood environments (Cerin et al., 2006). It comprises 6 subscales of access to services, street connections and walking/cycle routes, esthetics, traffic danger, crime rate and infrastructure. Responses to questions are given on a 4-point scale from 1 (definitely disagree) to 4 (definitely agree). Higher values for access to services, street connections and walking/cycle routes, esthetics and infrastructure are equivalent to a more walkable neighborhood, while higher values for traffic safety and crime indicate a less walkable neighborhood.

Statistical Analysis

Data analysis was performed through the SPSS 22.0 statistical package (SPSS Inc., Chicago, IL, USA). Means and SD were computed for all quantitative variables and percentages were computed for categorical variables. The Shapiro-Wilk test was used to inspect for the distributions of the variables. In statistical analysis, independent samples t-tests were used to test for group differences and One Way Anova tests for multiple group comparisons were used. In order to determine the group differences, Post-Hoc LSD test was used. Pearson correlation test was used to examine the

relationship between the variables. Significance

level was taken as $p < 0.05$ in statistical analysis.

RESULTS

The mean values for age, height, weight, BMI, access to facilities, streets in the neighborhood environment, walking and cycle

routes, esthetics of neighborhood environment, traffic danger, crime, physical activity and 3-day step counts for 88 volunteer participants are given in Table 1.

Table 1. Descriptive statistics of participants

	X	SD
Age	39.76	12.431
Height	171.38	8.745
Weight	74.53	13.958
BMI	25.2749	3.74668
Access to facilities	3.0492	.86939
Streets in neighborhood environment	3.1534	.93267
Walking and bicycle routes	2.8995	.72344
Esthetics of neighborhood environment	2.5114	.88645
Traffic danger	2.3744	.74117
Crime	1.5981	.78157
IPAQ Score	1.6477	.67874
3-day step count	4398.85	4017.279

SD= Std. Deviation

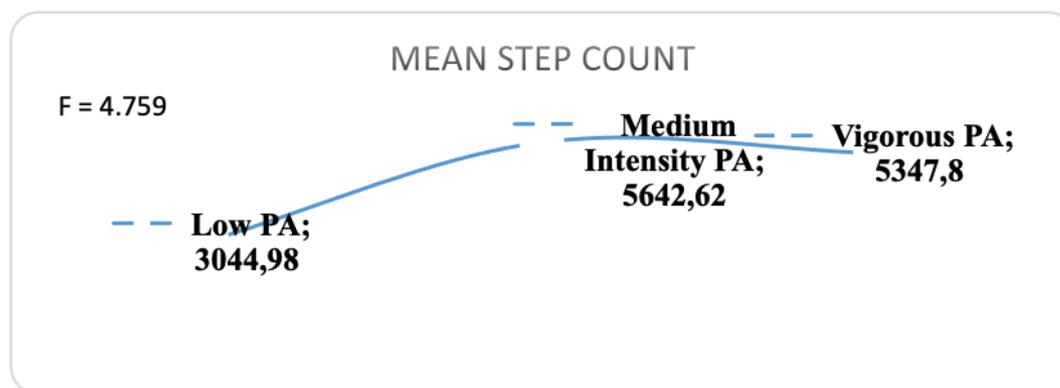


Figure 1: Difference between physical activity intensity and step count

According to analysis of step counts in Figure 1, there was a significant difference between the physical activity groups ($p < 0.05$). When the source of the difference between the groups was investigated, the group with low physical activity had mean step counts that were lower by statistically significant level compared to the groups with moderate and high intensity physical activity ($f(2,85) = 4.75, p = 0.011$).

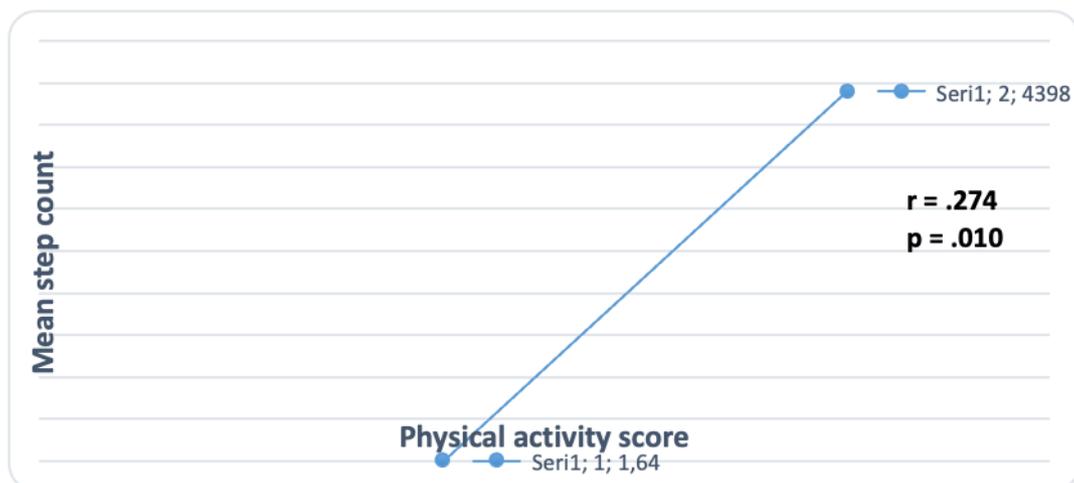
Table 2 gives the mean body composition and perceptions of neighborhood environment

walkability subscale scores according to physical activity levels for participants. Only the esthetics of neighborhood environment subscale scores were significantly different between those with high intensity physical activity compared to those with low and moderate intensity physical activity ($f(2, 85) = 5.25, p = 0.006$). The group with high intensity physical activity were identified to be the group with highest esthetic awareness of their environment.

Table 2: Difference in perceptions of neighborhood environment walkability according to physical activity levels

		N	X	SD	F	P	Differences
Facilities, shops in neighborhood environment	Low PA	41	3.7085	.87048	1.616	.205	-
	Moderate intensity PA	37	3.4516	.87976			
	High intensity PA	10	3.1820	1.23660			
Access to facilities	Low PA	41	3.0893	.90716	.081	.922	-
	Moderate intensity PA	37	3.0181	.77848			
	High intensity PA	10	3.0000	1.10039			
Streets in neighborhood environment	Low PA	41	3.2439	.90223	.397	.673	-
	Moderate intensity PA	37	3.0541	.95586			
	High intensity PA	10	3.1500	1.02875			
Walking and cycle routes	Low PA	41	2.8902	.75059	.007	.993	-
	Moderate intensity PA	37	2.9103	.65786			
	High intensity PA	10	2.8980	.90734			
Esthetics of neighborhood environment	Low PA	41	2.3110	.91135	5.525	.006*	a<c
	Moderate intensity PA	37	2.5203	.82575			
	High intensity PA	10	3.3000	.55025			
Traffic danger	Low PA	41	2.4134	.68215	.290	.749	-
	Moderate intensity PA	37	2.3059	.68703			
	High intensity PA	10	2.4680	1.14810			
Crime	Low PA	41	1.7315	.89522	1.793	.173	-
	Moderate intensity PA	37	1.5489	.69461			
	High intensity PA	10	1.2330	.41713			
BMI	Low PA	41	25.0029	4.08955	.199	.820	-
	Moderate intensity PA	37	25.5243	3.11580			
	High intensity PA	10	25.4670	4.67970			

SD: Std. Deviation

**Figure 2:** Correlation between step count and physical activity score

The correlation between mean step count and IPAQ scores of participants is presented in Figure 2. According to the analysis results, mean step

count and mean IPAQ scores were identified to have positive moderate level of correlation ($r = 0.27$, $p = 0.01$).

Table 3: Correlation between NEWS sub-domain scores, PA scores, step count and BMI

Correlations				
		NEWS Score	3-day step count mean	BMI
Facilities, shops in neighborhood environment	r	-.191	-.223*	.308
	p	.074	.037	.003
Access to facilities	r	-.042	-.215	-.205
	p	.700	.044	.056
Streets in neighborhood environment	r	-.068	-.129	.022
	p	.529	.231	.842
Walking and cycle routes	r	.009	-.126	.002
	p	.937	.243	.988
Esthetics of neighborhood environment	r	.308	.124	.062
	p	.004	.251	.564
Traffic danger	r	-.015	-.164	.030
	p	.889	.128	.780
Crime	r	-.198	-.046	.030
	p	.065	.669	.781

When the correlations between NEWS subscales with 3-day step count, physical activity scores and BMI are investigated, there was a significant, weak and negative correlation between access to facilities and 3-day step count ($r = -.215$, $p = 0.044$). Individuals with high access to facilities points were observed to have lower mean step counts. There was a significant correlation between the shops and facilities in the neighborhood environment subscale with step counts ($r = -.223$, $p = 0.037$). There was a significant positive correlation between esthetics of the neighborhood environment with physical activity ($r = .308$, $p = 0.004$). This means individuals living in esthetically organized environments were more physically active. There was a significant correlation between the survey

subscale of shops and facilities in neighborhood environment with BMI ($r = .308$, $p = 0.003$).

When the mean step count values in Table 4 are assessed according to body composition groups based on BMI of participants, those with normal body composition were found to have significantly different mean step counts compared to individuals in the overweight and obese groups ($f(3,84) = 4.49$, $p = 0.006$). The results of the analysis with the aim of determining the difference between the groups found that those with normal body composition had significantly lower mean step counts compared to individuals in the overweight and obese groups ($p < 0.05$). There were no statistically significant differences between the mean walkability perception of the neighborhood environment subscale scores according to body composition ($p > 0.05$).

Table 4: Difference in BMI classification and NEWS Scores

		N	\bar{x}	Std.	F	P	Differences
Facilities, shops in neighborhood environment	Underweight	4	3.70	.742	2.053	.113	-
	Normal	40	3.72	.666			
	Overweight	36	3.46	1.115			
	Obese	8	2.88	1.000			
Access to facilities	Underweight	4	3.16	.576	2.362	.077	-
	Normal	40	3.30	.743			
	Overweight	36	2.82	.981			
	Obese	8	2.75	.792			
Streets in neighborhood environment	Underweight	4	2.87	.250	.869	.460	-
	Normal	40	3.26	.839			
	Overweight	36	3.00	1.108			
	Obese	8	3.43	.623			
Walking and cycle routes	Underweight	4	2.54	.342	1.031	.383	-
	Normal	40	3.02	.749			
	Overweight	36	2.78	.752			
	Obese	8	2.95	.518			
Esthetics of neighborhood environment	Underweight	4	2.25	.735	.659	.579	-
	Normal	40	2.41	.963			
	Overweight	36	2.66	.801			
	Obese	8	2.40	.963			
Traffic danger	Underweight	4	2.33	.980	.249	.862	-
	Normal	40	2.43	.771			
	Overweight	36	2.29	.729			
	Obese	8	2.45	.616			
Crime	Underweight	4	1.91	1.132	.680	.566	-
	Normal	40	1.58	.819			
	Overweight	36	1.51	.705			
	Obese	8	1.87	.794			
Mean step count	Underweight	4	2602.5	2181.929	4.490	.006*	b<c,d
	Normal	40	3033.28	2995.067			
	Overweight	36	5488.22	4145.807			
	Obese	8	7222.75	5908.058			

*: $p < 0.05$, BMI classification based on World Health Organization reference values (WHO, 2000)

DISCUSSION

In recent years, the obesity pandemic has caused serious increases in morbidity and mortality in both developed and developing countries. With the increase in obesity prevalence, there has been an increase in the frequency of diseases linked to obesity (Kalan and Yeşil, 2010). The priority practices in the struggle against obesity are calorie control of nutrition and regular physical activity. In line with this, national and international health institutions have completed studies with the aim of creating awareness about physical activity to prevent obesity in society (WHO, 2021). In our study, during the COVID-19 pandemic, it was revealed that highest step counts were in the obese group, followed by the overweight group. The higher step counts for the obese and overweight groups are thought to be due to obese and overweight individuals being in the risk group due to chronic disease during COVID-19. The probability of greater effect from the coronavirus may have increased health anxiety among these individuals and as a result they achieved higher step counts compared to underweight and normal weight individuals. During the pandemic, no significant differentiation was identified between the perceptions of neighborhood environment in terms of body composition ($p>0.05$, Table 4). As mentioned previously, it is thought that sudden precautions because of the pandemic affecting the world in general and society being unprepared for this pandemic may have impacted this situation.

When the correlations between the NEWS subscales and physical activity are investigated, there were low and moderate significant correlations between built environment factors and physical activity. Similarly, Ewing and Cervero (2010) reported that street density and distance to close shops and services were strongly associated with walking for access. Yang et al. (2019) did not find consistent evidence about a correlation between any built environment feature with higher bicycle use for entertainment purposes; however, they found an association with the usability of cycle paths. The results obtained by McGrath et al. (2015) in studies researching the correlation between built environment and physical activity among young people found that the correlations between built environment features designed to encourage walking or playing and physical activity

changed according to age. Three studies focusing on correlations between the built environment and physical activity of elderly adults (Barnett et al., 2017; Cerin et al., 2017; Van Cauwenberg et al., 2018) found significant positive correlations between total walking and walkability, availability of shops and services in the neighborhood and access to public transport in the neighborhood. Finally, access to facilities had a significant positive correlation with total physical activity; however, it was not associated with walking (Barnett et al., 2017; Cerin et al., 2017; Van Cauwenberg et al., 2018).

Restrictions to social life during the COVID-19 pandemic are known to cause a fall in the physical activity levels of individuals. Scientific data supporting this view are presented in the literature. Restrictions implemented in spring 2020 were reported to significantly reduce the physical activity levels of people in England (Strain et al., 2022). Instantaneous data obtained from FitBit users showed lower daily step counts in countries implementing stay-at-home rules (FitBit, 2020). Considering all of these, the results of our study did not find a statistically significant correlation between perceptions of walkability of the neighborhood environment with physical activity because of restrictions and increased time spent at home. This situation is thought to be a result of the pandemic precautions and the fall in general physical activity levels. The different health concerns of people may have suppressed walkability perceptions about the neighborhood environment.

Opportunities to participate in physical environment are related to the physical environment. The availability and accessibility of PA facilities and programs are associated with people's exercise behavior (Mullineaux et al., 2001). The easiest way for individuals to be physically active is to walk. The results of our study confirm this. There was a positive significant correlation between the step counts of physically active individuals. Individuals who walked had increased physical activity points (Figure 2). A study by Ewald et al. (2010) found a correlation between physical activity with step counts. A way to ensure that walking becomes regular is to include this activity in daily life. There is a need for built environment features to sustain this process in a healthy and continuous way.

The COVID-19 pandemic emphasized the importance of regular physical activity for health and fitness one more time. People focused more on their homes and close environment and searched for different solutions to remain active in these spaces. Walkability perceptions of the close environment, natural areas and social support have important roles to protect human health, to reduce stress and to improve general welfare. In this period, it is important during urban planning and policy-making to encourage walkable neighborhoods, to increase access to green spaces and to provide opportunities for people to be able to do physical activity close to their homes. In this process, great responsibilities fall to local administrations. It is necessary to improve situations like walking and cycle paths, street connections, access to facilities, esthetics of the environment, and to reduce traffic danger and crime safety in the environment. According to the results of our study, the most important reasons for the lack of expected effect of the built environment features on physical activity and walking during the COVID-19 pandemic appear to be the precautions taken by country administrations and situations like the threat and uncertainty induced by the pandemic.

Conflict of interest

There is no personal or financial conflict of interest within the scope of the study.

Ethics Committee

The study was approved by the Scientific Research Ethics Committee of Çanakkale Onsekiz Mart University with the decision of 04/01/2021 and number 01/03

Author Contributions

Planned by the author: Study Design, Data Collection, Statistical Analysis, Data Interpretation, Manuscript Preparation, Literature Search. Author have read and agreed to the published version of the manuscript.

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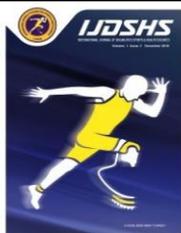
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RESEARCH ARTICLE

The Effect of Core Training Practices on Some Strength, Lower Limb Functions and Balance Performance in Judo Athletes

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Abstract

This study investigates the effects of core training on some strength, lower extremity functions, and balance performances in judoka. The study was based on a two-group pretest-posttest experimental design with repeated measures. The study included 12 female (F) judo athletes aged 12-18 years and 10 male (M) judo athletes aged 12-17 years. Three measurements for core strength (push-ups, planks, sit-ups), six different single leg hop tests (SLHT) for lower extremity muscle strength and YBT for balance were performed before and after 6-week core training. Shapiro-Wilk, Levene, and Paired sample t-tests were used in statistical analyses. The increases in limb symmetry index (LSI) scores were remarkable. When the push-up and plank times and sit-up scores of F and M participants were compared with the pre-test, a significant increase was observed in favor of the post-test. When we examined the dominant (D) leg hop for distance, we found that M and F judoka's SL_D, TH_D, MSTH_D, MRH_D, and CH_D post-test scores all increased (except F; CH_D) and also M and F showed better performance in SL6M_D. Similar performance outputs were seen in the non-dominant (ND) leg hop for distance measurements (only not changed F; TH_{ND}). Finally, it was valuable to note that both right and left leg YBT scores showed a considerable rise in the post-test assessments. As a result, core exercise practices may improve the sit-up score by improving the time in push-ups and planks in judoka. In addition, it may improve balance performance by affecting lower extremity functions.

Keywords

Core Training, Combat Sports, Limb Symmetry Index, Judo, Hop Tests, Y Balance Test

INTRODUCTION

Judo is a complex martial art in which competitors must constantly maintain control of their dynamic stance and have effective balance control in response to unexpected moves made by their opponents (Barbado et al., 2016; Perrin et al., 2002; Yoshitomi et al., 2006). Many different parameters such as speed, anaerobic power, lower

and upper extremity strength, and trunk muscle function are effective in a successful judo performance (Franchini et al., 2011; Iwai et al., 2008). Among these parameters, balance and lower extremity muscle strength are especially important in specific movements such as various throwing and pulling techniques (Acar and Yilmaz, 2021). The core is defined as an anatomical cage containing various muscles in the

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anterior (rectus abdominis), lateral (internal and external obliques), posterior (erector spinae, lumbar multifidus, and quadratus lumborum), upper (diaphragm) and lower (iliac psoas) sections (Akuthota and Nadler, 2004; Shinkle et al., 2012).

Core muscles are mainly responsible for trunk stabilization and balance, as well as being involved in the transmission of forces generated in the lower and upper extremities (Joyce and Kotler, 2017; Kibler et al., 2006). Various training programs are used in the development of core muscles (Martuscello et al., 2013). Core strength training ensures that the body has a balanced distribution of force (Kabadayı et al., 2022). At the same time, the development of core strength contributes to performance, especially in sports such as judo, where balance, lower and upper limb strength, and complex technical skills are intensively involved (Chok, 2020; Van Dieën et al., 2012). Improved lower extremity muscle strength, which is a requirement of judo sport, also increases the balance performance of the athlete (Drid et al., 2015; Franchini et al., 2011).

Although there are many different methods in the evaluation of lower extremity muscle strength and function, which is an important parameter in sporting success, one of the most commonly used methods is single leg hop tests (SLHTs) (Reid et al., 2007). SLHTs have many advantages such as minimal time requirements, ease of implementation, and functionality (Guild et al., 2021). SLHTs allow the assessment of lower limb muscle strength as well as inter-limb asymmetries (Noyes et al., 1991). While traditional SLHTs include only straight and forward movements, there are also tests with multidirectional movements, such as the 90° medial rotation hop for distance (MRH) and medial side triple hop for distance (MSTH), where researchers reported increased rates of asymmetry compared to traditional tests (Dingenen and Gokeler, 2017; Gokeler et al., 2017). In addition, the importance of using at least two SLHTs applied in different directions in the evaluation of lower extremity strength and asymmetries was emphasized by various researchers (Augustsson et al., 2004; Dingenen et al., 2019). In addition to lower extremity muscle strength, balance, which must be maintained throughout the competition, is also very important in a successful judo performance (Heitkamp et al.,

2002). There are many different methods for functional assessment of balance performance (Coughlan et al., 2012; Plisky et al., 2009). Y balance test (YBT) is one of the widely used tests for the assessment of lower limb performance and dynamic balance (Shaffer et al., 2013). In addition to being efficient in terms of time and implementation, YBT allows the assessment of asymmetric balance in three directions, anterior (ANT), posteromedial (PM), and posterolateral (PL) (Plisky et al., 2009).

Although there are several studies in the literature in which training programs for core muscles were applied with various subject groups and lower extremity strength and balance performance were evaluated, there are no studies in which both parameters were evaluated together (Cai, 2022; Martins et al., 2019; Meierbachtol et al., 2017). In Judo, where lower extremity strength and balance are at the forefront, it is thought that improved core strength will make significant contributions to performance components. When this information was evaluated, the study aimed to investigate the effect of a 6-week core training program applied to female and male judo athletes on core and lower extremity strength and balance performances of the athletes. The study hypothesized that the core training program would contribute positively to the lower extremity strength and balance performances of female and male judo athletes.

MATERIALS AND METHODS

Experimental Design

This study was based on a two-group pre-test/post-test experimental design with repeated measures. When the judoka came to the laboratory for the first time, their age, weight, height, BMI levels, and information about their age were recorded. Then, information was given about the core exercise practices to be applied for 6 weeks (Table 1). Judoka who voluntarily agreed to participate in the study were introduced to the tests and allowed to practice. The judokas came to the laboratory 4 times in total for both the pre-test and the post-test. When the judoka came to the laboratory for the first time, their time data in push-ups, planks, and sit-ups were recorded, on the second visit, the score of the SLHT with the D leg (SLHT_D) on the third visit, the scores of the

SLHT with ND leg (SLHT_{ND}) and on the fourth visit, the scores of the YBT test were recorded. The same procedure was followed for the post-test measurements. The conduct of this research was approved by the Van Yüzüncü Yıl University Ethics Committee with session 2023/18, decision 16 and document number 16813.

Subjects

According to G-power, the minimum sample size required to detect a significant difference using this test should be at least 10 in each group (20 in total), given a type I error (alpha) of 0.05, a power (1-beta) of 0.8, an effect size of 1.38 and a two-sided alternative hypothesis (H1). Therefore, twelve F participants aged 12-18 years (age 15.00 years, weight 57.00 kg, height 1.65 m, and BMI 20.93 kg/m²) voluntarily participated in the study. F participants had been practicing judo for an average of 5.66 years. Ten M participants aged 12-17 years (age 14.40 years, weight 63.70 kg, height 1.70 m, and BMI 21.78 kg/m²) voluntarily participated in the study. M participants had been practicing judo for an average of 3.30 years. All participants had no health problems or neuromuscular diseases in both D and ND legs. All participants signed a consent form before starting the study.

Procedures

All judoka ended their exercise practice 24 h before the SLHT and YBT test measurements to eliminate delayed muscle soreness (DOMS) exposure. On the first day of the post-test measurements, dynamic (push-ups and sit-ups) and static strength (planks) time scores of all athletes were recorded. On the second day, SLHT_D scores and on the third day, SLHT_{ND} scores were measured and recorded. Functional SLHT tests consisted of SL, TH, CH, MSTH, and MRH. On the final day, YBT test scores were obtained for balance measurements of all athletes. The YBT test consisted of three different directions as ANT, PL, and PM.

Single Leg Hop Tests (SLHT)

The starting lines in the practice area in SLHTs were 5 cm wide, while the horizontal long line at the start was 30 cm. The length of the vertical hop line from the center of this line was 6 m. Each hop test was performed three times and each score was recorded. After each hop, the athlete rested for 2 min. Athletes were allowed to use arm and leg movements while on a single leg,

before and during the movement. The success standard in the tests was accepted as 3 seconds.

Single and Triple Hop for Distance (SL and TH)

The athletes were standing on one leg with their toes in the middle and on the border of the starting line. In SL, athletes were asked to take the best step forwards while standing on one leg. In the TH, they were asked to make the best possible, consecutive three-step hop forwards. The athletes were asked to complete the forward movement on one leg at a predetermined line and wait in this position for three seconds. The distance between the heel level and the starting line of the athletes who completed the test was measured and recorded in cm (Munro and Herrington, 2011).

Crossover Triple Hop for Distance Test (CH)

Athletes stood on one leg at the starting line and performed three hops forwards. Step diagonally to the opposite side of the leg used in the first hop and continue laterally to the dropped side (Peebles et al., 2019).

Medial Side Triple Hop for Distance Test (MSTH)

The athletes had one leg in the middle of the baseline and the medial part of the leg at the baseline borderline. They were asked to take the best three hops in the medial direction with one leg on the line and wait for 3 seconds when they reached the third step. The distance between the medial level of the leg and the baseline of the athletes who were considered successful was measured and recorded in cm (Kivlan et al., 2013; Reid et al., 2007).

90° Medial Rotation Hop For Distance Test (MRH)

The athletes had one leg in the middle of the baseline and the medial part of the leg at the border of the baseline. They completed the movement with right-angled medial rotation by taking the best single step forward in the medial direction on one leg and holding this position for 3 seconds. The distance between the heel level and the baseline of the athletes who were considered to be successful in the test was measured and recorded in cm (Kivlan et al., 2013; Reid et al., 2007).

6m Timed Hop Test (SL6M)

Athletes stood on one leg behind the photocell at the starting line and hopped on one leg along the 6-meter tape, trying to finish as fast as they could.

The test ended with the athletes passing the photocell at the end of the 6-meter band. All athletes were tested 3 times and rested for 2 minutes at the end of each test (Yilmaz and Kabadayı, 2022).

Y Balance Test (YBT)

YBT assesses dynamic balance in ANT, PL, and PM directions. The floor was marked in 3 different directions (λ-shaped) with a 15 cm wide tape. The angle between the ANT, PM, and PL strips was 135 degrees and the angle between the two posterior strips was 90 degrees. The athletes participating in the YBT test were asked to place their stance leg in the zero mark position, reach out with the other leg as far as possible in the reach direction and then bring the extended leg back to the starting point. ANT score points were from the toe of the stance leg to the point reached, while PL and PM score points were from the heel of the stance leg to the point reached. If the athletes could not maintain their balance or could not bring

the outstretched leg back to the stance leg after reaching the maximum reach distance, the trials were considered unsuccessful and the measurement was repeated. Each athlete performed three barefoot trials in each direction (ANT, PL, and PM) (Plisky et al., 2006, 2009).

Statistical Analyses

All statistical analyses were carried out using SPSS 21 (Statistical Package for the Social Sciences) package program. Descriptive data in the current study were expressed as mean, standard deviation (SD), minimum (Min), and maximum (Max). Shapiro-Wilk test, histogram graphs, Q-Q plot, kurtosis, and skewness ranges were examined to test the normal distribution of the data. The independent sample t-test was used to determine pre-test or post-test differences between genders. Paired sample t-test was used for pre-post test comparisons within genders. Significance was evaluated as $p < 0.05$ with 95% confidence intervals.

Table 1. This is shows 6 weeks of core exercise practices

Weeks	Monday	Wednesday	Friday
I	plank, push-up, reverse crunch, bird dog, basic squat	plank, push-up, reverse crunch, superman, basic squat	plank, push-up, back bridge, toe taps, earthquake
II	side plank, sit-ups, bird dog, toe taps, squat leg raise	side plank, sit-ups, back bridge, T stabilization, single-leg squat	side plank, sit-ups, bird dog, squat with cross leg raise
III-IV	plank, push-up, T stabilization, squat with single leg squat	plank, push-up, reverse crunch, superman, squat with cross-leg raise	plank, push-up, reverse crunch, superman, back bridge, squat leg raise
V-VI	side plank, sit-ups, back bridge, squat with cross leg raise	side plank, sit-ups, reverse crunch, superman bird dog, squat leg raise	side plank, sit-ups, toe taps, T stabilization, single leg squat
Warm-up min/hr (10 min)			
aerobic running, active warm-up (Leg and arm rotation, lunges, squat pulses, etc.)			
Main training session min/hr (30- 40 min)			
Cool down min/hr (10 min)			
flexion, rotation, extension, and stretch of regions and muscles such as the lumbar, hamstring, hip adductors, gluteal and rotator muscles, hip abductor, soleus, triceps, pectoral muscles, biceps, supraspinatus			

According to Table 1, each movement consisted of 2 sets of 3 repetitions. The duration of the movement was between 15-20 seconds in the first week. Until the sixth week, the progress of the athletes was observed and the principle of increasing loading was obeyed. The duration of

the movement in the last exercise intervention was between 40-50 seconds. The rest between sets was set to be 2 minutes. Rest between repetitions was modeled as 1:4 in the first week, 1:3 in the second week, 1:2 in the third week, and 1:1 from in the fourth to sixth week.

RESULTS

According to Table 2, the F participants had an average age of 15 years, weight of 57, height of

1.65, BMI of 20.93, and training age of 5.66, while the M participants had an average age of 14.4 years, weight of 63.7, height 1.70, BMI 21.78 and training age 3.30.

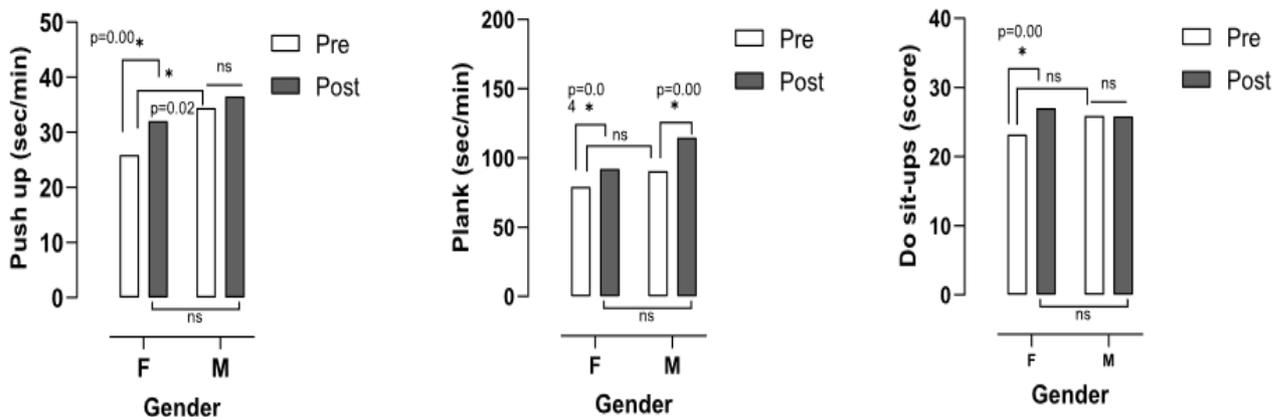
Table 2. This is descriptive data of subjects (at column width)

Gender		Mean	SS	Min.	Max.
Female (12)	Age (year)	15.00	2.33	12.33	18.00
	Weight (kg)	57.00	6.81	50.81	74.00
	Height (m)	1.65	0.04	1.60	1.73
	BMI (kg/m ²)	20.93	1.92	19.05	24.73
	Training Age (year)	5.66	2.88	2.00	13.00
Male (10)	Age (year)	14.40	2.22	12.00	17.00
	Weight (kg)	63.70	7.13	52.00	75.00
	Height (m)	1.70	0.04	1.65	1.76
	BMI (kg/m ²)	21.78	1.99	19.10	24.34
	Training Age (year)	3.30	1.56	1.00	5.00

SD: Standard deviation; Min: Minimum; Max: Maximum; BMI: Body mass index.

According to Figure 1, there was a significant difference in F pre-test/post-test push-up, plank, and sit-up scores. M participants were not significantly different in pre-post push-up and sit-up scores, but there was a significant difference between plank pre-post scores.

When comparing the pre-test scores between F and M, there was a significant difference in push-up scores, but there was no significant difference between planks and sit-ups. Finally, there was no significant difference between F and M in all post-test scores.

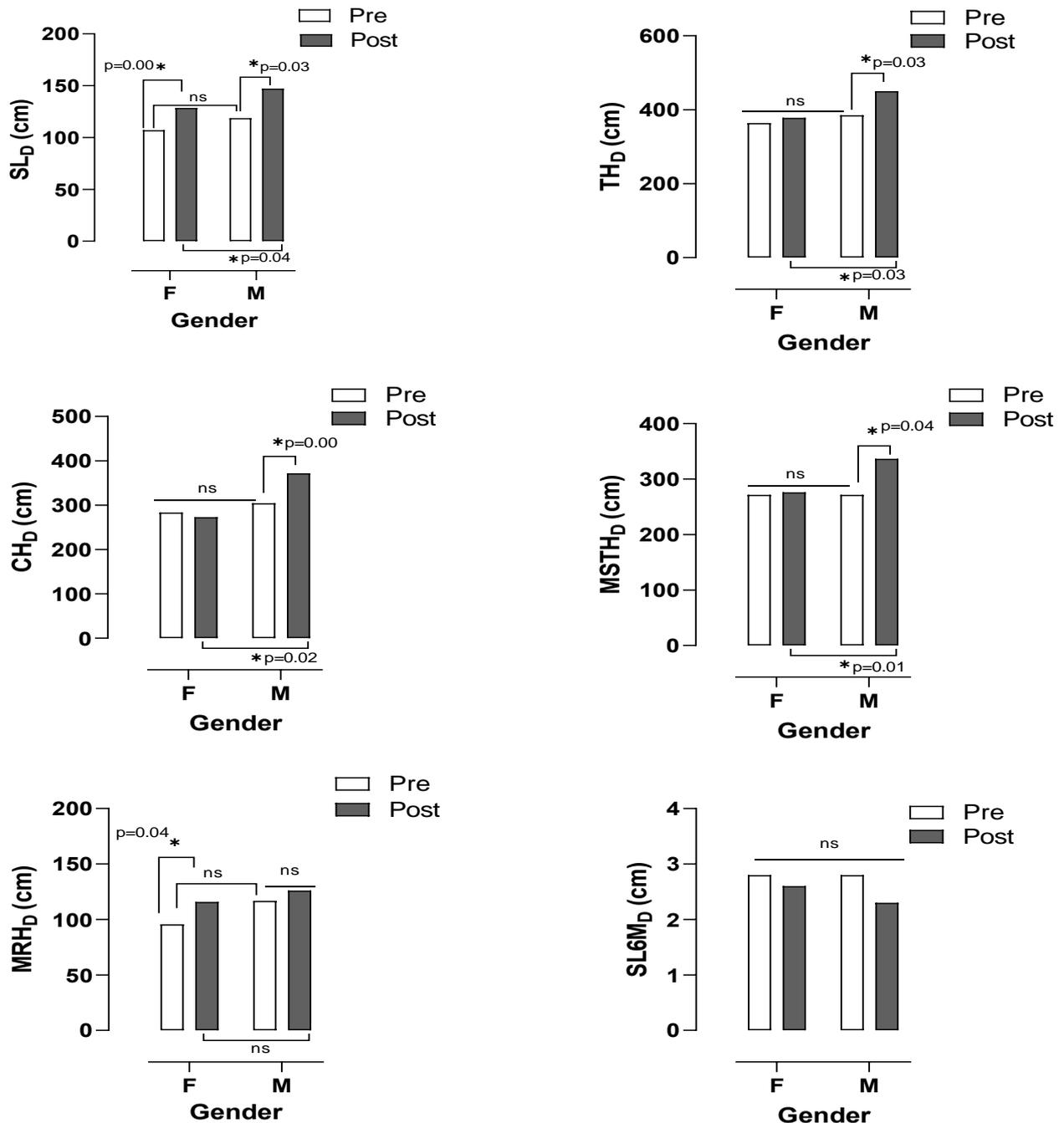


*: $p < 0.05$; ns: non-significant; F: female; M: Male; t: independent sample t test.

Figure 1. This is shows the athletes' push up, plank time, and sit-ups scores

According to Figure 2, there was a significant difference in F pre-post SL_D and MRH_D scores, while there was no significant difference in TH_D , CH_D , $MSTH_D$, and $SL6M_D$ scores. When M pre-post SL_D , TH_D , CH_D , and $MSTH_D$ scores were compared, there was a significant difference, but no significant difference in MRH_D and $SL6M_D$ scores. There was also no significant difference

between F and M when the pre-test SL_D , TH_D , CH_D , $MSTH_D$, MRH_D , and $SL6M_D$ scores were compared. Post-test MRH_D and $SL6M_D$ scores between F and M were not significantly different. However, there was a significant difference between F and M when post-test SL_D , TH_D , CH_D , and $MSTH_D$ scores were compared.

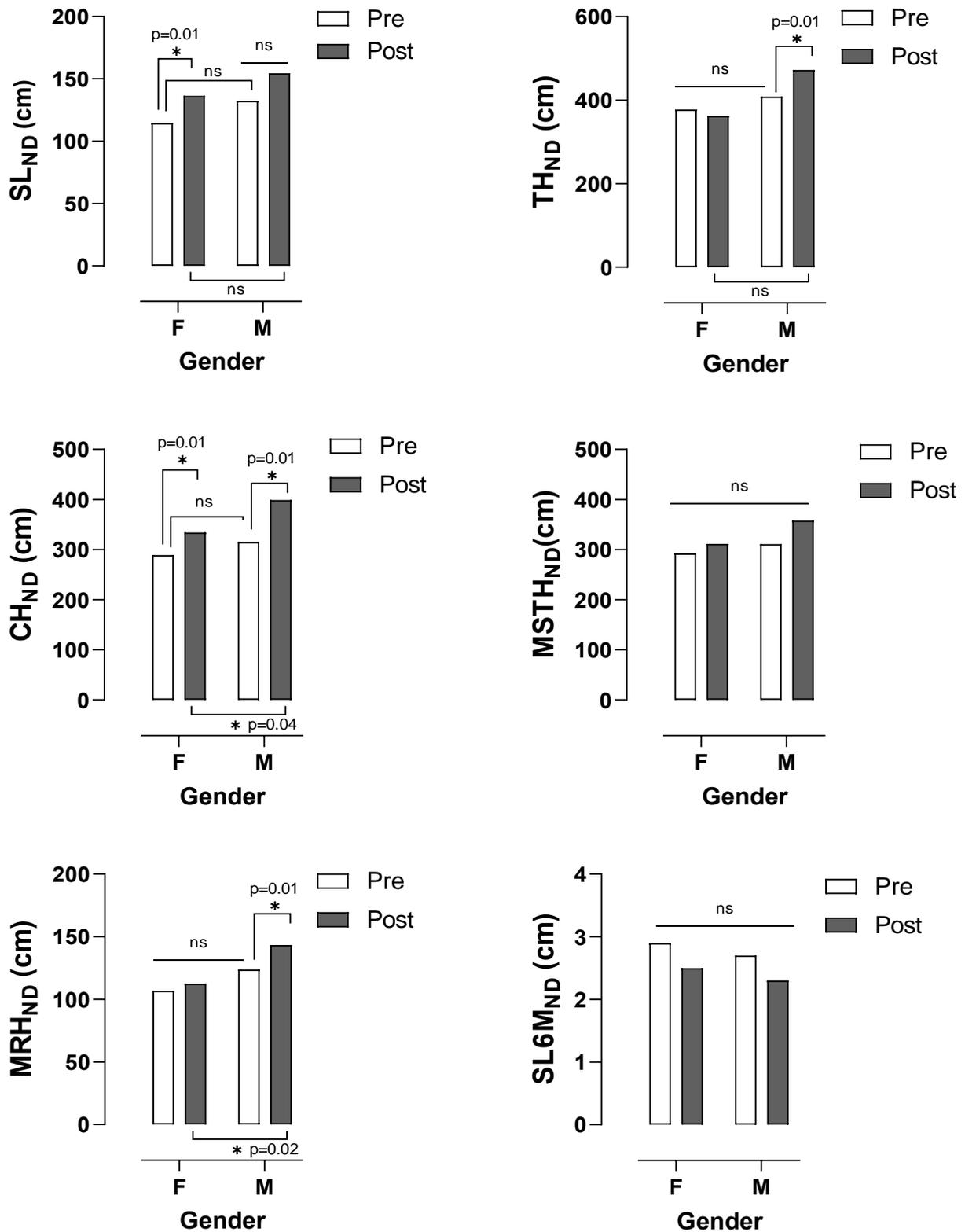


*: $p < 0.05$; ns: non-significant; F: female; M: male; t: independent sample t-test; SLD: single leg for distance; THD: triple hop of distance; CHD: crossover triple hop for distance; MSTHD: medial side triple hop for distance; MRHD: 90° medial rotation hop for distance; SL6MD: single leg 6 meter.

Figure 2. This is shows the differences in D leg hop for the distance between genders

According to Figure 3, there was a significant difference in F pre-post SL_{ND} and CHD_{ND} scores, while there was no significant difference in TH_{ND} , $MSTH_{ND}$, MRH_{ND} , and $SL6M_{ND}$ scores. When M pre-post TH_{ND} , CH_{ND} , and MRH_{ND} scores were compared, there was a significant difference, but no significant difference in SL_{ND} , $MSTH_{ND}$, and $SL6M_{ND}$ scores. There was

also no significant difference between F and M when the pre-test SL_{ND} , TH_{ND} , CH_{ND} , $MSTH_{ND}$, MRH_{ND} , and $SL6M_{ND}$ scores were compared. Post-test SL_{ND} , TH_{ND} , $MSTH_{ND}$, and $SL6M_{ND}$ scores between F and M were not significantly different. However, there was a significant difference between F and M when post-test CH_{ND} and MRH_{ND} scores were compared.



*: $p < 0.05$; ns: non-significant; F: female; M: male; t: independent sample t-test; SL_{ND}: single leg for distance; TH_{ND}: triple hop of distance; CH_{ND}: crossover triple hop for distance; MSTH_{ND}: medial side triple hop for distance; MRH_{ND}: 90° medial rotation hop for distance; SL6M_{ND}: single leg 6 meter.

Figure 3. This is shows the differences in ND leg hop for the distance between genders

According to Table 3, there was no significant difference when the pre-post and pre* post-LSI scores of M and F were compared. However, there

was a significant difference only in the MSTH_{LSI} post-test score.

Table 3. This is shows the differences in the limb symmetry index (LSI) between genders

	Gender	Pre			Post			Pre*Post		
		Mean±SD	t	p-Value	Mean±SD	t	p-Value	t	p-Value	
LSI Score	SL	Female	92.7±9.5	.631	0.53	95.4±14.4	-.409	0.68	-.505	0.62
		Male	88.9±17.8			98.3±18.8				
	TH	Female	96.3±7.6	.800	0.43	96.4±7.3	-.201	0.74	.330	0.74
		Male	94.1±4.7			96.1±11.0				
	CH	Female	94.5±13.6	-.533	0.60	94.8±24.2	-1.150	0.26	1.362	0.20
		Male	97.0±7.0			99.9±6.3				
	MSTH	Female	93.2±11.7	.279	0.78	93.7±8.3	-3.013	0.00*	.959	0.35
		Male	91.9±8.9			100.1±9.4				
	MRH	Female	93.8±7.0	.131	0.87	94.6±6.2	.147	0.88	-.136	0.89
		Male	93.0±11.3			94.2±6.6				

*: p<0.05; SD: standard deviation; Pre t: between-gender; post t: between-gender; Pre*Post t: within-gender; SL: single leg for distance; TH: triple hop of distance; CH: crossover triple hop for distance; MSTH: medial side triple hop for distance; MRH: 90° medial rotation hop for distance.

According to Table 4, there wasn't a significant difference in the pre-post and pre*post scores of the participants' right leg YBT (ANT, PL, and PM). However, there was a significant difference in PL post-test scores. In addition, a significant difference was found between M and F when the post-test scores of right leg YBT (ANT, PL, and PM) were compared. In addition, a significant difference was found between men and

women when the total post-test scores of the right foot YBT (ANT, PL, and PM) were compared. When we analyzed the results of the left leg YBT (ANT, PL, and PM), the pre-test and post-test ANT scores were significantly different between M and F. However, there was not any significant difference in the comparison of the other YBT (ANT, PL, and PM) and the total score.

Table 4. This is shows the reaching distances of the right and left legs (ANT, PL, and PM) in YBT.

	YBT	Gender	Pre			Post			Pre*Post
			Median (Min-Max)	t	p-Value	Median (Min-Max)	t	p-Value	p-Value
Right Leg	ANT	Female	59.3 (54.33-76.00)	-1.024	0.36	59.5 (48.00-77.33)	-1.601	0.11	0.83
		Male	65.0 (57.00-81.33)			66.3 (47.33-87.67)			
	PM	Female	56.1 (50.33-73.33)	-.996	0.37	59.8 (44.33-88.33)	-1.110	0.12	0.40
		Male	61.8 (55.67-81.33)			68.3 (42.67-89.00)			
	PL	Female	51.8 (47.67-72.67)	-1.449	0.22	55.3 (38.00-72.00)	-1.217	0.04*	0.53
		Male	55.8 (51.00-65.00)			66.1 (42.67-87.33)			
Total Score	Female	56.7 (51.80-59.30)	-2.091	0.10	58.2 (55.32-59.89)	-5.525	0.00*	0.32	
	Male	64.8 (55.80-65.00)			66.9 (66.11-68.35)				0.76
Left Leg	ANT	Female	54.5 (44.33-80.33)	-2.849	0.04*	60.3 (49.00-75.33)	-4.221	0.03*	0.30
		Male	68.6 (47.33-79.00)			71.5 (48.00-80.33)			
	PM	Female	58.3 (40.33-83.00)	-.945	0.39	60.1 (44.00-80.67)	-.941	0.22	0.51
		Male	65.1 (46.67-77.67)			68.5 (38.00-93.67)			
	PL	Female	51.6 (40.33-80.00)	-1.657	0.17	51.0 (43.33-82.00)	-.703	0.76	0.40
		Male	60.5 (45.67-79.33)			60.6 (40.33-93.33)			
Total Score	Female	57.4 (51.61-58.30)	-1.094	0.33	56.4 (51.12-60.38)	-1.803	0.14	0.74	
	Male	64.7 (60.52-68.65)			66.2 (60.61-71.56)				0.63

*: p<0.05; YBT: Y Balance Test; Min: Minimum; Max: Maximum; ANT: Anterior; PM: Posteromedial; PL: Posterolateral.

DISCUSSION

When the main findings of our study are evaluated, the results are as follows; the post-test scores of Fs in push-ups, plank, and sit-ups increased significantly. In M's, only the time in plank increased. When we compared F and M, while there was a significant difference in the pre-test scores in push-ups, this difference closed in the post-test and the duration of F's stay in push-ups reached a similar level with E's. F's SL_D and MRH_D and M's SL_D , TH_D , CH_D , $MSTH_D$ D leg hop for distance posttest scores increased significantly. When we compare F and M, SL_D , TH_D , CH_D , $MSTH_D$, MRH_D , and $SL6M_D$ D leg hop for distance pre-test scores were similar, while M's SL_D , TH_D , CH , CH_D , $MSTH_D$ post-test scores increased significantly compared to F's. F's SL_{ND} and CH_{ND} , M's TH_{ND} , CH_{ND} , and MRH_{ND} ND leg hop for distance posttest scores increased significantly. When we compared F and M, SL_{ND} , TH_{ND} , CH_{ND} , $MSTH_{ND}$, MRH_{ND} and $SL6M_{ND}$ pre-test scores were similar, while M's CH_{ND} and MRH_{ND} post-test scores increased significantly compared to F's. When LSI scores between F and M were evaluated, there was a significant difference only in $MSTH$ posttest scores and M judoka's $MSTH$ scores increased more than F's. While there was a significant difference between F and M YBT right leg posttest total scores, there was no significant difference between right leg posttest total scores. In addition, M's both right leg PL and left leg ANT scores increased significantly more than F's. In general, there were significant increases in some test scores, while there was no significant increase in some test scores. However, when all test measurements of F and M were evaluated, post-test measurements were scored higher than pre-test measurements. Therefore, core exercises improved strength functions such as push-ups, planks, and sit-ups, as well as LSI scores in the lower extremities and YBT dynamic balance functions.

Core stability increases trunk flexion angle, vastusmedialis and vastuslateralis muscle activation ratio, and quadriceps (H:Q) coactivation ratio, while decreasing knee valgus and hip adduction angles (Jeong et al., 2021) may alter motor control strategies and joint kinematics of the trunk and lower extremities. There may also be a strong relationship between core stability and dynamic balance stability (Barrio et

al., 2022). A recent study reported that an eight-week core exercise program improved the biomechanics of the lower limbs and trunk (Sasaki et al., 2019). In an experimental study with 40 athletes with trunk instability, it was reported that the trunk stability of athletes increased after nine weeks of core training (Sharma et al., 2012). In a different study, an increase in the retention time of core exercises horizontal bar pull-ups, sit-ups, and push-ups was observed compared to baseline (Chen et al., 2023). In a study with adolescent male handball players, six weeks of core exercises showed significant improvements in dynamic balance (Ozmen et al., 2020). In 29 female soccer players, eight weeks of core exercises significantly decreased frontal plane projection angle (FPPA) in dynamic landing in both D and ND lower extremities, increased knee flexion and peak hip angle, and significantly increased both bilateral and unilateral jumps in the experimental group compared to the control group (Ferri-Caruana et al., 2020). A meta-analysis of 13 studies found that individuals who participated in core programs improved dynamic balance stability (DBS) and developed a more solid and balanced base for lower extremity movements (Barrio et al., 2022). In a study of 16 male junior high school volleyball team players, the posttest measurements of the athletes demonstrated decreased trunk flexion angle during the box landing task and reduced maximum knee internal rotation angle during the spike jump landing task. In the same study, it was reported that the average isokinetic power of hip flexors and extensor rotators and knee flexors and extensors increased significantly (Tsai et al., 2020).

SLHT usually assesses movement in the forward direction to determine functional performance. This movement involves taking one or more steps in any direction with the same foot and keeping the other foot (pivot foot) in contact with the ground (Dingenen et al., 2019). In this context, in combat sports such as judo, where balance and body stabilization are at the forefront (Akdemir et al., 2022) We have the opinion that core exercise practices will be effective in increasing the functional performance scores of SLHT. Especially, the increases in the post-test scores of SLHT and LSI in the study are noteworthy because they make a significant contribution to the development process of

balance and body stabilization. Because Barbado et al (2016) stated that some physical and physiological characteristics should be dominant in judo where competition is of great importance and also pushing, pulling, and different techniques (throws, pins, chokes, arm bars, etc.) are intensively applied. This statement is associated with the ability to perform judo-specific movements correctly and efficiently with different contractions that often differ in kinesiological terms, skeletal muscles being strong enough, and body stabilization during training or competition (Franchini et al., 2005). In another aspect, having core stabilization in judo players during the execution of important movements such as pushes and pulls can reduce or eliminate both the power imbalance and the risk of injury (Ermiş et al., 2019; Thomeé et al., 2011). When we look at recent studies, it was stated that although LSI scores were not significant after 8 weeks of core practices in 24 professional athletes with anterior cruciate ligament reconstruction, the increases in post-test scores were worthwhile. In addition, the positive effect of core practices on reducing inter-limb asymmetries during SL and TH tests was noted and it was determined that functional performance was more symmetrical after core stability exercises (Fallah Mohammadi et al., 2022). A study of women with and without patellofemoral pain (PFP) reported a positive correlation between anterior and lateral trunk muscle endurance and performance on SLHT in patients without PFP (Botta et al., 2021). Following 6 weeks of core training with adolescents on core strength on fixed and non-fixed surfaces, it was reported that ventral and the lateral left chain following dorsal trunk muscle strength increased significantly in the core group (Granacher et al., 2014).

Upper and lower body strength and endurance, speed, anaerobic power, and trunk muscle function are important factors for success in judo competitions (Franchini et al., 2011). In relation to trunk muscle function, improving trunk strength and endurance will enable judo practitioners (judoists) to increase their ability to generate and sustain force throughout a fight. Hence, core stability is the ability to transfer the forces generated by the lower body to the upper body (and vice versa) during judo techniques (Kibler et al., 2006) and balance control, which is a key factor in dealing with opponent-induced

disturbances (Van Dieën et al., 2012) can contribute to the judoka's performance as it will improve (Perrin et al., 2002). In this context, we used YBT to reveal the effect of core exercises on the dynamic balance performances of the judo athletes who participated in the study. In studies conducted with athletes in different branches, it was emphasized that YBT is an important guide in predicting lower extremity injuries and time to return to sports, and the functional dynamic abilities of athletes. In the current study, it is noteworthy that there was an increase in all of the right and left foot YBT post-test scores, although it was not significant. In addition, the increase in the right foot PL and total scores of the M's was greater than that of the F's. In the left foot, there was a similar increase in all of the YBT posttest scores, and also the ANT score of the M judoka was significantly higher than that of the Fs. Although it was not significant in the current study, we think that this increase in post-test scores is related to core exercise practices. When we look at the previous studies, it was found that the distance reached in the Star Excursion Balance Test (SEBT) improved significantly from the post-test in the group with 15 healthy participants and a 6-week core stability intervention (Filipa et al., 2010). Another evaluation of a similar improvement in SEBT performance was observed in junior netball athletes (Kahleand Gribble, 2009). In the group with 12-week trunk stabilization exercises, there was a significant group-time interaction in SEBT PL and PM directions and significant improvements in static balance scores (Imai et al., 2014). Again, it was found that core intervention applied to 28 elite basketball players for 8 weeks in addition to their normal training routines improved their ICT dynamic balance development by affecting postural control and lower extremity stability (Benis et al., 2016). In recent studies, 8 weeks of core intervention in elite youth skiers showed significant improvements in both lower extremities according to the combined score of AN, PM, PL, and YBT (Vitale et al., 2018). According to the results of the 8-week core stability program applied to college athletes, not only the functional movement patterns of the participants improved, but also their dynamic postural control increased (Bagherian et al., 2019). It was emphasized that core exercises performed 2 days a week for 8 weeks in adult

soccer players can be an important strategy for the balanced development of athletes (Belli et al., 2022). At the end of an 8-week intervention in which the effects of core exercise practices on balance were investigated in 30 deaf students, both dynamic and static balance development increased significantly according to the YBT test scores (Zarei and Norasteh, 2023).

Our study has certain limitations. These are that we did not have any control group except the core strength group. In addition, male and female judoka in the study were evaluated separately and therefore the number of subjects was low. Finally, although all core training of the subjects was performed under the supervision of the researchers, their daily diet and meals were not monitored.

Conclusion

Core exercise practices can maintain structural integrity and keep the balance of the vertebral column within physiologic limits by reducing the displacement caused by perturbations in the lumbopelvic-hip complex in Judo players. This may affect the development of dynamic balance in the lower limbs. In addition, development in the core may also reduce the risk of injury in Judoka by forming the basis of the kinetic chain responsible for facilitating the transfer of torque and momentum between the lower and upper extremities. Therefore, the development of core stability can give Judoka a significant advantage over their opponents in performing pushing, pulling, or different techniques such as throws, pins, chokes, arm bars, pushes and pulls, etc.

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Disclosure Statement

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Ethics Committee

The study was approved by the van yüzüncü yıl university social and human sciences publication ethics committee presidency with the decision of 07/07/2023 and number 2023/18

Author Contribution

YY, AKY conceived and designed the study, and conducted the research. Material preparation and data collection were performed by EA, BA, EK, and MPK. YY, AKY and SÖ performed the data analysis and statistical interpretation and wrote part of there sultssection. The first draft of the manuscript was written by YY, AKY and all authors commented on previous versions of the manuscript. All the authors have critically reviewed and approved the final draft and are responsible for the content.

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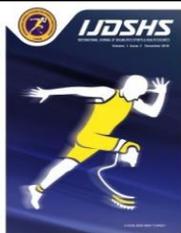
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RESEARCH ARTICLE

Evaluation of School Social Behaviors of Students with Special Needs From the Perspectives of Physical Education and Branch Teachers

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Abstract

This study aimed to evaluate the school social behavior of students with special needs from the perspective of physical education and branch teachers. The school social behavior scale was used in this study. The study was carried out by scanning method. The school social behaviors of 218 students in secondary school were evaluated by both their physical education and branch teachers according to their course performances. When the findings obtained in the research were evaluated, no significant difference was detected in the total and sub-dimensions of students' social competence in physical education and branch courses ($p>0.05$). Students' antisocial behavior, hostile- irritable scores and antisocial-aggressive scores in the physical education course were found to be significantly lower than in other branch courses ($p<0.05$). No difference was detected in the demanding-disruptive ($p>0.05$). According to the gender variable, a significant difference was found in favor of female students in the total and sub-dimensions of social competence in both physical education and branch courses ($p<0.05$). While there was a significant difference in the total and sub-dimensions of social competence of the students participating in school activities in physical education and other branch courses ($p<0.05$), there was no significant difference in the total and sub-dimensions of antisocial behavior ($p>0.05$). As a result, it was determined that the school social behaviors of students with special needs were similar in physical education and branch classes. It has been determined that students who participate in school activities have more positive school social behaviors.

Keywords

School Social Behaviors, Social Competence, Physical Education, Special Needs Student

INTRODUCTION

The term children with special needs is comprehensive. It covers those with learning disabilities as well as those with superior performance. In this context, the term children with special needs can be expressed as an integrative term (Akçamete, 2009). There are significant individual differences in children with special needs. Due to these differences, they need either special educational support or changes in school practices to develop their unique abilities (Sarı and Deniz, 2017). Many factors are effective in the education process of children with special needs.

Differences arising from students' special needs affect the success of the special education process (Demirci and Tzarova, 2021). Baykoç- Dönmez (2018) states that individuals in need of special education can start the education process appropriate for them through the diagnosis process. The diagnosis process is carried out in two ways: educational and medical. Emotional and behavioral problems, attention deficit and hyperactivity disorder, pervasive developmental disorders, autism, language and speech problems, visual impairment, hearing impairment, orthopedic, mental disability, specific learning

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disability, chronic diseases, gifted and special talents require special needs (Baykoç- Dönmez, 2018). Social skills have an important place in the education of individuals with special needs. Gül (2018) defined social skills as initiating and maintaining communication. In addition, the skills that enable conversation, social reinforcement, increase the probability of getting what you want, decrease the probability of encountering negative reactions or disappear completely are called social skills. In other words, social skills are defined as socially acceptable learned behaviors that children/individuals use in social environments, enabling them to interact effectively with the individuals around them and to avoid socially unacceptable behaviors (Gresham and Elliott, 1987; cited in Sazak-Pınar et al., 2012). In addition to academic skills, the development of social skills is also considered important in children's education. In the development of social skills, incidental learning and cognitive maturation are expected to develop together (Yılmaz, 2017). Social skills are one of the elements of social competence. Social competence is the ability of a person to use his/her social skills appropriately in necessary places, situations and times, and as a result, to be seen as socially competent by the people around him (Gül, 2018). The concept of social competence is the ability of individuals to engage in meaningful interactions with others in their (Junge et al., 2020). Children's social skills significantly affect their daily lives. These skills have a limiting effect on social adaptation, academic functioning, quality of life and many other factors (Fussell et al., 2005). In general, social skill deficiencies occur in two ways; some individuals have problems in learning different social skills, while others cannot use their existing skills in appropriate environments and situations (Serin, 2012). Individuals' deficiencies in social skills may not only affect them in aggressive behavior, but also cause them to display low social acceptability in society (Serin, 2012). The problems that individuals encounter in their social skills and social competence are effective in the emergence and continuation of many emotional and behavioral problems during childhood and adolescence (Spence, 2003). Students with disabilities may have fewer chances to communicate and interact socially with their peers in their environment (Odom, 2000; cited in More, 2008). Children's problems in social areas

negatively affect their daily lives (More, 2008). A child who does not have appropriate social skills is viewed by peers as an ineffective play partner, resulting in exclusion from peer group activities. The excluded child is limited in terms of social skills. It causes the child's skill level to be restricted by constant rejection or exclusion by peers with high skill levels, as well as active punishment of seemingly appropriate social behaviors (Campbell et al., 2010). It is important to help all children with poor social skills, and especially children with special needs, as early as possible to prevent the spiral of social rejection and failure from leading to anti-social behavior and emotional problems later in life. Children with special needs may be weak in terms of social skills. The fact that these children have poor social skills may cause them to be socially excluded by their peers. Excluded children may therefore show antisocial behavior. It is important to support these children at the youngest age possible. Children who are supported at an early age can gain skills in the social field. These children who receive help can demonstrate better social skills. In this way, they can establish basic friendships, be included in social life and be employed in the business field. Because if education starts at an early age, they can learn the accepted and unacceptable behaviors in society and behave accordingly (Csóti, 2001). This study will contribute to the literature by allowing the evaluation of the school social behavior of students with special needs from the perspective of physical education and other branch teachers. For this purpose, school social behaviors of students with special needs were evaluated from the perspective of physical education and branch teachers.

MATERIALS AND METHODS

Model of The Research

In the study, general screening model, one of the quantitative research methods, was used. The screening model is used in situations that require describing a phenomenon as it exists and in line with the purpose of the study (Karasar, 2000). This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Van Yuzuncu Yıl University of Social and Human Ethics Committee; 2023/12-03.

Population and Sample

The population of our study consists of students with special needs studying in the 5th, 6th, 7th and 8th grades in Van city center. However, the exact number of students with special needs could not be learned from the guidance research center. For this purpose, researcher visited schools and students with special needs who agreed to participate in the research were identified. A total of 218 students with special needs studying at the secondary school level (5th, 6th, 7th, 8th grade) in the 2022/2023 academic year constituted the sample of the study.

Data Collection Tools

The School Social Behavior Scale and a personal information form developed by the researcher were used in the study.

Personal Information Form

Based on the variables of the study, a personal information form was created for the participants. Regarding students with special needs, teachers are informed about students' gender, age, class, whether they participate in activities, etc. questions were asked.

School Social Behavior Scale

School social behavior scales, developed by Kenneth W. Merrell in 1993 and adapted to Turkish by Yüksel (2009), aim to rate the behavior of students in social and academic environments as well as the teachers' observation of students.

Scales Form A: Social Competence; thirty-two items and Form B: Antisocial Behaviors; thirty-three items. It contains a total of sixty-five items. Social Competence Scale; it consists of three sub-dimensions: interpersonal skills, self-management skills and academic skills. Antisocial Behaviors Scale; it consists of three sub-dimensions as hostile-irritable, antisocial-aggressive and demanding-disruptive. In our study,

cronbach's alpha internal consistency coefficient was examined for the reliability levels of the data. The results obtained are in the sub-dimensions of the scale; social competence was found to be .98, interpersonal skills .96, self- management .94, academic skills .93, antisocial behavior .98, hostile-irritable .95, antisocial-aggressive .95 and demanding-disruptive .91. These results showed that the data obtained from the study were reliable.

Data Collection

Necessary permissions were obtained from the ethics committee of the relevant university and the directorate of national education. Special needs students studying at secondary school level in Van were evaluated separately by branch and physical education teachers. The scales were delivered to the participants face to face and via google forms. The students were evaluated by the branch and physical education teachers using the same codes. Evaluations about the students selected as a sample were made by both branch and physical education teachers.

Analysis Of Data

The comparison of the data obtained from the study was analyzed with the statistical package program (SPSS). The normal distribution properties of the data were evaluated with the Kolmogorov-Smirnov test, and since the data did not show a normal distribution, non-parametric tests were used. Mann Whitney U test was used to compare two-level variables, and Kruskal-Wallis test was used to compare more than two groups. In this study, the level of significance was taken as $p < 0.05$.

RESULTS

The students participating in the study were 81 girls and 137 boys. The mean age of the students is 12.56 ± 1.47 .

Table 1. Social competence and antisocial behavior total scores and sub-dimension score evaluations by branch variable (Mann-Whitney U Test)

Variables		n	Rank Avg.	Rank Tot.	U	p
Social Competence	Physical Education	218	222,33	48467,00	22928,00	,526
	Other Branch	218	214,67	46799,00		
Interpersonal Skills	Physical Education	218	222,62	48530,50	22864,50	,495
	Other Branch	218	214,38	46735,00		
Self-Management skills	Physical Education	218	222,34	48470,50	22924,50	,524
	Other Branch	218	214,66	46795,50		
Academic Skills	Physical Education	218	219,89	47936,00	23459,00	,818

	Other Branch	218	217,11	47330,00		
Antisocial Behavior	Physical Education	218	205,57	44814,50	20943,50	,032
	Other Branch	218	231,43	50451,50		
Hostile-Irritable	Physical Education	218	205,62	44824,50	20953,50	,032
	Other Branch	218	231,38	50441,50		
Antisocial-Aggressive	Physical Education	218	203,01	44257,00	20386,00	,009
	Other Branch	218	233,99	51009,00		
Demanding Disruptive	Physical Education	218	208,67	45489,00	21618,00	,102
	Other Branch	218	228,33	49777,00		

As seen in Table 1, in the social competence dimension, there was no significant difference between the students' social competence total and sub-dimension scores in physical education and other branch courses ($p>0.05$). However, it was determined that the total and sub-dimensions of social competence were higher in physical education classes. When students' antisocial

behaviors were evaluated according to the branch variable, a significant difference was found between hostile-irritable and antisocial-aggressive behaviors ($p<0.05$). It was determined that students' antisocial behavior scores were lower in physical education class. There was no significant difference in students' demanding disruptive behaviors ($p>0.05$).

Table 2. Evaluation of students' social competence and anti-social behavior and sub-dimension scores by branch teachers according to gender variable (Mann-Whitney U Test)

Variables		n	Rank Avg.	Rank Tot.	U	p
Social Competence	Girl	81	124,60	10093,00	4325,00	,007
	Boy	137	100,57	13778,00		
Interpersonal Skills	Girl	81	121,00	9801,00	4617,00	,038
	Boy	137	102,70	14070,00		
Self-Management Skills	Girl	81	126,80	10270,50	4147,50	,002
	Boy	137	99,27	13600,50		
Academic Skills	Girl	81	127,65	10340,00	4078,00	,001
	Boy	137	98,77	13531,00		
Antisocial Behavior	Girl	81	102,19	8277,00	4956,00	,188
	Boy	37	113,82	15594,00		
Hostile-Irritable	Girl	81	103,27	8365,00	5044,00	,261
	Boy	37	113,18	15506,00		
Antisocial-Aggressive	Girl	81	96,66	7829,50	4508,50	,020
	Boy	37	117,09	16041,50		
Demanding-Disruptive	Girl	81	105,48	8543,50	5222,50	,467
	Boy	37	111,88	15327,50		

Looking at Table 2, a significant difference was found between the total and sub-dimensions of social competence in the evaluations of branch teachers according to the gender variable of the students in their classes in the dimension of social competence ($p<0.05$). A significant difference was found in favor of female students. In the antisocial

behaviors dimension, no significant difference was found between antisocial behavior, hostile-irritable and demanding disruptive behaviors in the evaluations made by the branch teachers according to the gender variable of the students ($p>0.05$). A significant difference was found in students' antisocial-aggressive behaviors ($p <0.05$).

Table 3. Evaluation of students' social competence and antisocial behavior totals and sub-dimension scores by physical education teachers according to gender variable (Mann-Whitney U Test)

Variables		n	Rank Avg.	Rank Tot.	U	p
Social Competence	Girl	81	122,54	9925,50	4492,50	,019
	Boy	137	101,79	13945,50		
Interpersonal Skills	Girl	81	120,84	9788,00	4630,00	,041
	Boy	137	102,80	14083,00		
Self-Management Skills	Girl	81	123,33	9990,00	4428,00	,013
	Boy	137	101,32	13881,00		
Academic Skills	Girl	81	122,41	9915,00	4503,00	,020
	Boy	137	101,87	13956,00		
Antisocial Behavior	Girl	81	104,60	8472,50	5151,50	,377
	Boy	137	112,40	15398,50		
Hostile-Irritable	Girl	81	106,07	8591,50	5270,50	,535
	Boy	137	111,53	15279,50		
Antisocial-Aggressive	Girl	81	104,36	8453,50	5132,50	,341
	Boy	137	112,54	15417,50		
Demanding-Disruptive	Girl	81	105,07	8511,00	5190,00	,424
	Boy	137	112,12	15360,00		

The evaluation of students' social competence dimension scores by physical education teachers according to gender variable is given in Table 3. Total and subscale scores were

found to be significantly higher in female students ($p < 0.05$). When the antisocial behavior dimension was evaluated, no difference was found between genders ($p > 0.05$).

Table 4. Evaluation of students' social competence and anti-social behavior and sub-dimension scores by branch teachers according to participation in the activity variable (Mann-Whitney U Test)

Variables		n	Rank Avg.	Rank Tot.	U	p
Social Competence	Yes	155	120,00	18600,00	3255,00	,000
	No	63	83,67	5271,00		
Interpersonal Skills	Yes	155	120,39	18661,00	3194,00	,000
	No	63	82,70	5210,00		
Self-Management Skills	Yes	155	117,78	18256,00	3599,00	,002
	No	63	89,13	5615,00		
Academic Skills	Yes	155	120,39	18660,50	3194,50	,000
	No	63	82,71	5210,50		
Antisocial Behavior	Yes	155	107,36	16641,50	4551,50	,433
	No	63	114,75	7229,50		
Hostile-Irritable	Yes	155	107,93	16728,50	4638,50	,562
	No	63	113,37	7142,50		
Antisocial-Aggressive	Yes	155	108,60	16832,50	4742,50	,737
	No	63	111,72	7038,50		
Demanding-Disruptive	Yes	155	106,29	16475,50	4385,50	,237
	No	63	117,39	7395,50		

As seen in the social competence dimension in Table 4, a significant difference was found between the total and sub-dimensions of social competence in the evaluation of students according to their participation in school activities

by branch teachers ($p < 0.05$). A significant difference was found in favor of the participants. In the antisocial behavior dimension, no significant difference was found in all sub dimensions ($p > 0.05$).

Table 5. Evaluation of students' social competence and antisocial behavior totals and sub-dimension scores by physical education teachers according to participation in the activity variable (Mann-Whitney U Test)

Variables		n	Rank Avg.	Rank Tot.	U	p
Social Competence	Yes	169	116,75	19730,50	2915,50	,002
	No	49	84,50	4140,50		
Interpersonal Skills	Yes	169	117,74	19898,00	2748,00	,000
	No	49	81,08	3973,00		
Self-Management Skills	Yes	169	114,77	19396,00	3250,00	,022
	No	49	91,33	4475,00		
Academic Skills	Yes	169	116,97	19767,50	2878,50	,001
	No	49	83,74	4103,50		
Antisocial Behavior	Yes	169	109,78	18553,50	4092,50	,902
	No	49	108,52	5317,50		
Hostile-Irritable	Yes	169	110,08	18604,00	4042,00	,799
	No	49	107,49	5267,00		
Antisocial-Aggressive	Yes	169	111,49	18842,50	3803,50	,372
	No	49	102,62	5028,50		
Demanding-Disruptive	Yes	169	108,70	18370,50	4005,50	,727
	No	49	112,26	5500,50		

In Table 5, a significant difference was found between the total and sub-dimensions of social competence in the evaluation of students by physical education teachers according to their

participation in school activities ($p < 0.05$). Participants in the event have higher scores. Participation in school activities does not affect antisocial behavior scores ($p > 0.05$).

Table 6. Branch teachers' evaluation of students' social competence and antisocial behavior total and sub-dimension scores according to class participation variable (Kruskal-Wallis Test)

Variables		n	Rank Avg	X ²	p	Post-hoc
Social Competence	is not willing	51	52,41	110,54	,000	a-b b-c a-c
	partially willing	78	87,92			
	is willing	89	161,12			
Interpersonal Skills	is not willing	51	55,32	98,99	,000	a-b b-c a-c
	partially willing	78	89,25			
	is willing	89	158,29			
Self-Management Skills	is not willing	51	57,62	94,31	,000	a-b b-c a-c
	partially willing	78	88,81			
	is willing	89	157,37			
Academic Skills	is not willing	51	48,55	120,73	,000	a-b b-c a-c
	partially willing	78	88,31			
	is willing	89	162,99			
Antisocial Behavior	is not willing	51	138,31	39,25	,000	c-b c-a
	partially willing	78	126,94			
	is willing	89	77,71			
Hostile-Irritable	is not willing	51	138,75	33,61	,000	c-b c-a
	partially willing	78	123,38			
	is willing	89	80,57			
Antisocial-Aggressive	is not willing	51	134,62	31,53	,000	c-b c-a
	partially willing	78	125,33			
	is willing	89	81,24			
Demanding-Disruptive	is not willing	51	137,75	43,42	,000	c-b c-a
	partially willing	78	129,31			
	is willing	89	75,94			

In Table 6, a significant difference was found in the total and sub-dimensions of the social competence dimension of the participation of the students to the lesson by the branch teachers ($p < 0.05$). Students who are willing to participate in the lesson have higher social competence total and subscale scores. In the antisocial behavior

dimension, a significant difference was found in the evaluations of the branch teachers regarding the variable of student participation in antisocial behavior, hostile-Irritable, antisocial-aggressive and demanding-disruptive behaviors ($p < 0.05$). It has been determined that willing students have more positive and anti-school social behaviors.

Table 7. Physical education teachers' evaluation of students' social competence and antisocial behavior total and sub-dimension scores according to class participation variable (Kruskal-Wallis Test)

Variables		n	Rank Avg	X ²	p	Post-hoc
Social Competence	is not willing	35	58,70	56,07	,000	a-b
	partially willing	77	89,75			b-c
	is willing	106	140,62			a-c
Interpersonal Skills	is not willing	35	56,69	59,52	,000	a-b
	partially willing	77	89,51			b-c
	is willing	106	141,46			a-c
Self-Management Skills	is not willing	35	63,36	46,93	,000	b-c
	partially willing	77	91,21			a-c
	is willing	106	138,02			
Academic Skills	is not willing	35	59,71	52,53	,000	b-c
	partially willing	77	90,89			a-c
	is willing	106	139,46			a-b
Antisocial Behavior	is not willing	35	125,03	5,46	,065	
	partially willing	77	115,88			
	is willing	106	99,74			
Hostile-Irritable	is not willing	35	125,90	4,96	,084	
	partially willing	77	114,31			
	is willing	106	100,59			
Antisocial-Aggressive	is not willing	35	113,47	2,09	,352	
	partially willing	77	116,08			
	is willing	106	103,41			
Demanding-Disruptive	is not willing	35	121,70	4,29	,117	
	partially willing	77	116,16			
	is willing	106	100,64			

When Table 7 is examined, significant difference was found in the total and sub-dimensions of the students' social competence in the evaluation of the physical education teachers according to the student class participation variable ($p < 0.05$). In the antisocial behavior dimension, no significant difference was found in all sub dimensions ($p > 0.05$).

DISCUSSION

As a result of the evaluation of the social behaviors of the students with special needs in terms of physical education and branch teachers, no significant difference was found between the total and sub-dimensions of social competence. However, it was determined that the students' scores in the total and sub-dimensions of social

competence in physical education courses were higher. Additionally, a significant difference was found between students' antisocial behaviors, hostile-Irritable and antisocial-aggressive behaviors. It was determined that students' antisocial behavior social behavior scores were lower in physical education classes. No significant difference was detected in students' demanding-disruptive behaviors. It is thought that allowing students with special needs to move more freely in physical education and sports classes reduces antisocial behaviors. In their study, Goudas and Magotsiou (2009) stated that physical education and sports activities carried out with the collaborative learning model make positive contributions to social skills. In Avcioglu's (2012) study on mentally disabled people, it was stated that cooperative learning and drama positively affected

children's self-presentation skills, and that they were able to generalize the skills gained after the program to free time activities with their peers at school. Eren (2012), according to the type of school they attend; it is stated that the social skill levels of mainstreamed students are higher than those of students attending special education schools. Sülün and Girli (2016) state that there is no significant difference between the social skills and problem behaviors of mainstreaming students depending on the type of inclusion they attend, and that the type of inclusion they attend does not affect the students' social skills and problem behaviors, but their academic proficiency. No literature directly related to our study was found. However, studies conducted with different educational practices and samples support our study. Our study reveals that physical education course practices are more effective in school social behavior than other branch courses.

In the evaluations made by branch and physical education teachers, a significant difference was found between the social competence total and sub-dimension scores according to the gender variable. It was determined that female students' social competence total and subscale scores were higher in physical education and other branch courses. In our study, no significant difference was found between antisocial behaviors, hostile-irritable and demanding-disruptive behaviors in the evaluations of branch teachers according to gender variable. A significant difference was found in the antisocial-aggressive behaviors of the students. No significant difference was found in antisocial behaviors, hostile-irritable, antisocial-aggressive and demanding-disruptive behaviors in the evaluation of physical education teachers according to gender. While parallel results were found with our study, different results were also detected. Duran et al., (2013) stated in their study with secondary school students and Eren (2012) in their study with hearing-impaired students that female students have higher social skills. In their study conducted by Işıklar et al., in 2015, the "Self-Control" subdimension scores of the School Social Behavior scale of female students studying in primary schools were found to be significantly higher than male students. However, Toksöz (2019) states that the social skills of mentally disabled students do not differ according to gender. Çifci-Tekinarslan et al., (2012), social skills of mentally disabled individuals; they state that the social skills

of girls are better than boys and that their problem behaviors are lower than boys. Çitil and Özkubat (2020) in their study with gifted and non-gifted students, it was determined that female students had better social skills, while male students exhibited more problem behaviors. Kara and Şahin (2021) state that female students' social skills scores are higher than the male students' social skills average scores. Sülün and Girli (2016) state that social skills, problem behaviors and academic competence dimensions do not have an effect on gender according to the gender variable. Uz- Baş (2003) states that the social adaptation levels of female students to school are higher than male students. Additionally, Arslan (2013) states that gender does not affect the social skill levels of mentally disabled people. The fact that our study was conducted in Van province was seen as a limitation of this study.

In the evaluation made by branch and physical education teachers according to their participation in school activities, a significant difference was found between the total and sub-dimensions of social competence. Those who participate in the event have higher scores. Participation in school activities of students with special needs does not affect their antisocial behavior scores. Literature directly not related to our study was found. This situation can be expressed as the limitation of our study. When the studies in the field are examined, there are studies in which the effects of the program are mostly experimental. These studies include different intervention programs in different sample groups. They state that different activities and activities performed in an adapted manner positively affect social skills, school social behavior, socialization and many parameters that can be associated with it (Yılmaz and Soyer 2018; İlhan, 2008; Çevik and Kabasakal 2013; Esentürk and Güngör, 2020; Kuruoğlu and Uzunçayır 2020; Karacan et al., 2003; Yaman, 2015; Nişli et al., 2021). Yıldırım (2013), in his study conducted with science and art center students within the scope of the social studies course, states that the activities make the course more enjoyable, contribute to the permanence of knowledge, and that the activities positively affect learning in the social studies course. In this study, it was stated by the branch teachers that participation in the activities positively affects social competence. Also Samalot-Rivera (2007) stated that social skills teaching is an effective strategy in physical education practices to improve the

behaviors of students with emotional or behavioral disorders in appropriate sports and games and to reduce negative behaviors. Van der Sluys et al., (2022) stated that physical activity may be promising in terms of reducing antisocial behaviors in children and adults. Şahin and Şahin (2020), in addition to school and family life, participation in social activities has an important place in the development of social skills in mentally handicapped children.

According to the results of branch and physical education teachers' assessment of students' willingness to participate in class, a significant difference was detected between the total and sub-dimensions of social competence. It was observed that the social competence total and subscale scores of students who were willing to participate in the lesson were higher. In addition, a significant difference was detected in anti social social behaviors and their sub-dimensions in the branch teachers' evaluations of the students according to the lesson participation variable. Students who were willing to participate in class had lower negative school social behavior scores. However, according to the evaluation results of the physical education teachers, the willingness of the students with special needs in the lesson does not affect the antisocial behaviors. In the studies conducted in the literature, parallel results with our findings could not be reached. The lack of research similar to our study is the limitation of our study. It is understood from the teacher evaluations that the high motivation of students with special needs to participate in the course increases their social competence scores.

Conclusion

It has been determined that many factors are effective in the social behavior of students with special needs at school. Students show less anti-social behavior in physical education classes. Students' participation in courses and different activities within the scope of education positively affects social behavior at school. It is necessary to create activity areas where students with special needs can actively participate in educational institutions. Exercise hours should be created for students with special needs in extracurricular activities.

We would like to thank our teachers, school administrators, students with special needs and their families who participated in this study.

Conflict of Interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Statement

This study is approved by the Van Yuzuncu yıl University of social and human ethics Ethics Committee of the (Approval Number: 2023/12-03).

Author Contributions

Planned by the author: Study Design, Data Collection, Statistical Analysis, Data Interpretation, Manuscript Preparation, Literature Search. Author have read and agreed to the published version of the manuscript.

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RESEARCH ARTICLE

Knowledge Level of Pelvic Floor and Pelvic Floor Disorders According to Gender and Education Levels

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Abstract

Pelvic floor disorders, their management and protective educational programs have become popular in recent years. The aim of this study is to determine the level of knowledge about pelvic floor health according to gender and education levels. This cross sectional study is conducted on women and men between January and September of 2021 in Turkey. The knowledge level of pelvic floor was assessed with Pelvic Floor Health Knowledge Quiz (PFHKQ). Oneway ANOVA test was used for comparing pelvic floor knowledge according to the education levels and the age groups. Chi-square test and Pearson chi square test were used for calculating binary variables, effect size, and confidence interval values between participants' pelvic floor knowledge level and gender. A total of 1215 (1115 women, 100 men) participants completed the study. Men had less knowledge about the topics related to the pelvic floor ($p < 0.05$) and the awareness of those that have graduated from higher education on these issues was found to be higher compared to the other education levels ($p < 0.05$). In conclusion, we determined that the Turkish population has insufficient knowledge about the relationship between the pelvic floor and other body systems, the causes and types of pelvic problems. In the future, educational programs emphasizing deficient points regarding the pelvic floor within the scope of preventive treatment may be planned to cover the general population.

Keywords

Pelvic floor, Knowledge, Gender, Education Level, Turkey

INTRODUCTION

Pelvic floor consists of muscles, ligaments, and fascia; it is an important structure that supports the pelvic organs, provides control of micturition and defecation, and plays a role in the respiratory system, sexual function, and reproduction (Eickmeyer, 2017; Han & Ha, 2015; Messelink et al., 2005). The abnormal function of the pelvic floor is termed pelvic floor dysfunction and includes conditions such as Urinary incontinence (UI), Pelvic organ prolapse (POP), pelvic pain,

sexual dysfunction, and anal incontinence (Good & Solomon, 2019; MacLennan, Taylor, Wilson, & Wilson, 2000). Conservative treatment and surgical intervention options are used in the treatment of pelvic floor dysfunctions. Delay of the treatment is associated with an increase in the burden of care and health expenditures and a deterioration in the quality of life (Duffield et al., 2017).

The level of patients' knowledge about pelvic floor health and the level of awareness about pelvic floor problems are important for preventive approaches. It has been shown that

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information and education programs about the pelvic floor lead to an increase in women's level of awareness (de Andrade et al., 2018; Geoffrion et al., 2009). On the other hand, in men, pelvic floor training is one of the treatment methods for pelvic floor disorders such as urinary incontinence after prostate treatment and erectile dysfunction (Ali et al., 2022; Cohen et al., 2016). For this reason, knowing the importance of the pelvic floor in both gender health can increase the chances of patients receiving effective treatment.

In researches conducted with different populations to determine the level of knowledge about the pelvic floor, it has been determined that the community has insufficient knowledge (de Freitas et al., 2019; Fante, Silva, Mateus-Vasconcelos, Ferreira, & Brito, 2019; Hill, McPhail, Wilson, & Berlach, 2017; Neels et al., 2016; Skaug, Eng, Frawley, & Bø, 2020). Although the number of studies conducted in this area is very limited in Turkey, the results show similarities with the results in the literature (Mamuk, Dişsiz, & Dinç, 2018; Süt & Küçükkaya, 2018). Patient education sessions are one of the most important ways of preventive health applications and the proportion of application increase day by day in Turkey.

To create a framework for guiding protective approaches in this area, we aimed to determine the level of knowledge of Turkish women and men about the pelvic floor and topics related to pelvic floor. We think that the results will obtain at the end of our study will provide up-to-date data on this subject. We hope that our results can be used in the design of preventive health policies.

MATERIALS AND METHODS

Study Design

This study was designed as a cross-sectional study. Ethical approval was obtained from the Scientific Research Ethical Committee of the Faculty of Health Science of Marmara University (Approval date and number: 28.01.2021/10). This study was conducted in accordance with the Declaration of Helsinki. This cross-sectional study was registered at the US National Institutes of Health (ClinicalTrials.gov) #NCT04893005.

Study Population

The volunteers who were invited via social media platforms (Facebook, Instagram) and accepted to participate the study were included.

Exclusion criteria included participants who did not complete the entire quiz and were under 18.

Study Interventions

After receiving the informed consent electronically, firstly demographic data was examined. These data included age groups (18-25; 26-35; 36-45; 46-55; 56-65; >65), gender, education levels (elementary school, high school, graduate education, postgraduate education, doctorate education), birth experience, number of births, type of birth (vaginal delivery, cesarean section, epidural, water birth), and education/working status.

The general questions were determined to elicit the basic information level of the participants about the pelvic floor. The general question set is presented as the following;

- Have you ever heard the expression of 'pelvic floor' before?
- In which source have you encountered the expression of 'pelvic floor' before? (The answer options which were given to the participants for this question were television; lecture, online education, course; internet, social media; friends, family. And 'others' choice is also among the options).
- In the "Pelvic Floor Health Knowledge Quiz", which is a part of the same study, it was asked that pelvic floor location correctly on the body was given (Fig. 1).

And subsequently, the location of the pelvic floor was shown at PFHKQ correctly.

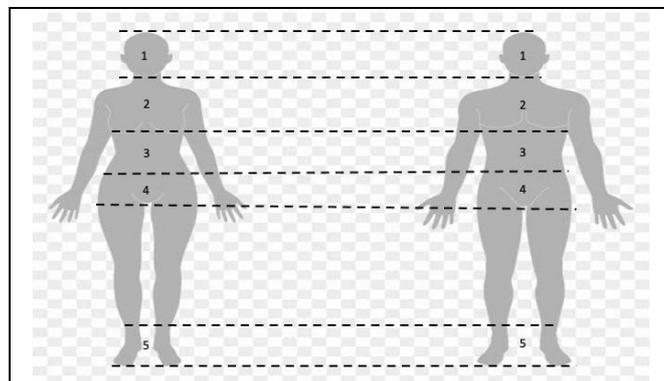


Figure 1. In your opinion, which number shows the pelvic floor location correctly on the body figure?

Pelvic Floor Health Knowledge Quiz

A special quiz consisting of 29 items that were previously developed and validated was used to determine the level of knowledge about pelvic floor function/dysfunction (items from 1 to 8),

risk/etiology (items from 9 to 21) and diagnosis, and treatment (items from 22 to 29) (Wala'a & Çelenay, 2021). The participants were asked to answer the items by choosing the appropriate option. The choices were 'yes, no, do not know'. The answers were by allocating one point for each question answered correctly, and zero points for answered incorrectly or to which the respondent does not know the answer. Higher scores show better knowledge. At the end of the quiz, considering that the participants were asked which pelvic floor disorder they had. The options were 'UI', 'POP', 'fecal incontinence', 'gas incontinence', 'pelvic pain', and 'none of them'.

Statistical Analysis

In the classification of the data, qualitative and quantitative statistical methods were evaluated with the SPSS 22.0 statistical program at the 95% confidence interval, and the significance was evaluated at the $p < 0.05$ level.

The characteristics of the participants were summarized as frequencies for categorical data, means±standard deviation for continuous variables, and medians (quartiles), minimum, maximum values, and percentages were calculated for assessment. The total scores obtained from the quiz were determined as a percentage according to gender and education level. The answers given by

the participants to the statements were categorized as correct or incorrect, and analyzes were made between groups according to age, gender, and education level. The Oneway ANOVA test was used to compare participants' knowledge levels according to the age groups and education levels. Chi-square test and Pearson chi-square test were used for calculating binary variables, effect size, and confidence interval values between participants' pelvic floor knowledge level and gender. Cramer's V test was used to detect the measure of association between two nominal variables.

RESULTS

A total of 1215 people, (1115 women, and 100 men), were included in the study (Fig. 2).

The age groups that participated the most in the research were 46-55 and 56-65 (27.1%, and 27.7%, respectively). It was determined that 73.8% of the participants had a graduate or higher education level, and 21.2% had continued health education and worked in medical fields. 72.2% of the participants had birth experience. All participants' sociodemographic statuses are shown in Table 1.

Table 1. Sample Characteristics

		n(%)
Age groups (years)	18-25	143(11,8)
	26-35	146(12)
	36-45	198(16,3)
	46-55	329(27,1)
	56-65	336(27,7)
	>65	63(5,2)
Gender	Female	1115(91,8)
	Male	100(8,2)
Education Level	Elementary School	19(1,6)
	High School	299(24,6)
	Graduate	718(59,1)
	Postgraduate	134(11)
	Doctorate	45(3,7)
Birth Experience	Yes	811(72,7)
	No	304(27,3)
Number of Births	1	329(40,6)
	2	416(51,3)
	3 and more	66(8,1)
Education/Work in a medical field	Yes	256(21,1)
	No	959(78,9)

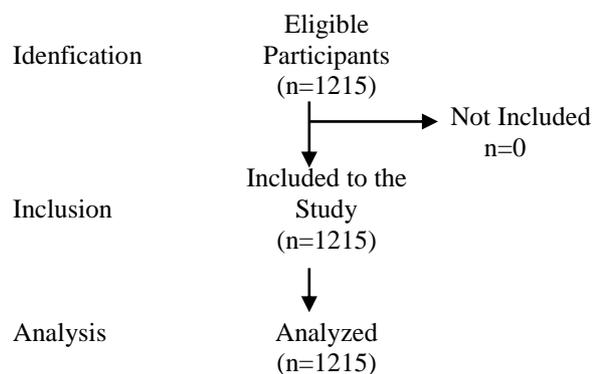


Figure 2. Study enrolment flow chart. STROBE, Strengthening the reporting of observational studies in epidemiology

52.7% of the participants had heard the expression ‘pelvic floor’ before. The participants stated that they encountered the term 'pelvic floor' mostly through lecture-online education-course, and internet-social media (42.2%, 28.4%, respectively). 72.8% of the participants showed the location of the pelvic floor correctly.

When the situation of the participants regarding pelvic floor disorders was examined, it was determined that 25.7% of the participants had UI, 4.7% had POP, and 13.7% had pelvic pain.

Participants generally correctly agreed that:

- In pelvic floor problems, besides the clinical examination, the patient's complaint is also important (79,4%)
- The patient examination is important in determining pelvic floor problems (79,2%)
- Regular physical activity and exercise are beneficial for pelvic floor problems (71,4 %).

When the total correct scores obtained from the quiz were examined, it was seen that 9.2% of

the men and 90.8% of the women scored 20 or more points out of a 29-point total; 23% of men, and 9.96% of women got 0 points. When the total scores obtained are analyzed according to their education levels, of the participants received 0 points, 15.79% had elementary school education, 16.72% had high school education, 10.72% had graduate education, and 2.96% had postgraduate education. Of the participants who received 20 or more points out of a 29-point total, 23.16% had high school education, 56.3% had graduate education, 15.07% had postgraduate education, and 5.51% had doctorate education. None of the participants who had a doctorate education received 0 points, and none of the participants who had an elementary school education received 29 points.

There was no difference between the correct answers according to the age groups ($p>0.05$).

Participants' knowledge of the pelvic floor function/dysfunction; risk/etiology; diagnosis and treatment were compared according to gender (Table 2).

Table 2. The Effect of gender on the level of knowledge of the pelvic floor

		Female n(%)	Male n(%)	p	CI (lower- upper)	Crammer s' V																																																																																						
Item 1. Urinary incontinence is a pelvic floor problem	Correct	783(70.2)	51(51)	<0.0001*	2.27 (1.50-3.42)	0.114																																																																																						
	Incorrect	332(29.8)	49(49)				Item 2. Pelvic organ (bladder, uterus, bowel) prolapse is one of the pelvic floor problems	Correct	823(73,8)	54(54)	<0.0001*	2.40 (1.59-3.64)	0.122	Incorrect	292(26,2)	46(46)	Item 3. Fecal or gas incontinence is not a pelvic floor problem	Correct	303(27,2)	14(14)	0.074	0,68 (0,45-1,04)	0,051	Incorrect	812(72,8)	86(86)	Item 4. Pelvic floor tension may be the cause of pelvic pain (pain in the pelvis)	Correct	641(57,5)	56(56)	0,773	1,60 (0,70-1,61)	0,008	Incorrect	474(42,5)	44(44)	Item 5. Pelvic floor problems are not associated with low back pain	Correct	182(16,3)	18(18)	0,631	1,11 (0,72-1,73)	0,014	Incorrect	933(83,7)	82(82)	Item 6. The pelvic floor is important for sexual health	Correct	724(64,9)	59(59)	0,235	1,29 (0,85-1,95)	0,034	Incorrect	391(35,1)	41(41)	Item 7. The pelvic floor is associated with the respiratory system	Correct	112(10)	19(19)	0,006*	0,48 (0,28-081)	0,079	Incorrect	1003(90)	81(81)	Item 8. Pelvic floor weakness can cause pelvic pain	Correct	643(57,7)	58(58)	0,949	0,97 (0,65-1,49)	0,002	Incorrect	472(42,3)	42(42)	Item 9. Pelvic floor problems can have many causes	Correct	778(69,8)	66(66)	0,432	1,19 (0,77-1,83)	0,023	Incorrect	337(30,2)	34(34)	Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)
Item 2. Pelvic organ (bladder, uterus, bowel) prolapse is one of the pelvic floor problems	Correct	823(73,8)	54(54)	<0.0001*	2.40 (1.59-3.64)	0.122																																																																																						
	Incorrect	292(26,2)	46(46)				Item 3. Fecal or gas incontinence is not a pelvic floor problem	Correct	303(27,2)	14(14)	0.074	0,68 (0,45-1,04)	0,051	Incorrect	812(72,8)	86(86)	Item 4. Pelvic floor tension may be the cause of pelvic pain (pain in the pelvis)	Correct	641(57,5)	56(56)	0,773	1,60 (0,70-1,61)	0,008	Incorrect	474(42,5)	44(44)	Item 5. Pelvic floor problems are not associated with low back pain	Correct	182(16,3)	18(18)	0,631	1,11 (0,72-1,73)	0,014	Incorrect	933(83,7)	82(82)	Item 6. The pelvic floor is important for sexual health	Correct	724(64,9)	59(59)	0,235	1,29 (0,85-1,95)	0,034	Incorrect	391(35,1)	41(41)	Item 7. The pelvic floor is associated with the respiratory system	Correct	112(10)	19(19)	0,006*	0,48 (0,28-081)	0,079	Incorrect	1003(90)	81(81)	Item 8. Pelvic floor weakness can cause pelvic pain	Correct	643(57,7)	58(58)	0,949	0,97 (0,65-1,49)	0,002	Incorrect	472(42,3)	42(42)	Item 9. Pelvic floor problems can have many causes	Correct	778(69,8)	66(66)	0,432	1,19 (0,77-1,83)	0,023	Incorrect	337(30,2)	34(34)	Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)	0,081	Incorrect	440(39,5)	54(54)						
Item 3. Fecal or gas incontinence is not a pelvic floor problem	Correct	303(27,2)	14(14)	0.074	0,68 (0,45-1,04)	0,051																																																																																						
	Incorrect	812(72,8)	86(86)				Item 4. Pelvic floor tension may be the cause of pelvic pain (pain in the pelvis)	Correct	641(57,5)	56(56)	0,773	1,60 (0,70-1,61)	0,008	Incorrect	474(42,5)	44(44)	Item 5. Pelvic floor problems are not associated with low back pain	Correct	182(16,3)	18(18)	0,631	1,11 (0,72-1,73)	0,014	Incorrect	933(83,7)	82(82)	Item 6. The pelvic floor is important for sexual health	Correct	724(64,9)	59(59)	0,235	1,29 (0,85-1,95)	0,034	Incorrect	391(35,1)	41(41)	Item 7. The pelvic floor is associated with the respiratory system	Correct	112(10)	19(19)	0,006*	0,48 (0,28-081)	0,079	Incorrect	1003(90)	81(81)	Item 8. Pelvic floor weakness can cause pelvic pain	Correct	643(57,7)	58(58)	0,949	0,97 (0,65-1,49)	0,002	Incorrect	472(42,3)	42(42)	Item 9. Pelvic floor problems can have many causes	Correct	778(69,8)	66(66)	0,432	1,19 (0,77-1,83)	0,023	Incorrect	337(30,2)	34(34)	Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)	0,081	Incorrect	440(39,5)	54(54)																
Item 4. Pelvic floor tension may be the cause of pelvic pain (pain in the pelvis)	Correct	641(57,5)	56(56)	0,773	1,60 (0,70-1,61)	0,008																																																																																						
	Incorrect	474(42,5)	44(44)				Item 5. Pelvic floor problems are not associated with low back pain	Correct	182(16,3)	18(18)	0,631	1,11 (0,72-1,73)	0,014	Incorrect	933(83,7)	82(82)	Item 6. The pelvic floor is important for sexual health	Correct	724(64,9)	59(59)	0,235	1,29 (0,85-1,95)	0,034	Incorrect	391(35,1)	41(41)	Item 7. The pelvic floor is associated with the respiratory system	Correct	112(10)	19(19)	0,006*	0,48 (0,28-081)	0,079	Incorrect	1003(90)	81(81)	Item 8. Pelvic floor weakness can cause pelvic pain	Correct	643(57,7)	58(58)	0,949	0,97 (0,65-1,49)	0,002	Incorrect	472(42,3)	42(42)	Item 9. Pelvic floor problems can have many causes	Correct	778(69,8)	66(66)	0,432	1,19 (0,77-1,83)	0,023	Incorrect	337(30,2)	34(34)	Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)	0,081	Incorrect	440(39,5)	54(54)																										
Item 5. Pelvic floor problems are not associated with low back pain	Correct	182(16,3)	18(18)	0,631	1,11 (0,72-1,73)	0,014																																																																																						
	Incorrect	933(83,7)	82(82)				Item 6. The pelvic floor is important for sexual health	Correct	724(64,9)	59(59)	0,235	1,29 (0,85-1,95)	0,034	Incorrect	391(35,1)	41(41)	Item 7. The pelvic floor is associated with the respiratory system	Correct	112(10)	19(19)	0,006*	0,48 (0,28-081)	0,079	Incorrect	1003(90)	81(81)	Item 8. Pelvic floor weakness can cause pelvic pain	Correct	643(57,7)	58(58)	0,949	0,97 (0,65-1,49)	0,002	Incorrect	472(42,3)	42(42)	Item 9. Pelvic floor problems can have many causes	Correct	778(69,8)	66(66)	0,432	1,19 (0,77-1,83)	0,023	Incorrect	337(30,2)	34(34)	Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)	0,081	Incorrect	440(39,5)	54(54)																																				
Item 6. The pelvic floor is important for sexual health	Correct	724(64,9)	59(59)	0,235	1,29 (0,85-1,95)	0,034																																																																																						
	Incorrect	391(35,1)	41(41)				Item 7. The pelvic floor is associated with the respiratory system	Correct	112(10)	19(19)	0,006*	0,48 (0,28-081)	0,079	Incorrect	1003(90)	81(81)	Item 8. Pelvic floor weakness can cause pelvic pain	Correct	643(57,7)	58(58)	0,949	0,97 (0,65-1,49)	0,002	Incorrect	472(42,3)	42(42)	Item 9. Pelvic floor problems can have many causes	Correct	778(69,8)	66(66)	0,432	1,19 (0,77-1,83)	0,023	Incorrect	337(30,2)	34(34)	Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)	0,081	Incorrect	440(39,5)	54(54)																																														
Item 7. The pelvic floor is associated with the respiratory system	Correct	112(10)	19(19)	0,006*	0,48 (0,28-081)	0,079																																																																																						
	Incorrect	1003(90)	81(81)				Item 8. Pelvic floor weakness can cause pelvic pain	Correct	643(57,7)	58(58)	0,949	0,97 (0,65-1,49)	0,002	Incorrect	472(42,3)	42(42)	Item 9. Pelvic floor problems can have many causes	Correct	778(69,8)	66(66)	0,432	1,19 (0,77-1,83)	0,023	Incorrect	337(30,2)	34(34)	Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)	0,081	Incorrect	440(39,5)	54(54)																																																								
Item 8. Pelvic floor weakness can cause pelvic pain	Correct	643(57,7)	58(58)	0,949	0,97 (0,65-1,49)	0,002																																																																																						
	Incorrect	472(42,3)	42(42)				Item 9. Pelvic floor problems can have many causes	Correct	778(69,8)	66(66)	0,432	1,19 (0,77-1,83)	0,023	Incorrect	337(30,2)	34(34)	Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)	0,081	Incorrect	440(39,5)	54(54)																																																																		
Item 9. Pelvic floor problems can have many causes	Correct	778(69,8)	66(66)	0,432	1,19 (0,77-1,83)	0,023																																																																																						
	Incorrect	337(30,2)	34(34)				Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)	0,081	Incorrect	440(39,5)	54(54)																																																																												
Item 10. Pregnancy can adversely affect the pelvic floor	Correct	675(60,5)	46(46)	0,005*	1,80 (1,19-2,71)	0,081																																																																																						
	Incorrect	440(39,5)	54(54)																																																																																									

Item 11. Having vaginal birth too many times can weaken the pelvic floor	Correct	631(56,6)	33(33)	<0.0001*	2,65 (1,72-4,08)	0,13
	Incorrect	484(43,4)	67(67)			
Item 12. The probability of pelvic floor problems is low in obese individuals	Correct	38(3,4)	4(4)	0,447	1,17 (0,78-1,77)	0,022
	Incorrect	1077(96,6)	96(96)			
Item 13. Smoking addiction can weaken the pelvic floor	Correct	336(30,1)	31(31)	0,857	0,96 (0,62-1,50)	0,005
	Incorrect	779(69,9)	69(69)			
Item 14. Weight-bearing continuously can damage the pelvic floor	Correct	697(62,5)	58(58)	0,373	1,21 (0,80-1,83)	0,026
	Incorrect	418(37,5)	42(42)			
Item 15. Constipation can cause weakening of the pelvic floor	Correct	503(45,1)	45(45)	0,983	1,01 (0,67-1,52)	0,001
	Incorrect	612(54,9)	55(55)			
Item 16. Pelvic floor problems are more common in younger people than older people	Correct	66(5,9)	8(8)	0,072	1,47 (0,96-2,24)	0,052
	Incorrect	1049(94,1)	92(92)			
Item 17. Unconsciously compelling sports/exercises (such as jumping, or lifting weights) can weaken the pelvic floor	Correct	448(40,2)	34(34)	0,226	1,30 (0,85-2,01)	0,035
	Incorrect	667(59,8)	66(66)			
Item 18. The postural disorder does not affect the pelvic floor	Correct	139(12,5)	11(11)	0,372	0,83 (0,55-1,26)	0,026
	Incorrect	976(87,5)	89(89)			
Item 19. Menopause can affect pelvic floor problems	Correct	570(51,1)	40(40)	0,033*	1,57 (1,03-2,39)	0,061
	Incorrect	545(48,9)	60(60)			
Item 20. Some medications can cause pelvic floor problems	Correct	410(36,8)	40(40)	0,522	0,87 (0,57-1,33)	0,018
	Incorrect	705(63,2)	60(60)			
Item 21. Surgical approaches to the pelvic organs (bladder, prostate gland, uterus...) can weaken the pelvic floor	Correct	469(42,1)	43(43)	0,856	0,96(0,64-1,46)	0,005
	Incorrect	646(57,9)	57(57)			
Item 22. The patient examination is important in determining pelvic floor problems	Correct	894(80,2)	68(68)	0,004*	1,90 (1,22-2,97)	0,082
	Incorrect	221(19,8)	32(32)			
Item 23. Some special tests are used to identify pelvic floor problems	Correct	513(46)	54(54)	0,443	0,85 (0,57-1,28)	0,022
	Incorrect	602(54)	46(46)			
Item 24. In pelvic floor problems, besides the clinical examination, the patient's complaint is also important	Correct	899(80,6)	66(66)	0,001*	2,14 (1,38-3,33)	0,099
	Incorrect	216(19,4)	34(34)			
Item 25. Pelvic floor exercises can prevent pelvic floor problems	Correct	786(70,5)	59(59)	0,017*	1,66 (1,09-2,52)	0,069
	Incorrect	329(29,5)	41(41)			
Item 26. Physiotherapy can be used to treat pelvic floor problems	Correct	517(46,4)	53(53)	0,203	0,77 (0,51-1,16)	0,037
	Incorrect	598(53,6)	47(47)			
Item 27. Medication is the only treatment for pelvic floor problems	Correct	24(2,2)	1(1)	0,972	1,01 (0,67-1,52)	0,001
	Incorrect	1091(97,8)	99(99)			
Item 28. Surgery may not be the definitive solution for pelvic floor problems	Correct	465(41,7)	43(43)	0,801	0,95 (0,63-1,43)	0,007
	Incorrect	650(58,3)	57(57)			
Item 29. Regular physical activity and exercise are beneficial for pelvic floor problems	Correct	802(71,9)	66(66)	0,209	1,32 (0,86-2,04)	0,036
	Incorrect	313(28,1)	34(34)			

CI: Confidence Interval; *p<0,05

Function/Dysfunction:

In both the 1st item (Urinary incontinence is a pelvic floor problem) (95% CI 1.50-3.42, Crammer's V= 0.114, p<0.0001) and the 2nd item (Pelvic organ (bladder, uterus, bowel) prolapse is

one of the pelvic floor problems) (95% CI 1.59-3.64, Crammer's V= 0.122, p<0.0001), it was found that females' knowledge levels were significantly higher than males'. But the males' knowledge level was higher than the females' for

the 7th item (the pelvic floor is associated with the respiratory system) (95% CI 0.28-0.81, Crammer's

$V= 0.079$, $p=0.006$). Other items' answers associated with this section were similar.

Risk/Etiology:

A statistically significant difference was found according to the genders. In the 10th (Pregnancy can adversely affect the pelvic floor) (95% CI 1.19-2.71, Crammer's $V= 0.081$, $p=0.005$), 11th (Having vaginal birth too many times can weaken the pelvic floor) (95% CI 1.72-4.08, Crammer's $V= 0.13$, $p<0.0001$), and 19th items (Menopause can affect pelvic floor problems) (95% CI 1.03-2.39, Crammer's $V= 0.061$, $p=0.033$), it was determined that females' correct answers were higher than males'.

Diagnosis and Treatment:

Females' knowledge rates about the diagnosis and treatment of the pelvic floor problems which are involved in the 22nd (Patient examination is important in determining pelvic floor problems) (95% CI 1.22-2.97, Crammer's $V= 0.082$, $p=0.004$), 24th (In pelvic floor problems, besides the clinical examination, the patient's complaint is also important) (95% CI 1.38-3.33, Crammer's $V= 0.099$, $p=0.001$), and 25th items (Pelvic floor exercises can prevent pelvic floor problems) (95% CI 1.09-2.52, Crammer's $V= 0.069$, $p=0.017$) were higher than males'. The other results were similar.

Participants' knowledge of pelvic floor function/dysfunction; risk/etiology; diagnosis and treatment were compared according to their education levels (Supplement 1).

The correct answers rate of the participants who had graduate, postgraduate, and doctorate education were higher than the participants who had an elementary school and high school education for the 2nd (Pelvic organ (bladder, uterus, bowel) prolapse is one of the pelvic floor problems), 6th (The pelvic floor is important in sexual health), 10th (Pregnancy can adversely affect the pelvic floor), 11th (Having vaginal birth too many times can weaken the pelvic floor), 12th (The probability of pelvic floor problems is low in obese individuals), 27th (Medication is the only treatment for pelvic floor problems), 28th (Surgery may not be the definitive solution for pelvic floor problems), 29th items (Regular physical activity and exercise are helpful for pelvic floor problems) ($p<0.05$).

The correct response rate of the participants who had elementary school education was found to

be lower than that of the other groups for the 9th item (Pelvic floor problems can have many causes) ($p<0.05$).

The rate of correct answers of the participants who had graduate and higher education were similar for the 1st (Urinary incontinence is a pelvic floor problem), 3rd (Fecal or gas incontinence is not a pelvic floor problem), 5th (Pelvic floor problems are not associated with low back pain), 6th (The pelvic floor is important in sexual health), 7th (The pelvic floor is associated with the respiratory system), 8th (Pelvic floor weakness can cause pelvic pain), 9th (Pelvic floor problems can have many causes), 10th (Pregnancy can adversely affect the pelvic floor), 12th (The probability of pelvic floor problems is low in obese individuals), 14th (Weight bearing continuously can damage the pelvic floor), 15th (Constipation can cause weakening of the pelvic floor), 18th (Postural disorder does not affect the pelvic floor), and 21st items (Surgical approaches to the pelvic organs (bladder, prostate gland, uterus) can weaken the pelvic floor) ($p>0.05$). For the 23rd (Some special tests are used to identify pelvic floor problems) and 26th items (Physiotherapy can be used to treat pelvic floor problems), the correct response rates of the participants who had postgraduate and doctorate education were higher than the participants who had high school and graduate education ($p<0.05$). Lastly, the correct response rates for all of the items were similar among participants who had postgraduate and doctorate education.

No statistically significant difference was found according to the education levels for the correct answers of the 4th (Pelvic floor tension may be the cause of pelvic pain (a pain in the pelvis)), 7th (The pelvic floor is associated with the respiratory system), 8th (Pelvic floor weakness can cause pelvic pain), 13th (Smoking addiction can weaken the pelvic floor), 17th (Unconsciously compelling sports/exercise (such as jumping, lifting weights) can weaken the pelvic floor), and 24th items (In pelvic floor problems, besides the clinical examination, the patient's complaint is also important) ($p>0.05$).

DISCUSSION

As a result of our research, it was determined that men had less knowledge about the topics related to pelvic floor function/dysfunction, risk/etiology, diagnosis and treatment, and the awareness of those that have graduated from higher education was found to be higher. In the statements evaluating the level of knowledge, it was remarkable that about a quarter of men and about 1 in 10 women knew nothing.

Having basic knowledge about the functioning of organs and systems enables people to apply to the right specialist without loss of time in the presence of any health problem and paves the way for early intervention of the disease. In recent years, research on the pelvic floor has drawn attention to the role of training programs on pelvic floor health and exercises in reducing the symptoms of patients, increasing their knowledge level and quality of life (Berzuk & Shay, 2015; Blanchard, Nyangoh-Timoh, Fritel, Fauconnier, & Pizzoferrato, 2021). In the literature, there are different results in studies investigating the level of knowledge about the anatomical location and function of the pelvic floor in different population groups. Blanchard et al. (Blanchard et al., 2021), reported that only 15.2% of women knew the location of the pelvic floor correctly before pelvic floor muscle training. de Freitas et al. (de Freitas et al., 2019), reported that only 24.1% of 133 women participants over the age of 18 had accurate information about the location of the pelvic floor. In a study by Neels et al. (Neels et al., 2016), the rate of knowing the location of the pelvic floor accurately was reported as 92%. In this study, it was seen that 74.1% of women and 59% of men had correct information about the anatomical location of the pelvic floor. The fact that the studies were conducted in different sample sizes and groups may be the reason for the differences in the results.

Pelvic floor dysfunctions can be hidden due to the feeling of shame in society. Wala'a and Çelenay (Wala'a & Çelenay, 2021), found that 23.5% of 370 participants felt shame due to pelvic floor problems. The fact that the individuals think of pelvic floor problems as a natural consequence of pregnancy, old age, and menopause, and in addition to this, not sharing their problems with health professionals due to the feeling of shame reduces the success of preventive health practices.

This situation can also prevent patients from accessing information about the existence of different treatment methods. Only 13% of our participants stated that they heard the pelvic floor expression from friends and family; 77.2% of them reported that they heard it through television, lectures/online education, the internet, and social media. The results support that this issue is not talked about much even among individuals of the same sex in society. This situation can also be attributed to the cultural characteristics of Turkish society. Individuals can be informed about the pelvic floor by implementing training programs containing accurate information, especially through television, the internet, and social media. This situation can positively affect the individual and the health system in terms of early treatment, preventive health services, and health care costs.

The prevalence of UI varies between 23% and 70% in the literature (Arbuckle, Parden, Hoover, Griffin, & Richter, 2019; Kim, Lee, & Park, 2004; Perera, Kirthinanda, Wijeratne, & Wickramarachchi, 2014). The studies conducted in Turkey have shown that the rate of UI in women varies between 5.65% and 56.7% (Akkus & Pinar, 2016; Demir, Sen, Irer, Bozkurt, & Esen, 2017; Öztürk, Toprak, & Basa, 2012; Şimşek & Yağcı, 2022). Wala'a and Çelenay (Wala'a & Çelenay, 2021), reported that POP is seen in 3.5% of men and women over the age of 18. Yıldız et al. (Yıldız, Çakmak, Gencer, & Boyama, 2018) detected POP as 66.2% in perimenopausal women. In our study, it was determined that 25.7% of our participants had UI and 4.7% had POP. 77% of men and 53.9% of women stated that they did not have any pelvic floor problems. Our findings are in agreement with the literature. Pelvic floor disorders are common, especially in women (MacLennan et al., 2000). We think that women have a higher level of knowledge as a result of the fact that these problems are more common in women. In our study, it was determined that women had a higher level of knowledge on items related to UI and POP, which questioned the knowledge of the participants about pelvic organ dysfunction.

Fante et al. (Fante et al., 2019), reported in a systematic review that women could not identify risk factors for pelvic floor dysfunction. On the other hand, Hill et al. (Hill et al., 2017), found that pregnant women who attended antenatal education classes had a higher level of pelvic floor

awareness. In our study, we found that women gave more correct answers than men, especially for items stating that pregnancy, vaginal delivery, and menopause are risk factors. We think that the reason why women have more information about these risk factors than men may be because these processes are a part of female physiology. 72.7% of our female participants gave birth; 48.89% reported that they had experienced of vaginal delivery. One of the reasons why women had a higher level of knowledge than men in our study may be that they received information about risk factors in pelvic floor dysfunctions in pregnancy and birth preparation training and books during pregnancy and childbirth. Moreover, this research showed that the most of women and a low range of men, and also persons who had high education levels, had got a score of 20 and above from the PFHKQ. A 20-point is not a cut of value for this scale. On the other hand, it can be said that is a high knowledge level according to the total score because higher scores show better knowledge for the PFHKQ. Moreover in a study, Mamuk et al. (2022), reported that students who perceived a high level of knowledge about pelvic floor health also had significantly higher sub-scales scores (18 points for PFHKQ scale total score) in the pelvic floor functions and dysfunctions as well as pelvic floor dysfunction's etiology and risk factors. Our results showed that the pelvic floor health knowledge levels of participants, who are women with and high education level, were higher than the others. It can be said that this is an expected result according to the literature.

Exercise practices are important in pelvic floor problems. Among these applications, pelvic floor muscle training provides an improvement in symptoms in the presence of UI and POP in women (Li, Gong, & Wang, 2016; Woodley et al., 2020). In men, the effectiveness of pelvic floor muscle training in the treatment of erectile dysfunction and premature ejaculation has been demonstrated (Myers & Smith, 2019). Skaug et al. (Skaug et al., 2020) reported that in athletes 43% of women and 72.5% of men did not know how to train their pelvic floor muscles. In studies conducted in Turkey, while Mamuk et al. (Mamuk et al., 2018), reported that 91.1% of women working in the field of health had knowledge about pelvic floor muscle exercise; Süt and Küçükkaya (Süt & Küçükkaya, 2018) reported that 16.5% of 559 patients had knowledge about pelvic floor

muscle exercise. 71.4% of the participants in our study reported that regular physical activity and exercise were beneficial for pelvic floor problems. In addition, 70.9% of women and 59% of men stated that exercise can prevent pelvic floor problems. Since our research was planned online, the knowledge level of the participants about pelvic floor exercise practices and exercises could not be questioned in detail. It can be considered as one of the limitations of this research.

The pelvic floor is important for sexual health in both sexes. In the literature, there are studies investigating the level of knowledge about sexual health in Turkey. Aydın Sayılan and Özbaş (Aydın Sayılan & Özbaş, 2018) determined that 4.2% of graduate students started to learn information about sexual health during their university years. Koluacik et al. (Koluacik, 2010) reported that the knowledge level of sexual and reproductive health increased as age and grades progressed. These studies support our conclusion that those with graduate or higher education have more knowledge about the relationship between the pelvic floor and sexual health. The low level of knowledge of our participants those with elementary and high school education may be due to deficiencies in the education curricula. In Turkey, education on the reproductive system is given in the 7th grade at the elementary education level and in the 11th grade at the high school level. We think that adding basic information about the pelvic floor, sexual health, and reproductive health to these training programs in accordance with the age levels will be beneficial in terms of raising awareness in this area in general.

The strength of our study is that the level of knowledge of the pelvic floor in Turkey is questioned in both genders and all education levels.

As a result it was determined that the participants had insufficient knowledge about the relationship of the pelvic floor with other body systems, the causes, and types of pelvic problems. We think that these points may be included in the content of the education programs to be planned within the scope of preventive interventions. In addition, it can be beneficial to design the education programs according to the participants' education level, to reach the goals. In further studies, the evaluation of the knowledge level of participants including more men can be investigated and which interventions can

effectively increase their pelvic floor knowledge level can also be investigated.

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Author Contribution

BBK conceived and designed the study and conducted the research. Material preparation and data collection were performed by HA and AYÖ. ET performed the data analysis and statistical interpretation and wrote part of the results section. The first draft of the manuscript was written by BBK and all authors commented on previous versions of the manuscript. All the authors have critically reviewed and approved the final draft and are responsible for the content.

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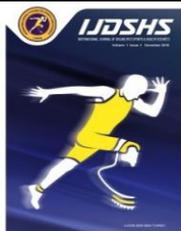
Supplement

	1--2	1--3	1--4	1--5	2--3	2--4	2--5	3--4	3--5	4--5
Item 1. Urinary incontinence is a pelvic floor problem.	0,532	0,128	0,009*	0,027*	0,782	0,005*	0,229	0,110	1,000	1,000
Item 2. Pelvic organ (bladder, uterus, bowel) prolapse is one of the pelvic floor problems.	0,683	0,172	0,007*	0,013*	0,75	0,001*	0,047*	0,033*	0,32	1,000
Item 3. Fecal or gas incontinence is not a pelvic floor problem.	0,382	0,116	0,027*	0,107	1,000	0,179	1,000	1,000	1,000	1,000
Item 4. Pelvic floor tension may be the cause of pelvic pain (a pain in the pelvis).	1,000	0,928	0,123	0,123	1,000	0,276	1,000	0,176	1,000	1,000
Item 5. Pelvic floor problems are not associated with low back pain.	0,256	0,093	0,036*	0,07	1,000	0,748	1,000	1,000	1,000	1,000
Item 6. The pelvic floor is important in sexual health.	0,064	0,004*	0,00*	0,00*	0,106	0,00*	0,008*	0,087	0,191	1,000
Item 7. The pelvic floor is associated with the respiratory system.	1,000	1,000	0,305	0,183	1,000	0,601	0,517	0,195	0,29	1,000
Item 8. Pelvic floor weakness can cause pelvic pain.	1,000	0,588	0,279	0,111	0,777	0,331	0,183	1,000	0,959	1,000
Item 9. Pelvic floor problems can have many causes.	0,015*	0,004*	0,00*	0,001*	1,000	0,02*	0,254	0,074	0,613	1,000
Item 10. Pregnancy can adversely affect the pelvic floor.	0,069	0,006*	0,00*	0,002*	0,17	0,001*	0,15	0,076	1,000	1,000
Item 11. Having vaginal birth too many times can weaken the pelvic floor.	0,292	0,027*	0,001*	0,007*	0,084	0,00*	0,105	0,026*	1,000	1,000
Item 12. The probability of pelvic floor problems is low in obese individuals.	0,356	0,018*	0,072	0,002*	0,009*	1,000	0,01*	1,000	0,514	0,337
Item 13. Smoking addiction can weaken the pelvic floor.	0,934	0,615	0,556	0,302	1,000	1,000	1,000	1,000	1,000	1,000
Item 14. Weight bearing continuously can damage the pelvic floor.	0,661	0,245	0,041*	0,035*	1,000	0,095	0,221	0,537	0,704	1,000
Item 15. Constipation can cause weakening of the pelvic floor.	1,000	0,307	0,034*	0,846	0,57	0,008*	1,000	0,212	1,000	1,000
Item 16. Pelvic floor problems are more common in younger people than older people.	0,922	0,28	0,012*	0,068	1,000	0,001*	0,323	0,026*	1,000	1,000
Item 17. Unconsciously compelling sports/exercise (such as jumping, lifting weights) can weaken the pelvic floor.	1,000	1,000	1,000	1,000	1,000	0,928	1,000	0,627	1,000	1,000

The Knowledge of Pelvic Floor and Pelvic Floor Disorders

Item 18. The postural disorder does not affect the pelvic floor.	0,618	0,16	0,03*	0,061	0,854	0,06	0,527	0,75	1,000	1,000
Item 19. Menopause can affect pelvic floor problems.	0,246	0,155	0,003*	0,177	1,000	0,004*	1,000	0,004*	1,000	1,000
Item 20. Some medications can cause pelvic floor problems.	0,244	0,287	0,01*	0,02*	1,000	0,086	0,51	0,016*	0,287	1,000
Item 21. Surgical approaches to the pelvic organs (bladder, prostategland, uterus...) can weaken the pelvic floor.	0,365	0,287	0,017*	0,053	1,000	0,079	0,933	0,053	0,975	1,000
Item 22. The patient examination is important in determining pelvic floor problems.	1,000	1,000	0,567	0,142	1,000	0,042*	0,017*	0,214	0,063	1,000
Item 23. Some special tests are used to identify pelvic floor problems.	1,000	1,000	0,06	0,017*	1,000	0,008*	0,009*	0,012*	0,014*	1,000
Item 24. In pelvic floor problems, besides the clinical examination, the patient's complaint is also important.	1,000	1,000	0,784	0,398	0,599	0,074	0,104	1,00	0,681	1,000
Item 25. Pelvic floor exercises can prevent pelvic floor problems.	1,000	1,000	0,504	0,216	0,319	0,004*	0,012*	0,178	0,155	1,000
Item 26. Physiotherapy can be used to treat pelvic floor problems.	1,000	1,000	0,084	0,268	1,000	0,00*	0,008*	0,00*	0,037*	1,000
Item 27. Medication is the only treatment for pelvic floor problems.	0,14	0,008*	0,001*	0,00*	0,033*	0,002*	0,001*	0,531	0,054	1,000
Item 28. Surgery may not be the definitive solution for pelvic floor problems.	0,117	0,010*	0,001*	0,002*	0,136	0,002*	0,07*	0,171	0,884	1,000
Item 29. Regular physical activity and exercise are helpful for pelvic floor problems.	0,296	0,037*	0,005*	0,011*	0,197	0,01*	0,179	0,53	1,000	1,000

Supplement 1. The Effect of Education Level on the Knowledge Level of Pelvic Floor 1: Elementary School, 2:High School, 3:Graduate, 4:Postgraduate, 5:Doctorate; *p<0,05



REVIEW ARTICLE

Effect of Movement Tempo During Resistance Training on Hypertrophy and Muscular Fitness: A Narrative Literature Review

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Abstract

Although many studies have demonstrated whether movement tempo, a training variable during resistance exercise, has an effect on muscle performance, there are still gray areas related to muscle hypertrophy and muscular fitness in different populations. The aim of this narrative systematic review was to investigate the effect of movement tempo on muscular performance such as maximal strength, skeletal muscle hypertrophy, muscle power and muscular endurance in resistance training performed at specific frequencies. Three electronic databases were searched using terms related to movement tempo and resistance training. The included studies were those published in English using randomized and non-randomized comparative dynamic resistance exercise interventions in healthy adults. The results suggest that changing the tempo of movement during resistance training may have an effect on muscle hypertrophy, but the results are not conclusive. There are conflicting research results, although faster tempos seem to be advantageous in terms of power outcomes at different movement tempos. More studies are needed to evaluate muscular endurance performance in terms of movement tempo. Differences in the size of the muscles studied, the structure of the training programs, and the standardization of the experimental approach and data collection tools used may partially explain the inconsistency in the results between tempos in different contraction phases or in the same contraction phases.

Keywords: Movement Tempo, Muscular Fitness, Resistance Training

INTRODUCTION

Resistance exercise program is widely used by athletes and sedentary individuals to improve physical fitness components. When designing a resistance exercise program, there are some acute training variables that can be manipulated to adapt the targeted fitness component (Baechle, Earle, & Wathen, 2008). Among the physical fitness components, resistance training is the most important type of exercise to achieve muscular fitness. The manipulation of exercise program variables is important in order to obtain a maximal muscular performance response after a resistance

exercise program. When programming resistance training, the primary training variables include number of sets, number of repetitions, rest between sets, training volume, exercise selection, intensity (load) and movement tempo (Bird, Tarpenning, & Marino, 2005). Among these variables, movement tempo is usually the most ignored variable. Repetition rate in resistance exercises is often defined as the tempo of a resistance exercise (Schoenfeld, Ogborn, & Krieger, 2015). The term tempo refers to the speed at which each repetition is performed. This tempo of movement can be conscious and unconscious. To illustrate this, a slow tempo may occur involuntarily during

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resistance training, which is unintentional due to a heavy load or fatigue (Mookerjee & Ratamess, 1999). In contrast, a voluntarily slow tempo can be used when the load is light enough to be controlled and fatigue does not affect one's ability to control movement speed. Regardless of whether movement tempo is voluntary or involuntary, movement tempo in resistance exercise is often communicated as a training variable using a series of digits where each digit describes the duration of a particular phase of movement (Wikl et al., 2021). For example, the movement tempo variable 2:0:X:0 refers to the eccentric, isometric, concentric and isometric phases in a resistance workout. 2:0:X:0 indicates an eccentric phase of two seconds, no intentional isometric pause during the transition phase, the maximum possible movement tempo during the concentric phase, and no pause between the completion of the concentric phase and the beginning of the next eccentric phase. As we mentioned before, since movement tempo is also classified as voluntary, V:0:V:0 can be used in training programs to express the use of voluntary speed. In addition, X:0:X:0 is used as a movement tempo variable in explosive strength training at the maximum possible speed with the load worked at the time of exercise. Some sources have suggested the use of 3-digit numbers for the repetition rate variable, which represents the sum of concentric, eccentric and isometric components of a repetition (Ogborn and Schoenfeld, 2014). Westcott et al. (2001) recommended 2:1:4 as the best standard for tempo in resistance exercise repetitions. Here, 2:1:4 tempo defines a two-second concentric phase, a one-second isometric phase and a four-second eccentric phase.

Furthermore, although resistance training volume is often thought of in terms of sets, repetitions and total work, a concept called time under tension (TUT) can also be considered as a relevant variable. TUT can be defined as the total time a muscle or muscle group is subjected to mechanical stress during resistance exercise. In addition, it should be noted that there is no uniform terminology to describe the tempo of resistance exercise. Since there is no uniform terminology defining the value of tempo of movement in our study, we used the following criteria (Table 1.). This confusion in terminology provides a

limitation for the evaluation of studies. The tempos mentioned above can be manipulated voluntarily in studies. Here, fatigue after exercise intensity is two important factors. Exercise at higher intensities lasts longer; concentric movement is slower at these loads. According to the force-velocity relationship, maximal strength production decreases as contraction velocity increases (Rogatzki et al., 2014). Therefore, lifters performing a fast movement experience a higher percentage of their maximum strength capacity to produce a given strength. Therefore, it can be predicted that training at a higher speed may reduce the number of repetitions that can be performed with a given weight. The decrease in power output with the onset of fatigue leads to a decrease in speed. A study by Mookerjee and Ratamess (1999) shows that partial range of motion in bench press exercise significantly increases bench press performance in both 1 RM and 5 RM conditions. For 1RM full range of motion, joint movement times during the flexion phase are significantly shorter than during the extension phase. For 5 RM, flexion times were significantly increased during both full and partial range of motion. Exercises performed at high intensities allow the concentric lift to change its tempo. Considering that eccentric strength is greater than concentric strength (Armstrong et al., 2022), different movement tempos and the contraction phases used in these movement tempos may produce differences in muscular performance with the training intensity variable. So far, there are review and meta-analysis studies evaluating muscular performances (hypertrophy, maximal strength, power) with research on movement tempos (Schoenfeld et al., 2015; Davies et al, 2017; Hackett et al., 2018; Wilk et al., 2021; Moreno-Villanueva et al., 2022). However, these studies did not present a holistic perspective as in our study. In addition, muscular endurance, which is an important muscular performance ability, was never evaluated in any of these studies. Furthermore, the effect of movement tempo on maximal strength, power, hypertrophy and muscular endurance at each stage of muscle movement is still not understood. Therefore, the aim of this review was to identify articles evaluating different contraction phases and tempo

of movement during resistance training programs and analyze how tempo of movement influences

strength, power, muscle hypertrophy and muscular endurance adaptations.

Table 1. Movement tempo classification.

Four-digit movement tempo variable	Example: 2:0:1:0
Three-digit movement tempo variable	Example: 2:1:2
Self-selected movement tempo variable	Example: SS:0:SS:0
Explosive strength movement tempo variable	Example: X:0:X:0
Isokinetic dynamometer tempo variable	Example: 30°/s or 180°/s

MATERIALS AND METHODS

Database Search

A literature search was conducted from 20/11/2022 with the last search being performed on 15/05/2023 with the years of research obtained from 1950-2023. Google Scholar, PubMed, Scopus databases were searched for all studies investigating the movement tempo. The research was performed using the following keyword combinations: ('repetition duration or 'tempo of movement ' or 'velocity of movement') and ('hypertrophy' or 'muscle mass' or 'strength' or 'muscle endurance' or 'muscle power' resistance exercise' or 'performance').

Inclusion and Exclusion Criteria

The literature search was conducted in November 2022 and included articles that were published from 1980 to May 2023. Study abstracts that did not provide sufficient information according to the inclusion criteria were retrieved for full-text evaluation This narrative literature review were conducted in accordance with the recommendations outlined in the Preferred Reporting Items for Systematic Reviews (PRISMA) statement (Moher, Liberati, Tetzlaff, & Altman, 2009).

In addition to this the studies must further have completed the inclusion criteria seen in Table 2.

Table 2: Study eligibility criteria.

1	Study published within the years of 1980–2023.
2	English language.
3	Study was conducted on both male and female participants.
4	Participants must have been healthy and have no injuries, disability, or illness.
5	Adult participants (≥18 years of age)
6	Analysed the chronic training effects (4≥ weeks).
7	Dynamic resistance training intervention
8	Studies must have completed research via a comparative measure.
9	Measured changes in muscular hypertrophy using some direct and indirect measures (e.g. MRI, ultrasound, muscle biopsy, DXA and air displacement plethysmography)

Quality analysis

Methodological quality of studies meeting the inclusionary criteria was assessed using a modified Downs and Black quality assessment tool (Downs

& Black, 1998). Scores range from 0 to 29 points, with higher scores reflecting higher-quality research.

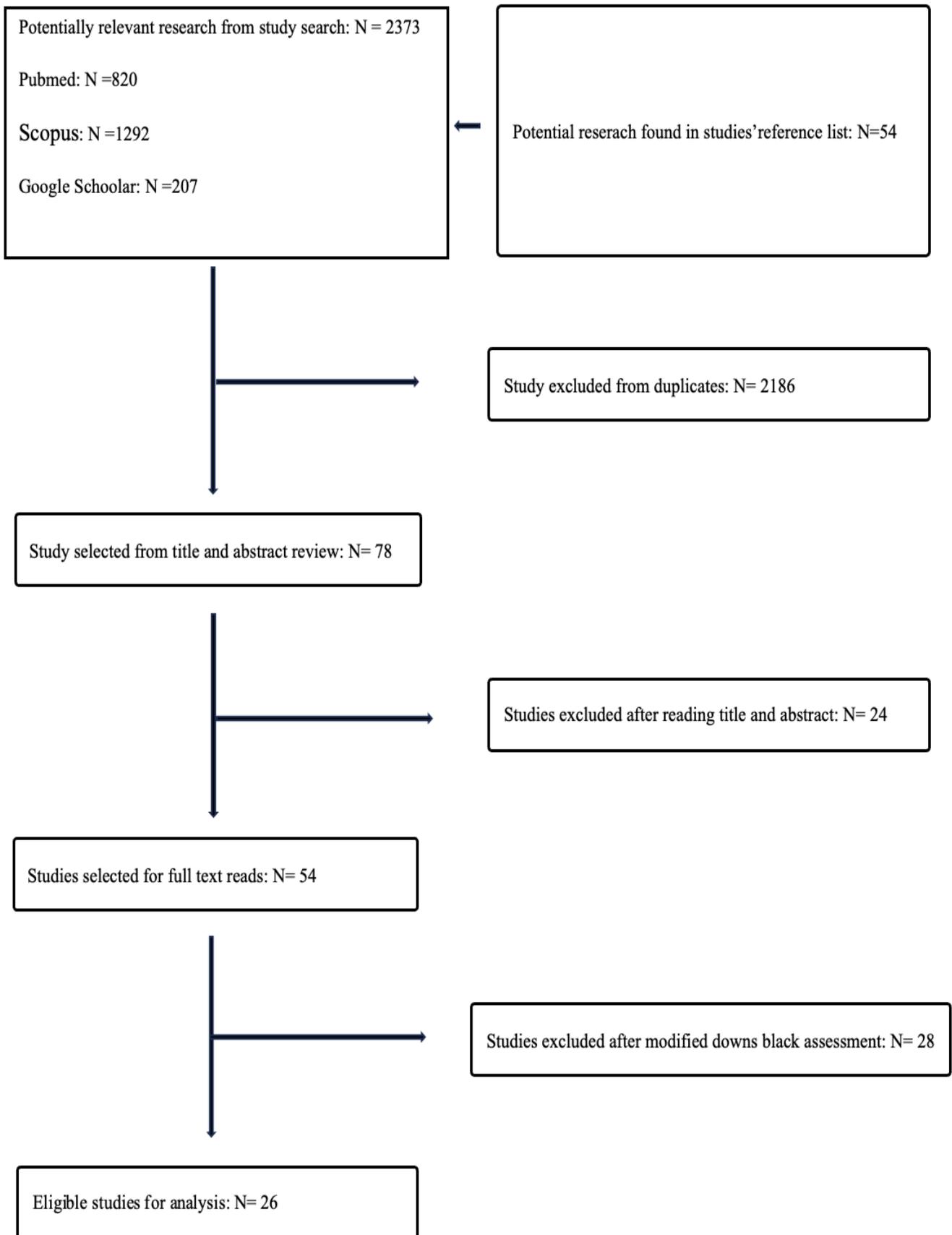


Figure 1: Study eligibility criteria.

RESULTS

Table 4 Experimental details of the studies in muscle hypertrophy with muscular fitness (Maximal Strength, Muscle Endurance and Power)

Study	Subjects	Age (year) ± (SD)	Protocols	Duration weeks	Frequency days/week	Measurement	Main Findings
Keeler et al. (2001)	14 healthy, sedentary women	32.2±9.4 33.4±8.5	Leg extension, leg curl, leg press, bench press, Rowing, anterior Lateral pull-down, Biceps Curl, Triceps Extension, 1 set × 8–12 repetitions 5/0/10/0 (50% 1RM) 4/0/2/0 (80% 1RM)	10	3	BodPod 1RM Test	No significant differences in body composition, both groups increased their strength significantly on all 8 exercises, 4/0/2/0 group increased significantly more than the 5/0/10/0 group on bench press, anterior lateral pull-down, leg press, leg extension and leg curl.
Neils et al.(2005)	16 healthy untrained men and women	23.2 ± 2.9 21.4 ± 1.5	Squat, Leg Extension, Leg curl, Upright row, Bench Press, Biceps Curl, Triceps Extension 1 set × 6–8 repetitions 5/0/10/0 (50% 1RM) 4/0/2/0 (80% 1RM)	8	3	DXA 1RM Test Force Plate (CMJ and SJ)	No significant differences in body composition. The 4/0/2/0 and 5/0/10/0 groups improved in strength the squat bench press, respectively. Peak power for the CMJ increased significantly in the TS group, no such increase was seen with respect to the 5/0/10/0 group. Both groups' 1RM increased significantly for both the bench press and the squat.
Rana et al.(2008)	34 untrained young females	20.6± 1.9 19.4 ± 1.3 22.3 ± 3.9 22.9 ± 2.4 C	Leg Press, Back Squat, And Knee Extension 3 set × 6-10 RM 4/0/10/0 3 set × 6-10 RM 2/0/1/0 3 set × 20-30 RM 2/0/1/0	6	3	BodPod 1RM Test Vertec device (VJ) 60% of 1 RM Test	Body composition improved for all groups including C (significant main effect). 4/0/10/0 increased relative leg press and knee extension 1 RM, but the percent increase was smaller than 2/0/1/0 (6-10 rep), and not different from C in the back squat. For muscular endurance, 4/0/10/0 improved similarly to 2/0/1/0 (20-30 rep) for leg press and less than 2/0/1/0 (6-10 rep) and 2/0/1/0 (20-30 rep) for knee extension.
Schuenke et al.(2012)	34 untrained young women	20.6 ± 1.9 22.3 ± 3.9 19.4 ± 1.3 22.9 ± 2.4 C	Squat, leg press, leg extension 3 sets × 6-10 repetitions 2/0/1/0 (80 85% 1RM) 4/0/10/0 (40–60% 1RM) 3 sets × 20-30 repetitions 2/0/1/0 (80 85% 1RM)	6	3	Biopsy 1RM Test	The percentage of type IIX fibers decreased and IIA increased in all three training groups. Only 2/0/1/0 (6-10 rep) showed an increase in percentage of type IIA fibers. CSA of fiber types I, IIA, and IIX increased in 2/0/1/0 (6-10 rep). In 4/0/10/0, only the CSA of IIA and IIX fibers increased.

Tanimoto and Ishii (2006)	24 untrained young men	19.0±0.6 19.5±0.5 19.8±0.7	Knee Extension 3 set × Max repetitions 1/1/1/0 (50% 1RM) 1/1/1/0 (80% 1RM) 3/1/3/0 (50% 1RM)	12	2	MRI Isometric Strength Test	3/1/3/0 and 1/1/1/0 (80% 1RM), exercise training caused significant increases in cross sectional area determined with MRI and isometric strength of the knee extensors, whereas no significant changes were seen in 1/1/1/0 (50% 1RM).
Watanabe et al. (2013)	35 untrained men	66.8 ± 3.8 66.8 ± 5.2	Knee Extension and Knee Flexion 3 sets × 8 repetitions 1/1/1/0 (80–90% 1RM) 3/1/3/0 (55–60% 1RM)	13	2	Ultrasound Isokinetic Strength Test	3/1/3/0 significantly increased thigh muscle thickness as well as isometric knee extension and flexion strength. 1/1/1/0 significantly increased strength, but its hypertrophic effect was limited.
Pereira et al. (2016)	12 healthy adults	28.3 ± 8.2 30.3 ± 5.6	Scott curl 3 sets × 8 repetitions less than 8 reps or more than 8 reps, the weight load was adjusted (1/0/1/0) (1/0/4/0)	12	2	Ultrasound 1RM Test	No significant differences were found between groups for hypertrophy and muscular strength.
Gillies et al. (2006)	28 female adults RT experience	24.3 ± 1.1	Bilateral Incline Leg Press, Parallel Squat, Bilateral Leg Extension and Leg Extension (2/0/6/0) 3 sets × 6-8 RM (6/0/2/0) 3 sets × 6-8 RM	9	3	Biopsy 1RM Test	Both groups experienced significant increases in leg press maximal strength. Immunohistochemical analyses demonstrated that both types I and IIA vastus lateralis fibre areas significantly increased following (2/0/6/0) training while only type I fibre area increased following (6/0/2/0) training.
Diniz et al. (2022)	44 untrained women	25.3±34.1 C 20.8±2.0 21.3±3.5 21.3±1.9	Knee Extension 3–5 sets × 6 repetitions at 50% 1RM (5/0/1/0) (3/0/3/0) (1/0/5/0)	10	3	MRI	The change in CSA of the rectus femoris at the middle region are greater in (5/0/1/0) and (1/0/5/0) groups than (3/0/3/0) and control groups. In addition, vastus lateralis at the distal region presenting greater increases in change of CSA than the others vastus only (5/0/1/0).
Azevedo et al. (2022)	Ten healthy young adults (8 men, 2 women)	25.3±4.8	Unilateral Knee Extension 5 sets 70% of 1RM until muscle failure (2/0/1/0) (4/0/1/0)	8	2	Ultrasound	Both a 2 second and 4 second eccentric duration promote similar improvements in whole muscle hypertrophy and strength of the lower limbs.
Chavez et al. (2020)	20 healthy untrained men	24.7 ± 2.9	Leg Extension 3 sets 70% of 1RM until muscle failure (2/0/2/0) (SS/0/SS/0) (volum equal) (SS/0/SS/0) (volum not equal)	8	2	Ultrasound 1RM test	All training protocols showed significant increases in values of 1-RM from Pre to Post. No significant main effect of group or groups vs. time interaction were found. Vastus lateralis muscle CSA values increased for all training protocols from Pre to Post. No significant main effect of group or groups vs. time interaction were found.

Repetition Duration During Resistance Training on Muscular Performance

Unlu et al.(2020)	41 young, healthy males	20.5±1.9 20.1±1.4 21.6±0.5 22.4±1.5 20.9±2.3 21.3±2.4 C	Knee Extension 3-5 sets × 6-10 repetitions at 115-50% 1RM HV 180°/s - LV 30°/s – CO/EC 180°/s	12	3	MRI Isokinetic Strength Test	Significant increases compared with the control group were found for muscle isotonic strength and isokinetic peak torque at 60°/s in all training groups after the 12 weeks of the training period. There was no statistically significant interaction between groups and time on muscle volume.
Usui et al.(2015)	16 healthy young men	22.2 ± 2.1 22.5 ± 0.5	Parallel Squat 3 sets × 10 repetitions at 50% 1RM (exercise load adjusted every week) (1/0/1/1) (3/0/3/0)	8	3	Ultrasound 1RM test Custom-made lifting power test Isokinetic Strength Test	The (3/0/3/0) group significantly (increased muscle thickness (6–10 %), isometric hip extension torque (18 %) and 1-RM squat(10 %), but not isometric knee extension torque, lifting power, leg extension power and vertical jump height.
Carlson et al. (2019)	59 male and female aduts RT experince	39 ±14 39 ±10 42 ±14	Two workouts were performed (A & B, all muscle group) (4/0/2/0) 8-12 RM (10/0/10/0) 3-5 RM (30s CO/30sEC/30sCO) 1-5 RM	10	2	BodPod 1RM test	Analyses revealed significant increases in strength for all exercises but no between group differences, and no statistically significant time course changes for the other variables.
Fisher et al. (2016)	59 male and female aduts RT experince	39 ±1.2 40 ±1.1 39 ±1.4	Leg Press, Leg Extension, Leg Curl, Chest Press, Pec Fly, Over Head Press, Pull Over (1 traditional (4/0/2/0) and 1 eccentric (10/0/0/0+%30 load) each week) 8-12 RM (10/0/2/0) 6 RM (4/0/2/0) 8-12 RM	10	2	BodPod 1RM test Muscular performance test	No significant between groups differences were identified for change in muscular performance measures for leg press or chest press exercises, or for body composition changes. Significantly greater improvement for (4/0/2/0) compared to other groups for change in absolute muscular endurance for the pull-down exercise. Effect sizes for muscular performance changes were moderate to large for all groups and exercises.
Claflin et al. (2011)	63 young and old untrained men and women	24.2± 2.3 76.0 ±3.8, 24.9± 2.7 75.2± 4.3	Leg Press 350 and 250°/s 90 and 30°/s, Knee Extension 160 100°/s, and 40 and 20°/s	14	3	Biopsy	Both types of RT 8-12 % increase in type II fibers, No effect of training on type I fibers
Nogueira et al. (2009)	24 older male	66.64 ± 5.68 66.33 ± 4.53	Leg Press, Knee Extension, Knee Flexion, Chest Press, Seated Row, Elbow Extension, And Elbow Flexion 3 sets × 8 repetitions 3/0/1/0 (40,50 and 60% 1RM) 3/0/3/0 (40, 50 and 60% 1RM)	10	2	Ultrasound 1RM test Peak muscular power test	Training-induced gains in strength were similar between groups, however 3/0/1/0 induced significantly greater development in muscle power. There were significant increases in rectus femoris muscle thickness for 3/0/1/0 but not for 3/0/3/0. There were not significant differences in the post training values of muscle thickness between groups. Biceps brachii muscle thickness significantly increased for both 3/0/1/0 and 3/0/3/0.

SD standart deviation, CSA cross-sectional area, °/s degrees per second, DXA dual x-ray absorptiometry, FFM fat-free mass, MRI magnetic resonance imaging, RM repetition maximum, RT resistance training, C Control, RM repetition maximal, CO concentric, EC eccentric, HV high velocity, LV low velocity, CMJ counter movement jump, VJ vertical jump, SJ squat jump

Table 5 Experimental details of the studies muscular fitness (Maximal Strength, Muscle Endurance and Power)

Study	Subjects	Age (year) ± (SD)/ Group	Protocols	Durati on weeks	Frequency days/week	Measurement	Main Findings
Gois et al. (2014)	105 healthy men	22±3 C 20±3 21±2.5	Knee Extensions 3 set × 1-8 repetitions (1/0/3/0) 80-100 % 1 RM (3/0/1/0) 80-100 % 1 RM	4	3	1RM test	The 1 TM test revealed an increase in muscle strength at the final timepoint in relation to the baseline for the (3/0/1/0) group.
Liow and Hopkins (2003)	27 male and 11 female sprint kayakers	22.0 ± 4.0 C 23.0 ± 5 23.0 ± 6	Bench Press and Dumbbell Rowing 3 sets to failure at 80% 1 RM Both groups (~1.7 s for the eccentric phase). LV (~1.7 s for the concentric phase). HV “explosively, as fast as possible” (in 0.86 s)	6	2	1RM Test Kayak sprint test	Relative to control, both types of weight training substantially improved strength and sprint performance. The improvements in mean sprint time over 15 m in each group.
Morrissey et al.(1998)	21 healthy college-age female	24.0 ± 3.0 24.0 ± 4.0	Barbell squat 3 sets × 8 repetitions 1/0/1/0 (8 RM) 2/0/2/0 (8 RM)	7	3	Isokinetic Strength Test Long jump tests	In the long jump, 1/0/1/0 was superior in numerous variables including knee peak velocity and total body vertical and absolute power. In isokinetic testing, 1/0/1/0 improved strength most at the faster velocities, while the 2/0/2/0 strength changes were consistent across the velocities tested.
Munn et al. (2005)	115 untrained healthy subjects (21 males and 94 females)	20.6 ±6.1	Elbow Flexion 1-3 set to failure at 6–8 RM 1/0/1/0 (8 RM) 1 Set 3/0/1/0 (8 RM) 3 Set 1/0/1/0 (8 RM) 3 Set 3/0/1/0 (8 RM) 1 Set	7	3	1RM Test	1 set 3/0/1/0 increased strength by 25% . Three sets of training produced greater increases in strength than one set and fast training resulted in a greater increase in strength than slow training. The interaction between sets and speed was negative and of borderline significance.
Pareja-Blanco et al. (2014)	21 untrained men	23.3 ± 3.2 23.3 ± 3.2	Parallel Squat (isoinertial) 3–4 sets 2–8 repetitions at 60–80% 1 RM maximal intended concentric (0.49m/s) half-maximal intended concentric (0.82m/s) controlled eccentric (~0.50–0.65m/s)	6	3	20-m sprint Test Jump Test (CMJ) progressive isoinertial loading Test	Training resulted in a significant increase in 1RM squat strength and isoinertial strength for both groups. Greater intra-group effect size in all isoinertial strength variables were found for maximal intended CON velocity when compared to half- maximal CON velocity. A significant ‘group’×‘time’ interaction was observed for CMJ height , whereas no significant interactions were found for T10 or T20.
Fielding et al. (2002)	30 untrained men	73.2 ± 1.2 72.1 ± 1.3	Knee extension, Leg Press 3 sets × 8 repetitions	16	3	1RM Test	Leg press and knee extension relative training strength and total work were similar between groups. However, 2/1/X/0 generated significantly higher power during training sessions than 2/1/2/0 for leg press and knee extension. Although leg press and knee

			2/1/X/0 (70% 1RM) 2/1/2/0 (70% 1RM)			Peak Muscle Power Test	extension 1RM muscle strength increased similarly in both groups as a result of the training, leg press peak power increased significantly more in 2/1/X/0 than in 2/1/2/0 . Furthermore, 2/1/X/0 resulted in a significantly greater improvement in leg press power at 40%, 50%, 60%, 70%, 80%, and 90% of the 1RM than did 2/1/2/0.
Mike et al. (2017)	30 college-aged males	22 ± 2.1 22 ± 2.1 23 ± 4.2	Plate-Loaded Barbell Smith Squat (2/0/2/1) 4 sets × 3-6 RM (4/0/2/1) 4 sets × 3-6RM (6/0/2/1) 4 sets × 3-6RM	4	2	1RM Test Plyometric Platform Test	Significant group x time interaction effects were found for average power production across all three sets of a squat jump protocol while vertical jump did not reach significance but there was a trend towards a difference. No other significant group x time interaction effects were found for the performance variables. All groups showed significant main effects for time in 1RM, vertical jump, peak power and average power.
Wei Lu et al.(2023)	17 healthy resistance-trained men	18.5 ± 0.5	Smith Machine Back Squat (2/0/2/0) 5 sets × 3 repetitions at 85 % 1RM (1/0/1/0) 5 sets × 3 repetitions at 85 % 1RM	8	3	1RM test Jump Test (CMJ)	Maximal strength, jump height, peak power and strength of the two groups were significantly improved. In addition, peak velocity significantly increased after the intervention in the (1/0/1/0) group, but not in the (2/0/2/0) group. A significant interaction effect between training groups was observed for jump height. However, no significant group by time interaction effects were found between training groups for maximal strength.
Bottaro et al.(2007)	24 inactive male subjects	66.6 ± 5.8 66.3 ± 4.8	Leg Press, Knee Extension, Knee Flexion, Chest Press, Seated Row, Elbow Extension, Elbow Flexion 3 sets × 8-10 repetitions X/0/X/0 (60% 1RM) 2-3/0/2-3/0 (60% 1RM)	10	2	1RM Test Isokinetic Strength Test	There was also an insignificantly greater improvement in muscular power in the X/0/X/0 group. There was no significant difference between groups in improved muscular strength.

SD standard deviation, CSA cross-sectional area, °/s degrees per second, DXA dual x-ray absorptiometry, FFM fat-free mass, MRI magnetic resonance imaging, RM repetition maximum, RT resistance training, C Control, RM repetition maximal, CO concentric, EC eccentric, HV high velocity, LV low velocity, CMJ counter movement jump, VJ vertical jump, SJ squat jump

DISCUSSION

Influence of Movement Tempo on Muscle Hypertrophy

Muscle hypertrophy, like many resistance training variables, can be influenced by manipulation of movement tempo, and research suggests that a wide range of movement tempos can be used during resistance training to elicit skeletal muscle growth (Schoenfeld et al., 2015; Davies et al., 2017; Wilk et al., 2021). The primary hypothesis in research on movement tempo for muscle hypertrophy is that intentionally extending the duration of repetitions leads to a superior hypertrophic response, and hypothetically, increased mechanical tension could promote a greater hypertrophic response by positively mediating intracellular anabolic signals (Schoenfeld, 2020). As we mentioned earlier, the concepts of movement tempo as a resistance exercise program variable are complex, as seen in research, but tempos that refer to eccentric, isometric, concentric, and isometric phases (e.g., 2/0/2/0), mostly consisting of four numbers, were generally used in research. In some studies, 3-digit numbers representing the sum of the concentric, eccentric and isometric components and angular velocities were specified as tempo in studies in which exercise was practiced with isokinetic dynamometers. In addition, while some studies compared eccentric and concentric phases for slow, medium or fast tempos, some studies compared a single contraction phase over different tempos. Within these studies, different resistance exercise intensities were also applied for similar tempos.

Some of the studies comparing different movement tempos dealt with traditional tempos and slower tempos. In these studies, although the movement tempos were characterized as traditional, 4/0/2/0 (80% 1RM) and 2/0/1/0 (80-85% 1RM) tempos were used as traditional resistance exercise tempos. Schuenke et al (2012) found a significantly greater increase in total mean fiber CSA in the conventional and super slow training protocol. The

training intensity of 4/0/10/0 and 40-60% 1RM for the super slow training protocol and 2/0/1/0 and 80-85% 1RM for the fast training protocol were determined and the training was performed for 3 sets of 6-10 repetitions until muscle exhaustion. The result of this study showed that strength training at slow speed elicited greater adaptation compared to training with similar resistance at "normal" speed, but training at higher intensity at "normal" speed resulted in the greatest overall muscle fiber response in each of the variables evaluated. In contrast, in another study using direct measurement by muscle biopsy, a similar level of hypertrophy response was obtained in both slow and fast tempo protocols (Claflin et al., 2011). In this study, the exercises were determined by means of an isokinetic dynamometer and the average repetition time was lower than in the study by Schuenke et al. In this case, it can be said that slow tempos have a limit in themselves. A follow-up study after this study found that satellite cell content was also significantly higher among fiber types after conventional training compared to super-slow training (Herman-Montemayor et al., 2015). In this study, the variable of voluntarily very slow movement tempo stimulated type IIx high-threshold fibers more. The results showed that although fatigue caused progressively greater recruitment of high-threshold motor units during light load training, the extent of high-threshold recruitment was greater during heavier loading. Although motor unit recruitment is necessary for muscle hypertrophy to occur, recruitment alone is not sufficient to promote hypertrophy; one of the most important factors is metabolic stress (Signorile et al., 2014; Tomeleri et al., 2020). Metabolic stress is the exercise-induced accumulation of metabolites, particularly lactate, inorganic phosphate and H⁺ (Schoenfeld, 2020). Some researchers have speculated that metabolite accumulation may have a greater effect on muscle hypertrophy than high-strain development (Ter Haar Romeny et al., 1982; Lacerda et al., 2016), but other researchers dispute this claim (Fonseca et al., 2014). In a study comparing energy expenditure and blood lactate responses to exercise at 2/0/2/0 (slow), 1/0/1/0 (recreational exercise) and 2/0/X/0 (fast) movement tempos in trained and untrained men, blood lactate concentrations continued to increase significantly at +90 and +120 minutes after 2/0/2/0

(slow) movement tempo in trained and untrained men compared to other groups (Mazzetti et al., 2007). Although the results of this study suggest that the slow movement tempo protocol induces more metabolic stress, it is insufficient to associate it with hypertrophy.

In addition, some studies dealing with traditional tempos and slower tempos do not reveal different results. Neils et al. (2005) compared a traditional training protocol of 4/0/2/0 movement tempo with 80% 1RM intensity with 5/0/10/0 50% 1RM. Keeler et al. used the same training protocols in their study, but no significant change in fat-free mass (FFM) was found in both studies. In another study in which FFM was measured, no significant difference was observed between 4/0/2/0 8-12 RM, 10/0/10/0 3-5 RM, 30s CO/30sEC/30sEC/30sCO 1-5 RM exercise protocols in terms of hypertrophy in the main effect (Carlson et al.,). Regarding FFM measurements, 3 months of resistance exercise training in adolescents resulted in a significant increase in appendicular skeletal muscle size when MRI was used as the measurement method, but there was no significant difference in fat-free mass by DXA (Lee and Kuk, 2013)²⁰. Another study, this time in older adults, reported increases in thigh muscle size after a 1-year resistance training protocol measured by CT but not by DXA (Nelson et al., 1996). One study found that DXA was unable to accurately detect changes in lean mass in response to resistance exercise, strongly questioning the recent recommendation that it be considered the "reference standard" for muscle measurement (Tavoian et al., 2019). Another study by Rana et al. (2008) showed significant increases in FFM from baseline to post-study in all groups, including the control group, that underwent a 4/0/10/0 (6-10 RM), 2/0/1/0 (6-10 RM), 2/0/1/0 (20-30 RM) training protocol. It is interesting to note that the control group achieved similar FFM gains as the other groups despite not performing any exercise during the 6-week training protocols. Therefore, the results of these studies should be interpreted cautiously when trying to draw evidence-based conclusions about the hypertrophic effects of training speed.

A study on the effect of changes in movement tempo of eccentric and concentric phases on muscle hypertrophy compared training programs with light load (3/1/3/0; 50% 1RM), heavy load (1/1/1/0; 80% 1RM) and lighter load (1/1/1/0; 50% 1RM) (Tanimoto and Ishii, 2006). In the 12-week, two-

day-a-week study, 3 sets of leg extension exercises were performed until muscle exhaustion. The 3/1/3/0; 50% 1RM tempo resulted in significantly greater hypertrophy in cross-sectional area (CSA) than the 1/1/1/0; 80% 1RM tempo. However, there was no difference in the hypertrophic response when the effect of training 1/1/1/0 with a lighter load (50% 1RM) was compared to 1/1/1/0; 50% 1RM tempo with a heavier load (80% 1RM). In another study with similar movement tempos other than isometric contraction tempo, healthy young men were assigned to 3/0/3/0 with 50% 1RM intensity for slow movement tempo and 1/0/1/0 with 50% 1RM intensity for normal movement tempo. Both groups underwent an 8-week squat training program (10 reps/set, 3 sets/day, and 3 days/week) using the assigned methods (Usui et al., 2015). The 3/0/3/0 group significantly increased muscle thickness (6-10%). Therefore, these studies suggest that slowing down the tempo for the goal of skeletal muscle hypertrophy may compensate for the reduction of the load used. In these studies, leg extension and squat exercises were used as a single exercise, but Tanimoto et al. (2008) compared fast (1/0/1/1; 80-90% 1RM) and slow (3/0/3/0; 55-60% 1RM) tempos in a whole-body resistance training program and showed that similar hypertrophic effects were observed in two different tempo and intensity protocols, consistent with these studies. Thus, from a practical point of view, it seems that a fairly wide range of repetition times can be used if the primary goal is to maximize muscle growth. The results suggest that voluntarily training at very slow times (10 seconds per repetition) is inferior in terms of hypertrophy. (2020), leg extension exercise (fast eccentric; fast-concentric; fast-concentric; slow-eccentric; slow-eccentric; slow-concentric; and concentric-eccentric, 30°-s for slow contractions and 180°-s for fast contractions) 3 days a week for 12 weeks were divided into 1 of 5 resistance training groups or a control group without training. There was no statistically significant interaction between group and time on muscle volume. In this study, the TUT for the fast movement tempo groups was 8-10 seconds, while the slow movement tempo groups had TUT times of 30-40 seconds. Voluntarily longer and slower tempos with longer TUT times require lower exercise intensity and consequently lighter loads. This may be interpreted as a result of decreased motor unit activation due to lighter loads, affecting the acquisition of muscle hypertrophy. However, although the TUT times are

equal, the duration of the eccentric and concentric phases are also important here. There are two studies in which the movement tempos of the concentric and eccentric phases were alternated with the same TUT times. One study evaluated directly with muscle biopsy while the other study evaluated with MRI. Gillies et al. compared 6/0/2/0 with 2/0/6/0 at 3 sets of 6-8 RMs and muscle biopsy analysis showed that both type I and IIA vastus lateralis fiber areas increased significantly following slower concentric contraction, whereas only type I fiber area increased following slower eccentric contraction, but the differences between the groups were not significant. (2022) compared 3-5 sets \times 6 repetitions at 50% 1RM 5/0/1/0, 1/0/5/0 and 3/0/3/0 movement tempos in knee extension exercise. According to the MRI results, the area of change in the CSA in the middle part of the rectus femoris was larger in the (5/0/1/0) and (1/0/5/0) groups than in the (3/0/3/0) and control groups.

In addition, the vastus lateralis distal region showed greater increases in CSA change than the others at movement tempo 5/0/1/0. Thus, although slow and fast tempos at different contraction types over 6-8 s TUT in the two studies elicited a muscle hypertrophy response, it is difficult to say whether it occurred as a result of changes in a combination of changes in both phases of movement. A meta-analysis by Schoenfeld and colleagues (2015) of randomized trials directly comparing training tempos in dynamic exercise using both concentric and eccentric repetitions shows little difference in muscle hypertrophy when training with isotonic repetition times ranging from 0.5 to 6 seconds until muscle failure. Therefore, he suggested that a fairly wide range of repetition times could be used if the primary goal is to maximize muscle growth. It has been stated that the limited research on this subject makes it difficult to draw concrete conclusions. In addition, training with very slow voluntary movement times of 10 seconds or more per repetition seems to cause lower increases in muscle growth, but again, the lack of studies on the subject makes it difficult to draw firm conclusions. In addition, some studies have compared eccentric and concentric phases within slow and fast tempos, and contradictory results have emerged. In one of the studies comparing different protocols in concentric phases, Nogueira and colleagues (2009) found greater increases in muscle thickness in the 3/0/1/0 movement tempo protocol with a 1-second concentric movement tempo compared to the 3/0/3/0 movement tempo protocol with a 3-second concentric

movement tempo. Asis-Pereira et al. (2016) compared 1/0/1/0 and 1/0/4/0 with a similar protocol, although the movement tempos were different, and there was no significant result in terms of muscle hypertrophy between the two groups. Although 3x8 repetitions were performed in both studies, in the study of Nogueira and colleagues (2009), 1 RM 40-60% in both groups, and in the study of Asis-Pereira and colleagues (2016), the weight load was adjusted when less than 8 repetitions or more than 8 repetitions were performed. It should also be noted that the study by Nogueira and colleagues (2009) was conducted in elderly individuals. There are some limitations in adjusting the intensities in these two studies. More research is needed in this regard. Also, in a study conducted in elderly individuals, 3/1/3/0 significantly increased thigh muscle thickness, but 1/1/1/0 only had a limited hypertrophic effect (Watanabe et al., 2013). In the study by Azevedo and colleagues (2022), although skeletal muscle hypertrophy was observed in both groups, the mean increases were similar. Only the vastus medialis showed more growth than the slower eccentric duration. The use of air displacement plethysmograph and ultrasound to determine muscle hypertrophy in these two studies is a limitation in terms of comparing the results of the two studies. A systematic review by Moreno-Villanueva and colleagues (2022) suggested that muscle hypertrophy in both trained and untrained subjects can be improved by concentric total repetitions of less than 8 seconds. He noted that the tempo of each individual muscle movement to maximize hypertrophic training results is still not completely clear. Another review study by Wilk and colleagues (2021) specifically mentioned the inconsistency of results and emphasized the differences in study experimental designs in this regard.

The results presented in this review suggest that changing the tempo of movement during resistance training may have an effect on muscle hypertrophy, but the results are not conclusive. Differences in the size of the muscles studied, the structure of the training programs, and the standardization of the experimental approach and data collection tools used may partially explain the discrepancy in results between tempos in different contraction phases or in the same contraction phases.

Influence of Movement Tempo on Maximal Strength

Maximal strength refers to the highest force that the neuromuscular system can produce during maximal voluntary contraction. Maximum strength

is indicated by the highest load that an individual can lift at one time (Bompa and Haff, 2009). It is important for both athletes and individuals exercising for health. Like muscle hypertrophy, maximal strength, like many resistance training variables, can be affected by manipulation of movement tempo. A meta-analysis by Davies and colleagues (2017) shows that regardless of age and training status, similar increases in dynamic muscle strength can occur when all intensities are combined, using either fast or moderate-slow movement speed. However, when moderate intensities were used, there was a trend towards increased strength gains when faster movement speeds were used. However, there are limitations in this study such as acute training variables such as intensity and movement speed differed between each study, the training status of the participants varied significantly, some studies included older participants with little training experience, and differences in data collection tools. In addition, due to differences in the duration of the eccentric and concentric phases evaluated, the effects of movement tempo on strength may not provide precise information about the effect of specific phases of movement (eccentric or concentric) on strength gains. Furthermore, this study compared fast or explosive movements with slower ones and did not allow comparing extremely slow tempos between concentric or eccentric phases of movement. Therefore, the evidence is still inconclusive on how changing movement tempo will affect muscle adaptations in resistance-trained individuals.

Studies comparing different movement tempos for maximal strength have generally compared traditional tempos (1/0/1/0, 1/1/1/0, 1/1/1/0, etc.) and 2-3 second protocols in eccentric and concentric phases (Morrissey et al., 1998; Munn et al., 2005; Tanimoto and Ishi, 2006; Watanabe et al., 2013; Pereira et al., 2016; Usui et al., 2016). Among these studies, there is only one study in elderly individuals, while there is only one study comparing eccentric contraction tempos. In the study by Watanabe and colleagues, 3/1/3/0 (55-60% 1RM) significantly increased isometric knee extension and flexion strength in elderly individuals. 1/1/1/1/0 (80-90% 1RM) significantly improved strength. It should be noted that this study was performed in elderly individuals. ACSM recommends the use of slow to moderate speed and 60-80% of 1RM for strength increases in older

adults (Chodzko-Zajko and American College of Sports Medicine, 2013). A meta-analysis (Borde et al., 2015) more specifically recommended 70-80% of 1RM and a slow duration under tension of 6 seconds per repetition, but this analysis did not consider movement tempo. However, studies comparing the effects of slow speed and moderate load versus fast speed and light to moderate load suggest that this is not the only way to increase maximal strength in the elderly (da Rosa Orsatto et al., 2019). Fast contractions at higher intensities appear to provide greater increases in strength compared to lower intensities (Byrne et al., 2016).

Unlike other studies, Pereira et al. (2016) evaluated the effect of changes in the eccentric phase of movement on strength gains during resistance exercise and compared slower eccentric movement tempo 4/0/1/0 with faster eccentric movement tempo 1/0/1/0 protocols and confirmed that the 4/0/1/0 group had an improvement in muscle strength between pre and post training. The 4/0/1/0 group had larger effect sizes in terms of strength from pre to post training than the 1/0/1/0 group. 4/0/1/0 training is more effective in increasing muscle strength in well-trained adults. As mentioned before, the time under tension during the eccentric phase of the movement increases metabolic stress and hormonal responses. This may affect both muscle hypertrophy and indirectly strength gains.

Although both slow (1/0/1/0 - 8 RM) and fast (2/0/2/0 - 8 RM) training protocols improved strength performance in isokinetic strength testing in the study by Morrissey et al. (1998), fast training may be superior to the slower speed used in this study in the magnitude of training effects. A study by Munn et al. (2005) showed that strength gains were greater with 1/0/1/0 tempo compared to 2/0/2/0. In the study by Usui and colleagues (2016), the 1/0/1/1 50% 1RM group did not show any change in all variables. The 3/0/3/0/3/0 50% 1RM group significantly increased isometric hip extension torque (18%) and 1-RM squat (10%), but not isometric knee extension torque. In Tanimoto and Ische's (2006) study, 3/1/3/0 (50% 1RM) and 1/1/1/0 (80% 1RM) exercise training caused significant increases in the isometric strength (maximal voluntary contraction) of the knee extensors, whereas 1/1/1/0 (50% 1RM) showed no significant change. In another recent study, Lu et al. (2023) compared 2/0/2/0 and 1/0/1/0 movement tempos and found that maximal strength improved

significantly in both groups. However, no significant group and time interaction effect was found between training groups for maximal strength. Isokinetic strength was measured in four of these eight studies, while three studies used 1 RM test and one study used both. Training frequency was more than 7 weeks in all studies in terms of durations and only one study applied training frequency two days a week and the other studies applied training three days a week. As mentioned before, one study compared eccentric phases in elderly individuals and one study compared plain eccentric phases. Considering these limitations, it can be said that no significant difference was observed in terms of maximal strength in these studies comparing traditional tempos (1/0/1/0, 1/1/1/0, 1/1/1/0, etc.) and 2-3 second protocols in eccentric and concentric phases. Similarly, in a study conducted in elderly individuals, maximum speed tempos with X/0/X/0 in eccentric and concentric phases were compared with 2 or 3 second tempos. No significant difference was found between the groups in terms of improvement in muscle strength (Bottaro et al., 2007).

Some studies on strength and movement tempo have investigated the effects of much slower eccentric and concentric movement tempos. Keeler et al (2001) compared a 4/0/2/0 tempo of 80% 1RM intensity with 5/0/10/0 50% 1RM training protocols. They showed that 4/0/2/0 tempo was more effective in increasing strength compared to 5/0/10/0. However, greater strength gains were not observed in every exercise for 5/0/10/0 compared to 4/0/2/0 movement tempo in the study of Neils et al. (2005) who applied the same protocol. The only difference in these two protocols was the number of repetitions. In addition, Keeler et al. (2001) included individuals with no experience and Neils et al. (2005) included individuals with resistance exercise experience. These differences may be the reason for the differences between the study results. However, although the protocols used were different, Schuenke et al. (2012) used 4/0/10/0 and 40-60% 1RM exercise intensity for the super slow training protocol, 2/0/1/0 movement tempo with 80-85% 1RM intensity for 3 sets of 6-10 repetitions and 2/0/1/0 movement tempo with 80-85% 1RM intensity for 3 sets of 20-30 repetitions until muscle exhaustion for the fast training protocol. As in other studies, no significant difference was observed in strength gain. Another study by Rana et al. (2008) compared 4/0/10/0 (6-10 RM), 2/0/1/0 (6-10 RM),

2/0/1/0 (20-30 RM) training protocols and found that 4/0/10/0 increased relative leg press and knee extension by 1 RM, but the percentage increase was smaller than 2/0/1/0 (6-10 repetitions) and not different from the back squat control group. In another study, Carlson et al. (2019) compared super slow (10/0/10/0), medium (4/0/2/0), and very fast (30sc/30sc/30sc) protocols and analysis revealed significant increases in strength for all exercises but no differences between groups. Repetition time did not affect the increase in strength in trained participants where the exercise was performed to immediate failure.

The inconsistencies in these results may be related to the fact that the training protocols used in the studies used both concentric and eccentric phases as variables. Although there is a difference in the comparisons in these studies, it is difficult to explain which phase this difference is related to. For this reason, there are studies that only reveal variable protocols in concentric or eccentric phases. For example, Mike et al. (2017) compared eccentric movement tempos of 2, 3 and 4 seconds and found no difference in maximal dynamic power in resistance-trained subjects. However, Pereira et al. (2016) suggested that based on effect size, a slow eccentric phase may be better for increasing strength gains in trained individuals. Fisher et al. (2016) compared eccentric movement tempos of 4 and 10 seconds and found no significant difference in measures of muscular performance. It should be noted that in these studies, there were differences in exercise type and eccentric tempo choices, such as population, compound and single-joint, and training intensity was rarely equalized between groups. Apart from the studies comparing eccentric contraction phases, two studies comparing concentric phases showed different results. In the study conducted by Nogueira et al. (2009), strength gains measured with leg press and chest press were similar in 3/0/1/0 and 3/0/3/0 movement tempo. In a study that showed similar results to this study, although the protocols were different, both groups were exercised explosively as fast as possible (at 0.86 s) at a tempo of ~1.7 s and slow tempo for the eccentric phase and ~1.7 s and fast tempo for the concentric phase. Compared to the control group, strength performance improved to a similar degree in the fast and slow concentric protocol (Liow and Hopkins, 2003).

Power performance was also evaluated in this study, but we will discuss this result in the next section. Fielding et al. (2002) compared 2/1/X/0 and 2/1/2/0 movement tempo and found that 2/1/X/0 movement tempo improved 1RM power. Again, it should be noted that while the sample groups in these studies were similar in terms of consisting of elderly individuals, there was a slight difference in the duration of the concentric phases, which may explain the differences in strength gains. In addition, there are studies comparing eccentric and concentric phases at moderate or high speeds in movement tempo protocols that are equal in terms of tension under the same time. In these studies, Gois et al. (2014) compared 1/0/3/0 with 3/0/1/0 and Gilles et al. (2006) compared 2/0/6/0 with 6/0/2/0. The 3/0/1/0 group showed an increase in muscle strength at the end of the study. The 3/0/1/0 group showed an increase in muscle strength at the end of the study. Gilles et al. (2006) showed that both groups experienced a similar increase in maximal leg press strength with training in all strength assessments. The increase in eccentric strength was greater than the increase in combined or concentric strength for both groups. The fact that the duration of the eccentric and concentric phases were twice as different in these two studies, as well as the fact that Gois et al. (2014) used a single exercise protocol while the other study used a program consisting of multiple exercises is an important factor.

Unlike the other studies, as a result of a study comparing the self-selected movement tempo of the individuals participating in the study with the traditional movement tempo, all training protocols showed significant increases in 1-RM values. There was no significant main effect of groups and time interaction. Resistance training with self-selected repetition time, with or without volume loading, was equally effective in increasing muscle strength in untrained men compared to the conventional protocol. In this study, the time under tension for the traditional protocol was 4□0 seconds, the self-selected repetition time was 1.8□0.3 seconds and finally 1.7□0.4 seconds in the self-selected equalized volume load group. In this study, 2/0/2/0 tempo was selected for the traditional tempo and the fact that the averages of the self-performed tempos were close to this tempo may indicate the situation in the research results. Finally, Ünlü et al. (2020), in their study in which they performed knee extension exercises separately in eccentric and

concentric phases at slow and fast tempos using a computer-based visual animation, found significant increases in muscle isotonic strength and isokinetic peak torque at 60°/s for all training groups after a 12-week training period compared to concentric+eccentric. There was no statistically significant interaction between group and time on isokinetic peak torque at 180°/s. The results of this study suggest that all training methods have the potential to cause isotonic power gains in the knee extensors and that there is insufficient evidence for the superiority of any particular muscle contraction or speed mode. From the literature, the available information does not indicate which eccentric and concentric repetition tempos are optimal for maximal strength development. However, a systematic review study by Moreno-Villanueva and colleagues (2022) showed that resistance training protocols with moderate eccentric muscle movement duration and fast concentric muscle movement duration, especially 4/0/1/0 tempos, produced the highest development values for maximal dynamic strength development in both trained (18-24%) and untrained subjects (10-14%). For maximal strength development, a medium total repetition muscle movement time of less than 4 seconds and a slow total repetition muscle movement time of less than 8 seconds seem to be appropriate for untrained and trained subjects, respectively, provided that the concentric muscle movement time is explosive or fast (cadence 4-8/0/max-3/0). In conclusion, the prescription of muscle movement time, total and phase-specific, should be planned according to the desired adaptations in untrained and trained subjects.

Influence of Movement Tempo on Muscle Power and Endurance

Power is the ability to generate strength rapidly. While power is important for athletes in most sports, it is not a muscular performance ability directly related to health for sedentary individuals, but it is an ability that may be needed for daily life activities (Bompa and Haff, 2009). Like power performance, muscular endurance is important for both athletes and sedentary individuals. Muscular endurance is the ability of the neuromuscular system to repetitively generate strength over long periods of time. The total number of repetitions that can be lifted with a given load is an indicator of muscular endurance (Hoffman, 2014). Resistance exercises are used to improve both components of physical fitness, and the variability of movement

tempos may show different responses in these abilities.

Power is based on the force-velocity relationship (Pozzo & Impellizzeri, 2022) and therefore a resistance exercise variable approach based on the performance of explosive efforts at lower intensities (50-80% of 1RM) makes sense. Studies comparing the effects of movement tempo on muscle hypertrophy and maximal strength abilities have also provided data on power ability. In studies comparing different eccentric and concentric phases, vertical jump and long jump tests were generally used. As mentioned above, we have previously stated that faster tempos are more logical to use in resistance exercises for power gain. Although studies show that faster tempos are slightly more effective in power gain than slower tempos, there are studies that show different results. The only one of these studies that showed a significant difference in the fast tempo group compared to the slow tempo group was Neils and colleagues' (2005) study in which peak power for CMJ increased significantly from 23.0 ± 5.5 W/kg to 25.0 ± 6.3 W/kg in the 4/0/2/0 group; no such increase was seen in the 5/0/10/0 group. The results of this study suggest that 4/0/2/0 is more effective than 5/0/10/0 in improving peak power. In the Morrissey et al. (1998) study, in the long jump, the 1/0/1/0 group was superior in several variables, including knee peak velocity and total body vertical and absolute power. In the vertical jump, 1/0/1/0 affected the ankle and hip more (i.e. average power), while 2/0/2/0 mostly affected the knee (average torque). Although both slow and fast training improved performance, fast training showed some advantages in terms of the amount and magnitude of training effects. In another study, similarly, jump height, peak power and strength of the fast and slow movement tempo groups improved significantly, although peak velocity increased significantly after the intervention in the 1/0/1/0 group, but not in the 2/0/2/0 group (Lu et al., 2023). For jump height, a significant interaction effect was observed between the training groups. Unlike these studies, Rana et al. (2008) found no significant difference for jump height or muscle power in the 4/0/10/0 (6-10 repetitions), 2/0/1/0 (20-30 repetitions) and 2/0/1/0 (6-10 repetitions) movement tempo groups. Again after Usui et al. (2015) intervention, the 1/0/1/0 group did not show any change in all variables. In the 3/0/3/0 group, there was no significant change in knee extension

power and vertical jump height. These results suggest that 3/0/3/0 has little effect on power production during dynamic explosive movements. It should be noted that although some of these studies had sample groups with resistance exercise experience, many studies included inexperienced individuals. This may affect the results. In addition, as we mentioned before when evaluating muscle hypertrophy and maximal strength, the fact that exercise intensities were not equalized may have had an effect in this case.

There are only studies investigating the effects of different eccentric and concentric movement tempos in relation to power. (2014) investigated the effects of concentric phases at maximal velocity and half-maximal velocity on CMJ and 20 m sprint test performance in terms of power. Pareja et al. (2014) performed Parallel Squat (isoinertial) exercise 6 weeks three days a week in a protocol (3-4 sets 2-8 repetitions at 60-80% 1 RM maximal intended concentric - 0.49m/s, half-maximal intended concentric - 0.82m/s, controlled eccentric - 0.50-0.65m/s.). While a significant 'group'×'time' interaction was observed for CMJ height, no significant interaction was found for the 10 m sprint. The change in individual CMJ values from before to after showed that maximal concentric velocity training probably caused a better effect on CMJ height performance compared to semi-concentric velocity, while the beneficial effects of maximal concentric velocity training compared to semi-concentric velocity on 10 m sprint and especially 20 m sprint are not clear. Another study, again comparing different movement tempos in concentric phases, although with differences in execution protocols, showed similar results between groups in relative training power and total work for leg press and knee extension, although 2/1/X/0 produced significantly higher power than 2/1/2/0 for leg press and knee extension during training sessions. Leg press and knee extension 1RM muscle strength increased similarly in both groups at the end of training, although Leg press peak power increased significantly more in 2/1/X/0 compared to 2/1/2/0. Also, 2/1/X/0 significantly.

Leg press power improved more at 40%, 50%, 60%, 70%, 80% and 90% of 1RM than 2/1/2/0. The evaluation criteria and protocols are different in these two studies, but it can be said that fast concentric phases show better results in power and output. Another study investigating concentric

phases on power output compared two protocols, 3/0/1/0 (40, 50 and 60% 1RM) and 3/0/3/0 (40, 50 and 60% 1RM), and training-induced power gains were similar between the groups, but 3/0/1/0 resulted in a significantly greater improvement in muscle power (Nogueira et al., 2009). In these studies, concentric phases and exercise intensities also differed from each other, making it difficult to compare the results with each other. However, it can be said that faster concentric phases have a more favorable effect on power outputs.

In the only study investigating different eccentric phases on power output, Mike and colleagues (2017) compared three protocols on 2/0/2/1, 4/0/2/1, 6/0/2/1 (4 sets × 3-6RM). For all performance data, significant group × time interaction effects were found for mean power production in all three sets of the squat jump protocol. All groups showed significant main effects for vertical jump, peak power and average power. Peak velocity data showed that the 6/0/2/1 group experienced a significant decrease in peak velocity during the squat jump protocol as a result of the 4-week training program. In this respect, further research is needed to elucidate the effects of different eccentric movement tempos on power performance.

Studies investigating muscular endurance performance through movement tempos are also in the minority. Rana and colleagues (2008) also evaluated muscular endurance performance. For muscular endurance, 4/0/10/0 improved similarly to 2/0/1/0 (20-30 repetitions) for leg press, but less than 2/0/1/0 (6-10 repetitions) and 2/0/1/0 (20-30 repetitions) for knee extension. Muscular endurance improved with 4/0/10/0 training, but not above that shown by 2/0/1/0 (20-30 repetitions) or 2/0/1/0 (6-10 repetitions). In another study evaluating muscular endurance, analyses revealed a significantly greater improvement for conventional training compared to eccentric groups for the change in absolute muscular endurance for the pull-down exercise (Fisher et al., 2016). The conventional group performed the exercises at a movement tempo of 4/0/2/0 and the eccentric group A performed the exercises at a movement tempo of 10/0/2/0. Eccentric group B performed 1 × traditional tempo and 1 × eccentric tempo only exercises each week. These two studies showed contradictory results in terms of contraction phases. Age difference and experience difference in the sample groups are the most important differences of

the two studies. In addition, differences in resistance exercise protocols and movement tempos may explain these contradictions.

Conclusions

The results presented in this review suggest that varying the tempo of movement during resistance training may have an effect on the level of maximal muscle strength, muscular power and muscular endurance along with muscle hypertrophy, but the results are not conclusive. Differences in the exercise prescriptions in the protocols applied in the studies and the experimental designs used are a factor in the discrepancies between the studies. As a result of this review, there are data indicating that movement tempo should be considered in resistance training programs to increase hypertrophy and maximal strength. It is not clear whether a particular tempo is more effective than another for increasing muscular strength and endurance. Faster movement tempos seem to be effective in relation to muscular strength, but more research is needed. In the light of the literature, longer-term longitudinal studies on movement tempo should be conducted in both athletes and sedentary individuals, and resistance exercise prescriptions should be prescribed in accordance with muscular adaptation in weekly frequencies. There is a need for studies to demonstrate the effects of concentric or eccentric phases at different tempos. This may provide us with more information about which phase of movement tempo is effective in muscular fitness performance.

Conflict of interest

There is no personal or financial conflict of interest within the scope of the study.

Author Contributions

Planned by the author: Study Design, Data Collection, Statistical Analysis, Data Interpretation, Manuscript Preparation, Literature Search. Author have read and agreed to the published version of the manuscript.

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REVIEW ARTICLE

The Effect of Digital Gaming Duration on Musculoskeletal System Symptoms: A Systematic Study

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Abstract

The aim of this study is to review the existing literature on the musculoskeletal system symptoms associated with digital gaming. Literature related to the subject was searched in Web of Knowledge, PubMed, Medline, PsycINFO, Proquest, Google Scholar, and Sport Discuss databases. Articles published from 2010 to 2022 were scanned using keywords describing digital gaming-related postural disturbances, and musculoskeletal system exposure (pain, muscle activity). The articles were independently scanned by three authors, the relevant data were extracted, and the methodological quality of the included studies was evaluated. A total of 1252 articles were scanned for eligibility. Eleven articles are included in the study. Systematic reviews and meta-analysis studies were not included in our study. A wide range of prevalence rates of musculoskeletal complaints in different body regions has been reported, with the highest prevalence commonly found in neck complaints. This review has only found some evidence showing that a neck flexion posture as well as the frequency of digital gaming are associated with musculoskeletal disorders and pain, postural disorders among users of digital devices. The findings were presented and discussed in relation to the effects of digital games on posture and the musculoskeletal system. There is limited evidence that digital gaming and its various aspects (occupancy and properties) are associated with musculoskeletal system symptoms and exposures. Therefore, it is considered that evidence-based guidelines should be presented by experts for the wise use of digital games.

Keywords

Digital Gaming, Posture, Musculoskeletal System, Health.

INTRODUCTION

Smartphone access and possession among children and adolescents have notably increased nowadays. Adverse health outcomes associated with excessive use of the device have also emerged with the increasing use of smartphones by children and adolescents (Sohn et al., 2019). Excessive phone

use has been reported to have negative effects on sleep quality, physical activity, obesity, headaches, and eye strain among children (Domoff et al., 2019). In another study, a relationship has been identified between the smartphone exposure time of adolescents and musculoskeletal system problems. It is noted that the symptoms of the neck, shoulder area, and

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musculoskeletal system (Toh et al., 2019). and forward head posture, and hunchback posture (Peter et al., 2019) have the highest prevalence rates. Some studies have shown that the neck flexion posture, the most common posture among smartphone users, potentially pose risks of pain in the musculoskeletal and discomfort in the back of the neck area. As a result of the forward head flexion, the posture generates excessive external flexion force, which in turn causes a greater load on the neck extensors and adjacent connective tissue of the neck in order to balance the increase in the external flexion moment caused by the forward moment (Eitivipart et al., 2018; Xie et al., 2017). The use of smartphones increases the muscular activity of the neck muscles, especially the cervical erector spinae (CES) and upper trapezius (UT), as well as the forward shift of the head (Hanphitakphong et al., 2021). It is argued that prolonged and continuous contraction of the neck muscles will cause an increase in neck muscle fatigue. The longer duration of the device use, the greater the severity of the awkward position of the neck and head. During prolonged static postures, overloading of the neck muscles due to the use of smart devices contributes to discomfort and fatigue (Eitivipart et al., 2018; Xie et al., 2017). When it is compared to the standing position, it is stated that the shift in the head-neck angle when using a smartphone occurs more than in a sitting position (Lee, 2014; Ning, 2015).

In recent years, some experimental studies have been conducted to determine the effectiveness of guideline practice strategies to reduce the risk of pain in the neck area and posture caused by smartphone use (Park, 2017). Smartphone usage time, such as playing games with digital devices, is known as an important risk factor affecting the musculoskeletal system. There is evidence that helps guide the practice recommendations for the prevention of the risk of developing musculoskeletal problems in the neck area among smartphone users. Likewise, there is evidence reporting that children and adolescents are at a higher risk of injury compared to adults (Hanphitakphong et al., 2021). In addition, musculoskeletal problems that occur in childhood lead to problems that persist into adulthood (Jones et al., 2007). Therefore, the related smartphone (Morley and Thomas, 2017). The primary search was based on title, abstract, and keywords, using Boolean logic for the combination of terms.

activities that lead to symptoms of musculoskeletal pain in children and adolescents should not be ignored.

In the studies that are the subject of our review, there are common negative points such as posture, musculoskeletal system symptoms, pains, and forward head posture of digital gaming duration and digital device use. Especially as the digital gaming duration increases, muscle fatigue and pain occur in the posterior neck area. In addition, existing studies suggest that postures in digital device use and digital gaming duration may be associated with musculoskeletal problems that are common in the neck, shoulder, and back areas, and awkward postures (Hanphitakphong et al., 2021; Park et al., 2017; Alfaitouri and Altaboli, 2018; Lui et al., 2012). Limitations of the current studies include the use of measurements of the digital gaming duration and musculoskeletal system symptoms without the reliability and validity of the measurement methods indicated by the authors.

Assessment of the quality of the study, systematic it is an indication of the strength of the evidence provided by the review and informs the standards required for future research. It is thought that our study will benefit researchers who will investigate the postural effects of digital game addiction in the future.

Since the widespread use of smartphones is increasing, there is a need for guidelines that can reduce musculoskeletal problems. In conclusion, the objectives of this study are: (i) to examine the changes in the upper body postures of smartphone users, (ii) to examine the fatigue that occurs in the muscles depending on the duration of smartphone use.

MATERIALS AND METHODS

Study Strategy and Eligibility Criteria A systematic literature review was conducted in 2022 using Web of Science, PubMed, Google Scholar, and Sport Discus databases. This study was conducted as an observational study with publicly available data. The study data were obtained from the official websites open to the public. Since the study data are not collected through experiments, there is no ethical concern

Two authors (PA and AB) have scanned all the possible titles (abstracts, full-text articles) for eligibility. The disputes that arose about inclusion

were resolved in consultation with the third author (IB). The search terms were determined based on previous reviews and agreements between authors. These are concepts such as digital game, digital gaming duration, posture, and musculoskeletal system. Some limitations have been imposed on the study of comprehensive literature. In addition, searches in databases are conducted in the following sequence (digital gaming & posture* digital gaming & neck pain* digital gaming &

pain* digital gaming & joint pain* digital gaming & fatigue*, digital game duration & musculoskeletal system).

The components of the PICOS question, including population, intervention, comparison, outcomes, and study design, were answered to define eligibility criteria (Methley et al., 2014). The study covers only articles published between 2010 and 2022 in English-language peer-reviewed journals.

Table 1. Study selection criteria

PICOS	Eligibility Criteria
Population	Children and adults
Interventions	Any physical activity conducted in nature
Comparators	Comparison group not determined
Outcomes	Physiological consequences: changes due to stimulus response
Study Designs	No limitations with the study design

Scanning and Study Selection

The reference results of the database search were transferred to the Mendeley reference program. The studies were scanned in terms of inclusion criteria according to the title in the first stage, followed by abstract and full-text scans. The scanning process was conducted independently by the authors. The authors discussed the results, and the full texts were included in the analysis based on mutual agreement. In this review article, authors, year, participants and sample group, objectives and hypotheses, findings, and results are included in the analysis table.

The "Effective Public Health Practice Project" (EPHPP) was used to evaluate the bias risk of the included studies (Thomas et al., 2014). EPHPP is used for observational, cross-sectional, cohort, and randomized controlled trial designs (Armijo-Olivo et al., 2012). The EPHPP tool has six equiponderant categories that are included in an overall rating to assess the quality of work. These are selection bias, study design, confounders, blinding, data collection practices, and withdrawal.

The category of withdrawals and dropouts was also applied to cross-sectional studies since it contains information about the percentage of participants who completed the study. Each category received a strong (Sohn et al., 2019), medium (Domoff al., 2019) or weak (Toh et al., 2019), rating, which is the basis for the overall rating of the work. In addition, systematic reviews and meta-analysis studies were not included in the study.

RESULTS

After the duplications were extracted from the database search, 1252 references were taken. These have been scanned for eligibility according to their titles (Figure 1). Then, 192 abstracts and 64 full-text articles were evaluated for eligibility.

Articles on posture correction or musculoskeletal system improving digital games are excluded from the study. In addition, articles conducted on adults have not been evaluated. A total of 11 articles were included in this study.

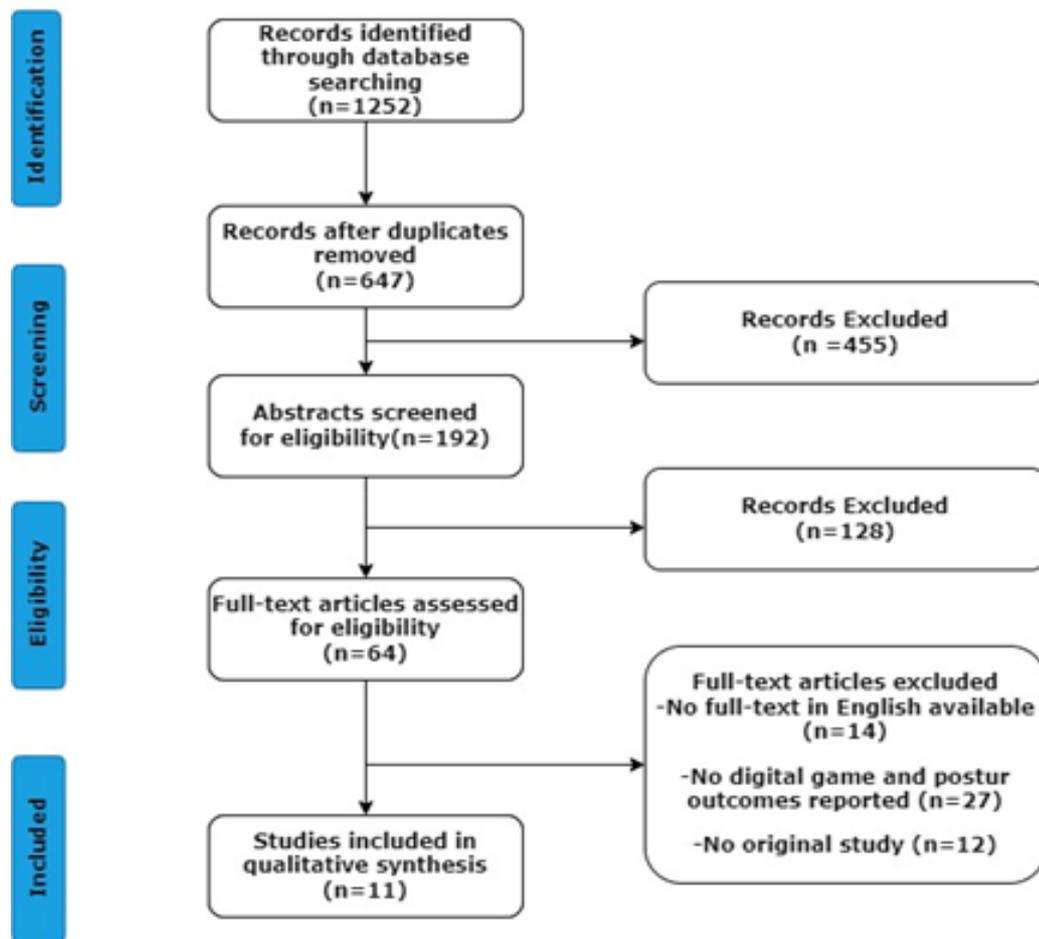


Figure 1. PRISMA flowchart for selecting relevant articles.

The Quality of the Reviewed Articles

It was identified that five articles are of high quality (Hanphitakphong et al., 2021, Young et al., 2013; Kim and Koo 2020), and four articles are acceptable (Park JHM, et al., 2017, Ashok et al., 2020; Lam et al., 2022) and two articles are of low quality (Cankurtaran et al., 2022; Lui et al., 2012).

In more than half of the included studies, smartphone usage conditions were simulated so that participants could apply them in a laboratory environment. Accordingly, it is seen in Table 2 that the data do not fully represent smartphone use in real life and therefore the external validity of the studies is low.

Table 2. Methodological quality scores of studies

Included studies	External validity criteria				Internal validity criteria						Overall quality
	1	2	3	4	5	6	7	8	9	10	
(Kim & Koo, 2016)	N	N	N	Y	Y	Y	Y	Y	N	Y	++
(Hanphitakphong et al., 2021b)	N	N	Y	Y	Y	Y	N	Y	Y	N	++
(Park et al., 2017b)	N	N	N	N	Y	Y	N	Y	Y	Y	+
(Young et al., 2013)	N	N	Y	Y	N	Y	N	Y	Y	Y	++
(Anna et al., 2018)	N	N	N	Y	Y	Y	N	Y	Y	Y	++
(Alfaitouri & Altaboli, 2019)	Y	N	Y	N	Y	Y	N	Y	Y	N	++
(Cochrane et al., 2019)	N	N	N	Y	Y	Y	N	Y	Y	N	+
(Lui et al., 2011)	N	N	N	N	N	Y	N	Y	Y	Y	-
(Lam et al., 2022)	N	N	Y	Y	Y	Y	N	Y	Y	N	+
(Ashok et al., 2020)	N	Y	N	Y	Y	N	N	Y	N	Y	+
(Cankurtaran et al., 2022)	N	N	N	N	Y	Y	N	Y	N	Y	-

Note; N=No; Y=Yes; +=high quality (low risk of bias); +=acceptable (moderate risk of bias); -=low quality (high risk of bias); 1 – Was the study's target population a close representation of the national population in relation to relevant variables, e.g. age, sex, occupation? 2 – Was the sampling frame a true or close representation of the target population? 3 – Was some form of random selection used to select the sample, OR, was a census undertaken? 4 – Was the likelihood of non-response bias minimal? 5 – Were data collected directly from the subjects (as opposed to a proxy)? 6 – Was an acceptable case definition used in the study? 7 – Was the study instrument that measured the parameter of interest (e. g. prevalence of low back pain) shown to have reliability and validity (if necessary)? 8 – Was the same mode of data collection used for all subjects? 9 – Was the length of the shortest prevalence period for the parameter of interest appropriate? 10 – Were the numerator(s) and denominator(s) for the parameter of interest appropriate? 11 – Summary item on the overall risk of bias (Hoy et al., 2022).

Musculoskeletal system symptoms, posture, and body areas reported in pain complaints that occur along with the duration of digital gaming are the neck, upper extremity areas, and upper and lower back. The common point revealed in the studies examined is that phone use for a long time usually causes pain in the shoulder and neck area (Kim and Koo 2020). In the studies, it has been reported that pain occurs after 16 minutes of phone use, 20 minutes of playing digital games cause muscle fatigue and pain, feeling pain in the neck during phone use, and suffering from neck pain in children who are exposed to digital games for more than 2 hours, and there is a positive relationship between electronic device use and neck pain.

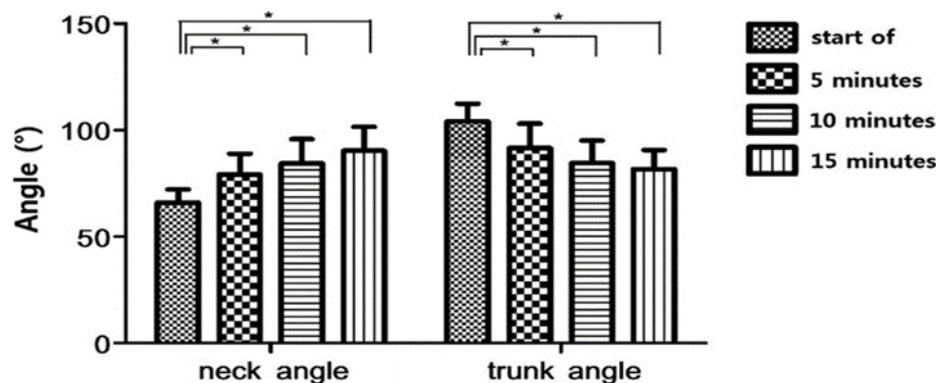


Figure 2. Pain rate associated with phone use time (Park et al., 2017).

In the figure above, the rate of pain that occurs along with the duration is shown. As time extends, muscle fatigue and discomfort occur in the posterior neck area. However, a situation arises that is unsuitable for posture (Park et al., 2017). The neck flexion angle increased significantly in all postural positions (standing, arms-free sitting, and sitting with arms resting on a table) as the time spent on the phone progressed (Alfaitouri and Altaboli 2019). The flexion of the neck is considerably high during digital gaming. And this is a potential risk factor for the development of neck pain, musculoskeletal system fatigue and disorders (Anna et al., 2018). Increased shoulder protraction along with neck flexion causes scapula dysfunction during upper extremity movement. For this reason, it has been stated that the use of smartphones negatively affects the supine posture (Cochrane et al., 2019). Individuals who spend a long time with electronic devices have a high risk

of developing a forward head posture due to static load acting on the cervical spine (Ashok et al., 2020). It is also noted that esports players have significantly poor spinal posture compared to the normal reference range (Lam et al., 2022).

Risk Factors and Evidence

In general, the risk factors identified in the reviewed studies can be grouped into two main categories. These are (i) the postures adopted when using digital devices (ii) and the time spent. Besides neck flexion, there is evidence that the frequency of playing games causes musculoskeletal system complaints among digital device users. The selected studies reflected consistent results with each other. It is seen in the studies which we have included in our study, that playing digital games causes pain, forward head posture, musculoskeletal system symptoms, and posture impairments as time spent.

Table 3. Studies on musculoskeletal symptoms associated with digital games

Author, Year	Participants	Intervention	Finding	Conclusion
1 (Lui et al., 2011)	-Age range 8-13 -N=464 children	-Questions about frequency, duration, and pain have been directed to children who have been playing games with technological devices in the last 8 months.	- About 1/3 of the participants (28.9%) reported discomfort in different parts of the body associated with playing e-games. The vast majority of 20% stated that the pain was in the shoulders.	Exposure to digital devices, especially for more than 2 hours daily was significantly associated with neck and upper limb discomfort. Long durations of play would increase the cumulative muscle loading and contribute to musculoskeletal symptoms.
2 (Young et al., 2013)	-N=15 - tablet users	Participants were asked to complete tasks by holding the tablet with one hand, two hands, on a desk, and on their knees.	There was a difference between the postures for the wrist ($p<0.05$). Wrist extension was especially high for the dominant hand when a tablet was placed on the lap. Differences were observed in the posture and muscle activity of the shoulder according to the position of the tablet.	Users of touchscreen tablets are exposed to excessive wrist postures, which may put them at a higher risk of developing musculoskeletal symptoms.
3 (Kim & Koo, 2016)	-N=34 -young individuals	The participants were divided into 3 groups. The first group was 10 minutes, the second group was 20 minutes, and the third group used 30 minutes of smartphones.	In the second group, a significant difference was found in the degree of fatigue in the left upper trapezius muscles whereas, in the third group, a significant difference was found in the left cervical erector spinae and bilateral upper trapezius muscles. A significant difference was found in terms of fatigue in the left trapezius muscles in the first and third groups.	Pain has occurred with fatigue after using a smartphone for a long time.
4 (Park et al., 2017b)	-N=18 male -smartphone users	Muscle activation and angular changes in the neck and torso of the participants were examined during 16 minutes of smartphone use. EMG and digital camera were used.	Neck and trunk flexion increased significantly at the 5 th , 10 th , and 15 th minute ($p<0.05$) onwards the beginning of smartphone use.	Smartphone use has changed posture and muscle activation in a relatively short period of time (5 min), and pain occurred after 16 minutes of use.
5 (Anna et al., 2018)	-N=15 healthy young individuals -Age range 21-25	Four activities were performed with the smartphone (gaming, messaging, video watching) in two different postures (standing and sitting).	Differences were found for neck and torso angles in both postures ($p<0.05$). It showed that significant changes in neck and torso posture occurred when the activities were performed in a sitting position.	The flexion-extension of the neck is greater during digital gaming than compared to watching a video. It has been stated that posture during smartphone use is a potential risk factor for the development of neck pain, musculoskeletal fatigue and disorders.
6 (Alfaitouri & Altaboli, 2019)	-N=20 young individuals	The participants stood against a scaled board and for 20 minutes (0, 5, 10, 15, and 20 th minutes) photos were taken. The procedure was performed in three different postures (standing, sitting with arms free, and sitting with arms on the table).	Statistically significant results ($p<0.05$) were found in both posture and smartphone use time.	The neck flexion angle increased significantly as time progressed in all postures. Neck flexion is significantly less in the standing posture than in the sitting posture.
7 (Cochrane et al., 2019)	-N=63 students -Age mean 22.7	Photographic posture analysis was performed on the participants. Photos of the students were taken before using the smartphone and 5 minutes after using it.	-A significant increase in the amount of shoulder protraction ($p<0.001$) was found in the non-dominant hands of the students. Significant ($p<0.001$) results were found in pelvic curvature after smartphone use.	Increased shoulder protraction causes scapula dysfunction during upper extremity movement, and this causes students to be unable to use the arm well. It is clearly seen that smartphone use negatively affects the upper back posture of university students.
8 (Ashok et al., 2020)	-N=160 participants -Age mean 22.8	Forward head posture angles were measured using the photogrammetry method.	A total of 97 participants had a forward head posture and an association was found between the duration of game playing and forward head posture.	It has been reported that individuals who spend a long time on electronic gaming devices have a high risk of developing a forward head posture due to static loading affecting the cervical spine.
9 (Hanphitakphong et al., 2021a)	-Age range 10-18 -N=44 students	Participants were instructed to play digital games continuously for 20 minutes in a sitting position during the dynamic posture analysis. Wireless EMG was used to collect data from CES and UT.	Neck, trunk, left shoulder and bilateral elbow flexion angles increased significantly at the 10 th and 20 th minute ($p<0.05$) compared to baseline. Bilateral CES has been associated with fatigue increased significantly at the 20 th minute. After the completion of the game, the neck discomfort increased significantly.	As a result, it has been concluded that continuous (20 minutes) smartphone gaming causes a posture that is not suitable for posture to a significant extent and causes muscle fatigue and discomfort, especially in the back neck area.
10 (Lam et al., 2022)	-N=48 e-Sports players -Age mean 20.1	- Spine evaluation was performed via SpinalMouse after e-sports.	The spinal posture, mobility, and stability of e-Sports players were found to be significantly worse.	It was determined that e-Sports players have significantly weaker spinal posture, mobility, and stability compared to the normal reference range.
11 (Cankurtaran et al., 2022)	-N=1000 children -age mean 11.95	Pain assessment has been performed to detect musculoskeletal problems.	When the pain complaints of children were examined, 93 people reported headache, 69 children reported shoulder pain, 48 children reported elbow pain, 50 children reported hand pain and 128 children reported back pain.	A positive relationship has been found between the duration of electronic device use and neck pain. In addition, it has been reported that there is a positive relationship between neck pain and headache.

DISCUSSION

Our study is a review that systematically describes the available evidence on postural symptoms associated with digital game use. In the studies included in this review, the findings in three specific body regions were examined. In the studies that are the subject of our review, there are common negative points such as posture, musculoskeletal system symptoms, pains, and forward head posture of digital gaming duration

and digital device use. Especially as the digital gaming duration increases, muscle fatigue and pain occur in the posterior neck area. In addition, existing studies suggest that postures in digital device use and digital gaming duration may be associated with musculoskeletal problems that are common in the neck, shoulder, and back areas, and awkward postures (Hanphitakphong et al., 2021; Park et al., 2017; Alfaitouri and Altaboli, 2018; Lui et al., 2012). Limitations of the current studies

include the use of measurements of the digital gaming duration and musculoskeletal system symptoms without the reliability and validity of the measurement methods indicated by the authors.

The objectives of our review (i and ii) are supported in detail below. In case-control and experimental laboratory studies, there is consistent evidence that musculoskeletal system symptoms were associated with digital gaming duration (Hanphitakphong et al., 2021; Park et al., 2017; Kim et al., 2022) and its use in different positions (16–18) may have an impact on the symptoms experienced. Neck flexion occurs very quickly among individuals who play games with digital devices. The increase in neck flexion occurs within five minutes (Park et al., 2017). It has been reported that neck flexion begins after typing on a desktop for ten minutes while crossing legs (Lee et al., 2011). In another study, participants played a digital game for twenty minutes in a sitting position during a dynamic posture analysis. The neck flexion angles increased in the 20th minute compared to the initial one. This condition has been associated with increased fatigue and an inappropriate posture has emerged (Hanphitakphong et al., 2021). It is in line with current findings that longer smartphone use can lead to poor posture and progressive muscle loading in the posterior of the neck. It has been pointed out that significant fatigue of UT and CES muscles was noticed after 20-30 minutes of smartphone use (Kim and Koo, 2020). An adult's neck can typically lift about 10 to 12 pounds of force in the neutral position (Hansraj, 2014). Another issue that is worth noting is that children's heads are larger compared to adults according to their body size. As the digital gaming duration increases, the extensor muscles are activated to resist the flexion moment of the neck, and the load on the CES and UT muscles increases (Eitviviart et al., 2018). In addition, the size of muscle fibers in children is less compared to adults. When the head stays in the forward flexion position for a long time, the onset of fatigue begins earlier than in adults (Hanphitakphong et al., 2021). Digital device use in relation to different body positions has a higher risk of developing musculoskeletal system symptoms (Young et al., 2013). It is stated that using a smartphone while sitting or standing without a support surface can cause more physical stress on the neck muscles compared to using a desktop or laptop computer (Lee et al., 2014). In

addition, it has been stated that different activities such as gaming, texting, and watching videos in two different postures such as sitting and standing cause more changes in neck and torso posture in a sitting position compared to standing posture. As a piece of interesting information, the flexion extension of the neck during digital gaming is more significant than when watching videos (Alfaitouri et al., 2014; Anna et al., 2018). In different postures (standing, arms-free sitting, and sitting with arms resting on a table), the angle of flexion of the neck increased significantly as time progressed (Alfaitouri et al., 2014). In one study, photographic postures were taken from participants before and after using a smartphone. A significant increase in the amount of shoulder protraction was found in the non-dominant hands of the participants, and significant results were found in pelvic curvature after using a smartphone. In addition, increased shoulder protraction causes scapula dysfunction during upper extremity movement, which causes participants to be unable to use the arm well. In summary, it has been reported that smartphone use negatively affects supine postures (Cochrane et al., 2019). In the study in which spinal posture and mobility were evaluated, the spinal posture, mobility, and stability of e-sports players were found to be significantly poor (Lam et al., 202). In individuals with a forward head posture, a relationship was found between the duration of playing games and the forward head posture (Ashok et al., 2020; Hakala et al., 2006). It has been reported that individuals who spend a long time on digital gaming devices have a high risk of developing a forward head posture due to static loading affecting the cervical spine (Ashok et al., 2020).

Further Research

Since the current studies are mostly cross-sectional, case-control and experimental laboratory designs with low methodological quality, the findings obtained in our study should be interpreted carefully. Therefore, high-quality epidemiological studies are needed to strengthen the evidence, including longitudinal studies that study the duration of smartphone use in natural environments. In addition, the right methods are available to accurately measure the duration of smartphone use in everyday life. Accurate measurement methods should be used for the symptoms and exposures of the forward head posture, postural disorder, musculoskeletal system,

and laboratory studies. Anatomical angle definitions should be clearly remarked and preferably harmonized between studies.

Due to the heterogeneity of the study designs, methods, results, and data presented, narrative synthesis was used in the review rather than meta-analysis. The systematic approach used to scan articles, extract data and evaluate the meteorological quality of the included studies has helped us to minimize biases. In our review, studies examining gait and balance parameters during smartphone use were excluded.

Limitations of this review

There are some limitations in this systematic review. A lack of effort to identify unpublished peer-reviewed studies and non-English written articles as well as the exclusion of laboratory studies may introduce bias in this review. In addition, some studies have probably been missed out although an extensive literature search was performed.

Conclusion

Five articles of high quality, four articles of acceptable quality and two articles of low quality were evaluated in this systematic review. A wide range of prevalence rates of musculoskeletal complaints in different body regions has been reported, with the highest prevalence commonly found in neck complaints. This review has only found some evidence showing that a neck flexion posture as well as the frequency of digital gaming are associated with musculoskeletal disorders and pain, postural disorders among users of digital devices. Interpretation of the results of risk factors in this review should be treated with caution since many risk factors have been examined by only eleven studies. More high-quality and prospective studies are needed to reveal the correlation between musculoskeletal disorders, postural disorders and pain stemmed from digital games.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Statement (Prospero ID)

Permissions for the study named The Effect of Digital Gaming Duration on Musculoskeletal System Symptoms (A Systematic Study) were obtained from York University National Institute for Health Research on April 28, 2023 with ID number 422287.

Author Contributions

Study Design, MS; Data Collection, MS, AB, IB; Statistical Analysis, AB, GK, NS, PA; Data Interpretation, MS, PA, IB, GK Manuscript Preparation, MS, NS, NS, IB; Literature Search, NS, GK, PA, AB. All authors have read and agreed to the published version of the manuscript.

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