ATATURK UNIVERSITY PUBLICATIONS

Research in Sport Education and Sciences

Formerly:
Journal of Physical Education and Sport Sciences Official journal of Atatürk University Faculty of Sport Sciences
Volume 27 • Issue 2 • June 2025

EISSN 2822-3527
https://dergipark.org.tr/en/pub/rses

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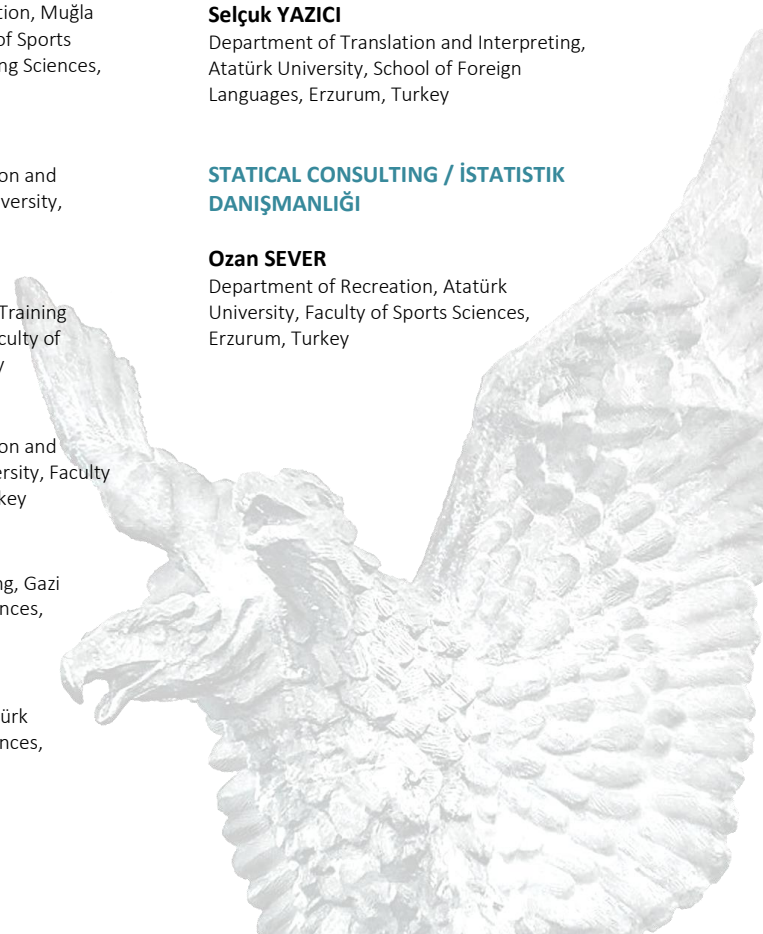

Research in Sport Education and Sciences

ABOUT the RESEARCH in SPORT EDUCATION and SCIENCES

Research in Sport Education and Sciences is a peer reviewed, open access, online-only journal published by the Atatürk University.

Research in Sport Education and Sciences is a quarterly journal published in English and Turkish in March, June, September, and December.

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As of 2022, the journal has changed its title to Research in Sport Education and Sciences.

Previous Title (1999-2021)

Atatürk Üniversitesi Beden Eğitimi Spor ve Yüksekokulu Dergisi/Journal of Physical Education and Sport Sciences
ISSN: 1302-2040

Current Title (2022-...)

Research in Sport Education and Sciences
EISSN: 2822-3527

Abstracting and Indexing

Research in Sport Education and Sciences is covered in the following abstracting and indexing database;

- Web of Science - Emerging Sources Citation Index (ESCI)
- Scopus
- DOAJ
- EBSCO
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Research in Sport Education and Sciences aims to publish original articles, case reports, reviews, and letters to the editor of the highest scientific value across all fields of physical education and sports science. The journal also includes book reviews and biographies within the scope of its content.

The scope of the journal includes, but is not limited to, movement and training sciences, physical education and sport teaching sciences, recreation, health sciences in sport, management sciences in sports, and psycho-social sciences in sport.

The target audience of the journal includes sport professionals, amateurs and researchers who are interested or working in physical education and sports sciences, and sports medicine physicians.
You can find the current version of the Instructions to Authors at https://dergipark.org.tr/en/pub/rses.

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Publisher: Atatürk University
Address: Atatürk University, Yakutiye, Erzurum, Turkey
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Research in Sport Education and Sciences

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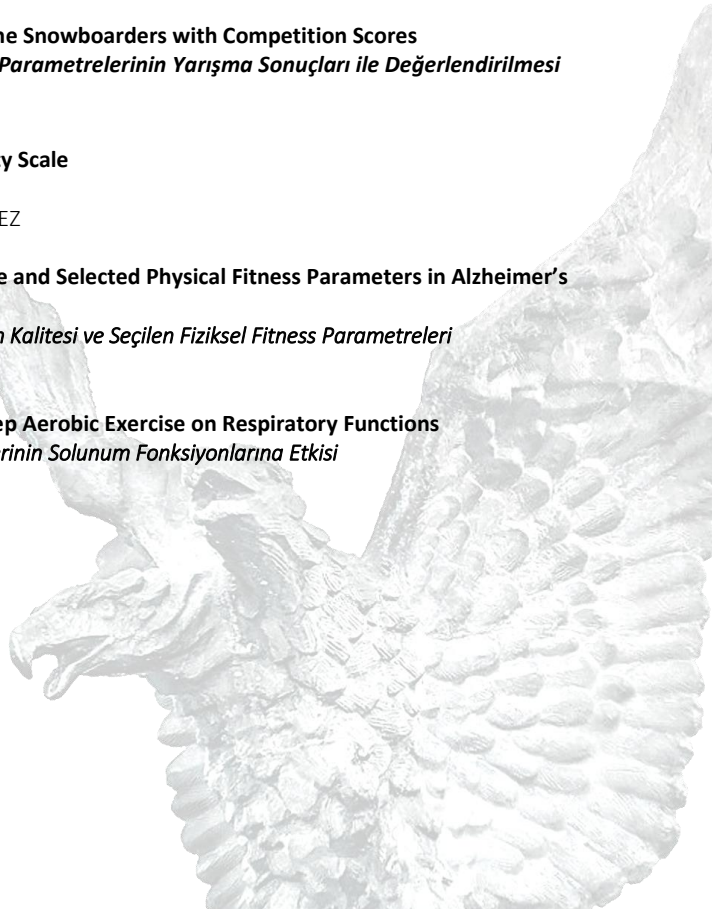

ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Research Article *Araştırma Makalesi* DOI: 10.62425/rses.1521040

The Relationship Between Perceived Stress, Body Image and Eating Behaviors in Athletes

Sporcularda Beden İmajı, Yeme Davranışları ve Stres Durumları Arasındaki İlişki

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ABSTRACT

The aim of the study was to evaluate the relationship between body image, eating behaviors, and stress states in athletes. The study was conducted with 72 volunteer athletes aged 13-23. The Perceived Stress Scale, the Dutch Eating Behavior Scale, the Multiphasic Body-Self/Self Relationship Scale and a questionnaire including questions about body weight satisfaction and emotional eating were applied to the athletes. Anthropometric measurements were taken using bioelectrical impedance analysis (BIA). The perceived stress levels of female athletes (28.29±5.24) were found to be higher than those of males (24.34±7.16). Restrictive and emotional eating behaviors were found to be higher in females. While the emotional eating subscale mean score was higher in taekwondo athletes (29.63±14.213) than in rowing athletes (21.69±10.058), the total body image score and physical adequacy orientation, health evaluation and health orientation subscale mean scores were higher in rowing athletes (p<.05). It was observed that being anxious, angry, nervous, excited, happy and cheerful significantly affected appetite according to gender (p<.05). Positive correlations were found between perceived stress and emotional eating subscale and between external eating and appearance evaluation subscales (p<.05). The tendency of athletes to perfectionism can affect their eating behaviors, stress situations and body perception. In order for their performance not to be negatively affected, athletes need to be able to control their emotional eating and perceived stress levels, be aware of which emotinos trigger these situations and seek solutions to these situations.

Keywords: Athlete, eating behaviors, stress, body ımage

ÖZ

Araştırmanın amacı, sporcularda beden imajı, yeme davranışları ve stres durumlarının ilişkisini değerlendirmektir. Çalışma yaş aralığı 13-23 olan 72 gönüllü sporcu ile yürütülmüştür. Sporculara Algılanan Stres Ölçeği, Hollanda Yeme Davranışı Ölçeği, Çok Yönlü Beden-Benlik/Benlik İlişkisi Ölçeği ve vücut ağırlığı memnuniyeti ile duygusal yeme ile ilgili soruları içeren bir anket uygulanmıştır. Biyoelektrik empedans analizi (BIA) ile antropometrik ölçümleri alınmıştır. Kadın sporcuların algılanan stres düzeyleri (28.29±5.24) erkeklere (24.34±7.16) göre daha yüksek bulunmuştur. Kısıtlayıcı ve duygusal yeme davranışları kadınlarda daha yüksek saptanmıştır. Duygusal yeme alt ölçek puan ortalamasının tekvando sporcularında (29.63±14.213) kürek sporcularına göre (21.69±10.058) daha yüksek iken beden imajı toplam puanı ve fiziksel yeterlilik yönelimi, sağlık değerlendirmesi ve sağlık yönelimi alt ölçek puan ortalamaları kürek sporcularında daha yüksek saptanmıştır (p<.05). Kaygılı, öfkeli, sinirli, heyecanlı, mutlu ve neşeli olmanın iştahı cinsiyete göre anlamlı şekilde etkilediği görülmektedir (p<.05). Algılanan stres ile duygusal yeme alt ölçeği arasında ve dışsal yeme ile görünüm değerlendirme alt ölçekleri arasında pozitif korelasyonlar saptanmıştır (p<.05). Sporcuların mükemmeliyetçilik eğilimlerine yatkınlığı yeme davranışlarını, stres durumlarını ve beden algılarını etkileyebilmektedir. Sporcuların performanslarının olumsuz etkilenmemesi için duygusal yeme ve algılanan stres düzeylerini kontrol edebilmeleri ve hangi duyguların bu durumları tetiklediğinin farkında olmaları ve bu durumlara çözüm aramaları gerekmektedir.

Anahtar Kelimeler: Sporcu, yeme davranışları, stres, beden imajı

Geliş Tarihi/Received 23.07.2024
Kabul Tarihi/Accepted 14.05.2025
Yayın Tarihi/Publication Date 20.06.2025

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Cite this article: Şentürk, G., Deliceoğlu, G., Atasoy, M., & Yıldırım, İ.G. (2025). The relationship between perceived stress, body image and eating behaviors in athletes. *Research in Sport Education and Sciences, 27*(2), 77-87.

Introduction

Body image perception in societies; Social media perceptions can be affected by many factors such as education level, sports, age, impulsivity, social pressure, health, appearance perception, gender, and peer relations. Due to body dissatisfaction in body image, individuals may push individuals into different behaviors such as dieting, mood disorders, excessive exercise and sports, ergogenic support or drug use in order to achieve the desired body shape (Fidan et al., 2023). Generally, a lean and thin body composition is perceived as the ideal female figure, while a muscular and well-built body composition is perceived as the ideal male figure (Grogan, 1999). Eating disorders can be affected by many factors such as gender, race, ethnicity, body weight, socioeconomic status, sports activities, coach or peer relationships (Frideres & Palao, 2005; Yu & Muehleman, 2023). Eating behavior disorders can be seen more frequently in athletes, especially female athletes, compared to the general population (Joy et al., 2016; Scott et al., 2020). It is stated that the reason for the higher risk in women is that they tend to experience mood disorders such as body dissatisfaction, depression, and stress more frequently compared to men (Yu & Muehleman, 2023). In sports where body weight is at the forefront and endurance sports, the risk of eating disorders may increase due to factors such as the negative attitudes and behaviors of coaches and teammates and their perfectionist nature (Frideres & Palao, 2005; Reardon et al., 2019). The performance of the athlete is affected depending on whether the stress is manageable or not (Keser, 2013). When the threshold limit of unmanageable stress is exceeded, it may be inevitable that learning becomes difficult, hindered, and performance deteriorates (Koyuncu et al., 2015). In this context, the contribution of the research to the literature is to support the development of science and related fields. The aim of the research is to evaluate the relationship between body image, eating behaviors and stress situations in athletes competing in different sports branches according to gender.

Methods

Subjects

This study is a cross-sectional study and G*Power 3.1.9.7 program was used to calculate the sample size of the study. For this purpose, the information obtained from a study conducted by Mutlu et al., (2022) was taken as reference and as a result of the analysis made by taking alpha (α) = 0.05, effect size (g) = 0.5 and power (1-β) = 0.95, It was determined that at least 54 athletes should take part. 72 athletes between the ages of 13-23 who volunteered to participate in the study were included. Athletes who did not volunteer to participate in the study or wanted to leave the study in the middle of the study were excluded from the study. The research population consists of athletes applying to an Athlete Health Center. Necessary permissions and ethics committee were obtained. Relevant consent forms were obtained from both the participants and their parents.

Forms used in data collection:

The contents of the sections and body composition analysis in the survey form prepared by the researchers in the study are as follows;

Demographic Information:

In this section consisting of ten questions, demographic information and ergogenic supplement use status of the participants were questioned.

Anthropometric Measurements:

Body weight (kg), lean mass (kg), fat mass (kg) and body fat percentage (%) values of the athletes were determined by bioelectrical impedance analysis (BIA) (MC 980, Tanita Corp., 1000 kHz, Japan), which is a body composition analysis method applied to athletes. The height of the athletes was measured on a stadiometer in anatomical posture without shoes.

Dutch Eating Behavior Questionnaire (DEBQ):

The Dutch Eating Behavior Questionnaire (DEBQ) consisting of 33 items, the Turkish validity and reliability of which was performed by Bozan in 2009, will be used to evaluate the eating behaviors of the participants. This questionnaire consists of 3 subscales evaluating emotional eating behaviors, external eating behaviors and restricted eating behaviors. The items in the questionnaire are evaluated with a 5-point Likert scale (1: never, 2: rarely, 3: sometimes, 4: often, 5: very often). The total score of the test is not evaluated, but the 3 subscales are evaluated within themselves. While there is no cut-off point in the scoring of the test, a high total score evaluated within the 3 subscales indicates a negative eating behavior. In the Turkish version of the Dutch Eating Behavior Questionnaire, the first 10 questions are restricted eating, 11-23 are emotional eating, and 24-33 are questions evaluating external eating attitudes. The 31st question in the external eating scale is a reverse question (Bozan et al., 2011).

Multidimensional Body-Self/Self-Relationship Questionnaire (MBSRQ):

It is a self-assessment scale consisting of 69 items developed to evaluate the self-attitudinal aspects of the structure of body image. The original MBSRQ was developed by Winstead and Cash (1984). It was adapted to the Turkish population by Doğan and Doğan (1992) after a Turkish validity-reliability study. The Turkish version of the scale consists of 57 items and is a 5-point Likert-type scale like the original version. The scale consists of 7 sub-dimensions including “Appearance Evaluation”, “Appearance Orientation”, “Physical Competence Evaluation”, “Physical Competence Orientation”, “Fitness, and Health/Illness Evaluation”, “Fitness, and Health/Illness Orientation” and “Body Areas Satisfaction”. Each statement in the scale is scored from 1 to 5. “Strongly disagree” response receives 1 point, “Mostly disagree” response receives 2 points, “Undecided” response receives 3 points, “Mostly agree” response receives 4 points, “Strongly agree” response receives 5 points. There are items with reverse expression in the scale (12, 13, 14, 25, 26, 27, 29, 30, 31, 33, 35, 37, 39, 40, 41). In these items, the options are reverse scored as 5, 4, 3, 2, 1. A minimum of 57 and a maximum of 285 points can be obtained from the scale. The mean total score is calculated by dividing the sum of the scores obtained from all items in the scale by the number of items. Rising scores indicate a healthy body and high body image. In this study, only the mean total score of the scale was used and the Cronbach's alpha internal consistency coefficient was found to be 0.94 (Doğan & Doğan, 1992; Hovardaoğlu, 1990).

Questions on Body Weight Satisfaction and Emotional Eating:

This is a section in which participants are questioned about their body satisfaction and emotional eating.

Perceived Stress Scale:

The Perceived Stress Scale developed by Cohen, Kamarck and Mermelstein (1983) was designed to determine the extent to which an individual perceives certain situations in his/her life as stressful (Cohen et al., 1983). The lowest score that can be obtained from the 5-point Likert-type scale consisting of 14 items is 0 and the highest score is 56. High scores obtained from the scale indicate that the stress perception of the person is high. The scale was adapted into Turkish by Baltaş et al. (1998) and Eskin et al. (2013). In the study of Eskin et al. (2013), the Cronbach alpha internal consistency coefficient of the scale was found to be .84 and test-retest reliability was found to be .87 (Eksin et al., 2013).

Statistical Methods:

SPSS 23.0 (IBM Corp., Armonk, NY) package program was used for statistical analyses. Descriptive statistics are presented as frequency (n), percentage (%), mean, standard deviation (SD) values. Fisher's Exact Test or Pearson chi-square test was used to analyze the relationships between categorical variables. The normal distribution assumption was checked with the Shapiro Wilk test. Independent t-test was used in the analysis of the difference between the measurements of two independent groups because it conformed to the normal distribution. Pearson correlation test was used to determine the relationships between continuous variables. $p < .05$ values were considered statistically significant.

Ethics of the Research

Ethics committee approval for this study was received from Ankara Medipol University Non-Interventional Clinical Research Ethics Committee (Date: 22 April 2024, Decision Number: 50, Protocol Number: E-81477236-604.01.01-2040). Verbal consent was obtained from all the participants.

Results

Descriptive statistical results obtained from the athletes constituting the research group are given in tables 1 and 2.

Table 1.
Descriptive characteristics

	N	Mean	SD	Minimum	Maximum
Age (years)	72	17.2	2.15	13	23.0
Sports age (years)	72	7.6	3.11	1.0	13.0
Body Weight (kg)	72	66.5	13.26	43.9	115.7
Height (cm)	72	176.2	9.60	148.0	194.0
Body Mass Index (kg/m^2)	72	21.3	2.63	16.5	31.2
Body Fat Percentage (%)	72	17.8	6.68	3.0	30.9
Body fat (kg)	72	11.7	5.01	1.8	24.6
Lean Body Mass (kg)	72	54.7	11.90	33.9	91.1

Table 1 shows the distribution of some demographic characteristics of the athletes participating in the study. According to this table, it was determined that the mean age of the athletes between the ages of 13-23 years was 17.2±2.15 years and the mean number of years of sport was 7.6±3.11 years.

When the mean anthropometric measurement values of the athletes were analyzed, it was found that the mean body weight was 66.5±13.26 and the mean lean body mass was 54.7±11.90 kg. The mean fat percentage was determined as 17.8±6.68.

Table 2.
Descriptive characteristics

		N (n=72)	%
Gender	Female	34	47.2
	Male	38	52.8
Sports Branch	Taekwondo	56	77.8
	Rowing	16	22.2
Education Level	Primary school	2	2.8
	Secondary school	46	63.9
	High school	17	23.6
	University	7	9.7
Ergogenic Supplements Usage	No	58	80.6
	Yes	14	19.4
Type of Ergogenic Supplements*	BCAA	8	57.1
	Mg	5	35.7
	Kreatin	1	7.1
	l-karnitin	2	14.3
	Omega-3	4	28.6
	Whey	2	14.3
	Total	14	157.1

* More than one option is marked.

According to Table 2, 47.2% of the athletes were female, 52.8% were male, 77.8% were interested in taekwondo and 22.2% were interested in rowing. Most of the athletes (63.9%) stated that they graduated from secondary school. It was stated that 19.4% of the athletes used ergogenic support. Of the individuals using supplementation, 57.1% stated that they used BCAA, 35.7% magnesium, 28.6% omega-3.

Table 3.
Comparison of DEBQ, MBSRQ, and perceived stress scale scores by gender (statistically significant differences ındicated)

Gender		N	Mean	SD	t	*p*
Perceived Stress Scale -Total	Female	34	28.29	5.24	2.645	**.010**
	Male	38	24.34	7.16		
Restrained Eating (DEBQ)	Female	34	27.76	8.41	2.762	**.007**
	Male	38	22.95	6.34		
Emotional Eating (DEBQ)	Female	34	34.03	13.77	3.956	**.000**
	Male	38	22.34	11.27		
External Eating (DEBQ)	Female	34	28.35	6.95	-.365	.716
	Male	38	28.97	7.42		
Appearence Evaluation (MBSRQ)	Female	34	21.12	4.50	-1.327	.189
	Male	38	22.47	4.17		
Appearence Orientation (MBSRQ)	Female	34	36.53	5.19	.613	.542
	Male	38	35.79	5.04		
Physical Competence Evaluation (MBSRQ)	Female	34	23.38	3.60	.253	.801
	Male	38	23.18	3.03		
Physical Competence Orientation (MBSRQ)	Female	34	34.56	4.69	-1.167	.247
	Male	38	35.87	4.82		
Fitness, and Health/Illness Evaluation (MBSRQ)	Female	34	20.09	3.69	-2.120	**.038**
	Male	38	21.97	3.84		
Fitness, and Health/Illness Orientation (MBSRQ)	Female	34	38.32	5.13	.488	.627
	Male	38	37.66	6.30		
Body Areas Satisfaction (MBSRQ)	Female	34	33.38	8.15	-1.741	.086
	Male	38	36.37	6.37		
Multidimensional Body–Self Relations Questionnaire (MBSRQ)-Total	Female	34	207.09	25.50	-1.077	.285
	Male	38	213.32	23.58		

DEBQ: Dutch Eating Behavior Questionnaire; MBSRQ: Multidimensional Body–Self Relations Questionnaire.

Table 3 shows the total and sub-dimension mean scores of Body Image, Eating Behaviors and Perceived Stress Scale according to the gender of the athletes. According to the information in this table, the mean scores of the perceived stress scale showed a significant difference according to gender and women (28.29±5.24) had higher stress levels compared to men (24.34±7.16) (p<.05).

The mean scores of restrictive eating and emotional eating subscales of the eating behavior scale showed a significant difference according to gender and women were found to have higher restrictive and emotional eating behaviors compared to men (p<.05). While total scores and most of the subscales for body images did not differ significantly by gender, the health assessment subscale was found to differ significantly by gender (p<.05).

Table 4.
Comparison of the participants' dutch eating behavior questionnaire (DEBQ), multidimensional body-self/self-relationship questionnaire (MBSRQ) and perceived stress scale scores according to sports branch

Sports branch		N	Mean	SD	*p*
Perceived Stres Scale-Total	Taekwondo	56	26.68	6.003	.342
	Rowers	16	24.56	8.350	
Restrained Eating (DEBQ)	Taekwondo	56	25.55	7.998	.424
	Rowers	16	24.06	6.797	
Emotional Eating (DEBQ)	Taekwondo	56	29.63	14.213	**.042**
	Rowers	16	21.69	10.058	
External Eating (DEBQ)	Taekwondo	56	29.41	7.336	.059
	Rowers	16	26.13	5.999	
Appearence Evaluation (MBSRQ)	Taekwondo	56	21.55	4.129	.373
	Rowers	16	22.81	5.076	
Appearence Orientation (MBSRQ)	Taekwondo	56	35.46	4.835	.055
	Rowers	16	38.50	5.404	
Physical Competence Evaluation (MBSRQ)	Taekwondo	56	22.98	3.182	.079
	Rowers	16	24.31	3.554	
Physical Competence Orientation (MBSRQ)	Taekwondo	56	34.32	4.632	**.001**
	Rowers	16	38.50	3.795	
Fitness, and Health/Illness Evaluation (MBSRQ)	Taekwondo	56	20.32	3.578	**.002**
	Rowers	16	23.75	3.715	
Fitness, and Health/Illness Orientation (MBSRQ)	Taekwondo	56	37.18	5.772	**.027**
	Rowers	16	40.75	4.879	
Body Areas Satisfaction (MBSRQ)	Taekwondo	56	34.36	7.728	.299
	Rowers	16	37.06	5.651	
Multidimensional Body–Self Relations Questionnaire (MBSRQ)-Total	Taekwondo	56	206.00	24.235	**.005**
	Rowers	16	225.69	19.297	

DEBQ: Dutch Eating Behavior Questionnaire; MBSRQ: Multidimensional Body–Self Relations Questionnaire.

According to Table 4, the total and sub-dimension mean scores of Body Image, Eating Behaviors and Stress Status of the athletes according to their branches are given. According to the information in this table, while the perceived stress scale scores did not show a significant difference between the sports branches ($p > .05$); the mean score of the emotional eating subscale of the eating behavior scale was significantly higher in taekwondo athletes than in rowing athletes ($p < .05$).

It was found that the total score for body images and physical competence orientation, health assessment and health orientation subscale mean scores differed significantly according to the branches and rowing athletes had a higher mean score ($p < .05$).

Table 5.
Comparison of the participants' answers about body composition and emotional eating questions

		Gender			
		Female (n=34)	Male (n=38)	X^2	*p*
What do you think about your current body weight is?	I want to gain weight	3	6	3.498	.174
	I want to lose weight	16	10		
	I don't have a weight problem	15	22		
Do you have your body composition measured?	Yes	21	23	0.012	.554
	No	13	15		
What do you think about your muscle mass?	Few	7	8	0.068	.967
	Normal	24	26		
	High	3	4		
What do you think about your fat mass?	Few	3	10	4.727	.094
	Normal	22	23		
	High	9	5		
How is your appetite affected when you're anxious?	My appetite increases	7	2	19.616	**.00**
	My appetite decreases	22	11		
	My appetite is not affected	5	25		
How is your appetite affected when you're angry?	My appetite increases	7	1	8.93	**.012**
	My appetite decreases	17	15		
	My appetite is not affected	10	22		
How is your appetite affected when you're angry?	My appetite increases	9	1	10.711	**.005**
	My appetite decreases	15	15		
	My appetite is not affected	10	22		
How is your appetite affected when you're excited?	My appetite increases	14	6	9.239	**.01**
	My appetite decreases	6	3		
	My appetite is not affected	14	29		
How does your appetite affected when you're happy?	My appetite increases	27	18	7.936	**.019**
	My appetite decreases	1	2		
	My appetite is not affected	6	18		
How does your appetite get affected when you're pessimistic?	My appetite increases	11	6	5.931	.052
	My appetite decreases	12	9		
	My appetite is not affected	11	23		
How is your appetite affected when you are happy?	My appetite increases	20	8	11.188	**.004**
	My appetite decreases	0	1		
	My appetite is not affected	14	29		

According to Table 5, the results of the chi-square test for the difference of the questions related to body composition and emotional eating of the athletes according to gender are given. According to the information in this table, it is seen that being anxious, angry, nervous, excited, happy and joyful according to gender significantly affects appetite ($p< .05$). It was observed that appetite decreased in women when they were anxious, angry and irritable, while appetite increased when they were excited, happy and joyful. In men, appetite was not affected more in these emotional states, while appetite increased when they were happy. There was no significant difference between the athletes' self-assessment of body weight, muscle and fat weights according to gender, but most of them thought that they had a normal body composition ($p> .05$).

Table 6.
Correlations between dutch eating behavior questionnaire (DEBQ), multidimensional body-self/self-relationship questionnaire (MBSRQ) and perceived stress scale scores

	Restrained Eating (DEBQ)		Emotional Eating (DEBQ)		External Eating (DEBQ)		Perceived Stres Scale-Total	
	r	*p*	r	*p*	r	*p*	r	*p*
Appearence Evaluation (MBSRQ)	-.063	.597	-.175	.141	.277*	.018	-.311**	.008
Appearence Orientation (MBSRQ)	.221	.063	-.091	.446	.043	.717	-.167	.160
Physical Competence Evaluation (MBSRQ)	.075	.534	-.059	.623	.182	.126	-.076	.525
Physical Competence Orientation (MBSRQ)	.086	.472	-.070	.557	.154	.198	-.233*	.049
Fitness, and Health/Illness Evaluation (MBSRQ)	-.097	.420	-.342**	.003	-.035	.772	-.335**	.004
Fitness, and Health/Illness Orientation (MBSRQ)	.221	.062	-.012	.923	-.069	.564	-.138	.249
Body Areas Satisfaction (MBSRQ)	-.127	.287	-.275*	.019	-.003	.981	-.364**	.002
Multidimensional Body–Self Relations Questionnaire (MBSRQ)-Total	.058	.631	-.213	.072	.091	.446	-.341**	.003
Perceived Stres Scale-Total	.114	.342	.382**	.001	.025	.835	1	

According to Table 6, the correlation of total scores and subscales of the athletes with various parameters is given. According to the information in this table, there are significant negative correlations between perceived stress and total scores of appearance evaluation, physical competence orientation, health evaluation, satisfaction with body areas and multidimensional body-self/self-relationship, while there is a positive correlation between perceived stress and emotional eating subscale (p<.05). Negative correlations were observed between emotional eating subscale and body image, satisfaction with body areas and health assessment subscales. A significant positive correlation was found between the external eating subscale and the appearance evaluation subscale (p<.05).

Discussion

Since perfectionist tendencies increase in individuals doing sports, their eating behaviors, stress states and body perceptions may be affected due to both performance and body appearance (Cash, 1990; Icbudak, 2021). In one study, it was found that there was no difference between the perceived stress status of tennis athletes and gender variable (Ilhan, 2021). In this study, the mean perceived stress scale scores showed a significant difference according to gender and stress levels of women were found to be higher (p< .05). In a study conducted with national wrestlers, it was reported that 12.9% of wrestlers between the ages of 18-35 had negative stress levels (Coşkun, 2011). In this study, it was found that perceived stress scale scores did not differ significantly between taekwondo and rowing athletes.

Eating disorders may be affected by psychological, individual, sociocultural and external factors related to competition in sports activities (Frideres & Palao, 2005). In some studies, it was observed that gender was effective on DEBQ scores (Andres et al., 2017; Nagl et al., 2016). In a study conducted with volleyball players, it was found that there was no significant difference between the DEBQ scores of individuals according to gender (Mutlu et al., 2022). In a study, the mean restrictive

eating scores of female athletes and male athletes were found to be 30.12 and 23.50, respectively. In line with these results, it was observed that female athletes tended to restrictive behavior in their diets due to fear of weight gain or the possibility of weight gain (İçbudak, 2021). In a study conducted in dancers, no statistically significant difference was found between DEBQ scores and gender (Felek, 2018). In this study, restrictive eating and emotional eating subscale mean scores of the eating behavior scale showed a significant difference according to gender, and restrictive and emotional eating behaviors were found to be higher in women compared to men (p<.05).

In a study on wrestling athletes, the mean scores of emotional, restrictive and external eating subgroups were found to be 24.4±9.6, 24.4±6.3 and 32.0±6.4, respectively. In 40.0% of the individuals in the study group, the restrictive eating subgroup score was found to be above the mean score of 27.6 (Coşkun, 2011). In this study, while there was no difference in restrictive eating and external eating subscales according to branches, the mean score of emotional eating subscale of the eating behavior scale was significantly higher in taekwondo athletes (29.63±14.21) than in rowing athletes (21.69±10.06) (p<.05).

Perceived stress has been found to increase eating behaviors related to the prediction of emotional eating behavior (Sims et al., 2008; Young, 2016; Elagöz & Çenesiz, 2022). In this study, a positive correlation was found between perceived stress and emotional eating subscale supporting these findings (p<.05). At the same time, significant negative correlations were observed between perceived stress and appearance appraisal, physical competence orientation, health appraisal, satisfaction with body areas and multidimensional body-self/self-relationship total scores.

Increased scores on the Multidimensional Body-Self Relationship Questionnaire (MBSRQ) indicate a healthy body and high self-image (Cash, 1990). In a study conducted in soccer players, a statistically significant difference was found between Appearance Orientation, Assessment of Physical Competence, Physical Competence Orientation, Health Assessment and gender variable and the scores of women were found to be higher than men. In terms of Health Orientation and Satisfaction with Body Areas, no significant difference was found between gender variables (Emin & Baştuğ, 2008). In this study, no significant difference was found in total scores and most of the subscales for body images according to gender, whereas the health assessment subscale showed a significant difference according to gender and men had higher scores than women (p<.05).

In wrestler athletes, the individuals in the study group scored higher in all questions of the MBSRQ scale and showed higher body and self-image compared to the control group (Coşkun, 2011). Studies have revealed the positive effects of physical activity on body image (Hausenblas & Gıacobbi, 2003). In this study, it was found that the total score for body images and the mean scores of physical competence orientation, health assessment and health orientation subscales differed significantly according to the branches and rowing athletes had higher mean scores (p<.05). At the same time, a negative correlation was observed between the emotional eating subscale and the body image subscales of satisfaction with body areas and health assessment. A significant positive correlation was found between the external eating subscale and the appearance evaluation subscale (p<.05).

It has been reported that various emotional states such as stress, anger, joy, boredom, sadness and fear affect eating behavior. This effect also affects all digestive stages such as emotional response to food, digestion, metabolism, eating motivation, eating speed, food selection, amount digested, and chewing (Macht, 2008). In one study, it was reported that higher food intake occurred in conditions such as depression, fatigue and distress, whereas lower food intake occurred in emotional states such as pain, tension and fear (Sevinçer & Konuk, 2013; Van Strein et al., 2009). Emotional appetite has been reported to cause individuals to consume more food than normal in negative emotions and states such as depression, loneliness and stress (Litwin et al., 2017). It has been observed that individuals who cannot express themselves in the presence of negative emotions tend to eat more than normal (Cotter & Kelly, 2018). On emotional appetite, it is generally stated that stress-related food intake is higher in women than in men (Bektaşoğlu, 2021). According to the information in this study, being anxious, angry, irritable, excited, happy and joyful significantly affected appetite according to gender (p<.05). It was observed that appetite decreased in women when they were anxious, angry and irritable, while appetite increased when they were excited, happy and joyful. In men, appetite increased when they were happy.

In a study, it was reported that 60.0% of male wrestling athletes were satisfied with their current body weight, that is, they did not have weight problems. It was stated that 58.3% of the individuals in the study group who were not satisfied with their

body weight wanted to gain weight. When satisfaction with body muscle ratios was examined, 56.7% were found to be satisfied with muscle ratios (Coşkun, 2011). In this study, no significant difference was observed between the athletes' self-assessment of body weight, muscle and fat weights according to gender, but most of them thought that they had a normal body composition (p>.05).

Conclusion and Recommendations

Since athletes are in competition, perfectionist tendencies can be seen more. This situation affects their eating behaviors, stress and body perceptions due to both their performance and body appearance. It is seen that the perceived stress level is significantly higher in female athletes compared to male athletes. According to their emotional states, the effect on appetite states differs compared to men. Restrictive eating and emotional eating behaviors were also found to be higher in women compared to men. Emotional eating subscale was found to be higher in taekwondo athletes compared to rowing athletes. In this sense, it is important to evaluate emotional eating behaviors in weightlifting athletes in branches where body weight is more prominent. Physical competence orientation, health assessment and health orientation towards body images were found to be higher in rowing athletes. Taking action to improve one's physical capacity, thoughts about personal health and taking action were found to be higher in rowing athletes. In order to control emotional eating behavior in individuals with emotional eating behavior, they must first be aware of which emotions cause emotional eating. When athletes are faced with various emotions such as stress, anxiety and excitement, it affects their emotional appetite and eating behaviors. If preventive treatment approaches are not taken, this may negatively affect the performance and health of athletes. In this case, approaches should be taken to increase the self-worth of athletes by providing trainings on psychological support and approach to athletes to both athletes and their peers, families and coaches during training seasons, competition seasons, taking into account peer, family and coach relationships. At the same time, it should be recommended that athletes seek support from dieticians specialized in this field for nutritional advice that will support them in this process, improve their mood and support a healthy microbiota environment. Coaches should consider the impact of stress and emotional eating behaviors on female athletes and develop individualized support programs. Athletes should regularly seek guidance from professional dietitians to ensure mindful eating habits.

Etik Komite Onayı: Bu çalışma için etik komite onayı Ankara Medipol Üniversitesi'nden (Tarih: 22 Nisan 2024, Karar No: 50, Protokol No: E-81477236-604.01.01-2040) alınmıştır.
Hasta Onamı: Çalışmaya katılan tüm katılımcılardan sözlü onam alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir- G.Ş., İ.G.Y.; Tasarım- G.Ş., İ.G.Y.; Denetleme- İ.G.Y.; Kaynaklar- G.Ş.; Veri Toplanması ve/veya İşlemesi- G.Ş., M.A.; Analiz ve/ veya Yorum-G.Ş., G.D.; Literatür Taraması-G.Ş.; Yazıyı Yazan-G.Ş; Eleştirel İnceleme-İ.G.Y.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Ankara Medipol University (Date: Apr 22, 2024, Decision Number: 50, Protocol No: E-81477236-604.01.01-2040).
Informed Consent: Verbal consent was obtained from all the participants.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept - G.Ş., İ.G.Y.; Design- G.Ş., İ.G.Y.; Supervision- İ.G.Y.; Resources-G.Ş.; Data Collection and/or Processing-G.Ş., M.A.; Analysis and/or Interpretation- G.Ş., G.D.; Literature Search-G.Ş.; Writing Manuscript-G.Ş.; Critical Review-İ.G.Y.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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Research Article *Araştırma Makalesi* DOI:10.62425/rses.1552246

Comparison of Swimmers' Health-Related Fitness Parameters in General and Special Preparation Periods

Yüzmede Genel ve Özel Hazırlık Döneminde Sağlığa İlişkin Fitness Parametrelerinin Karşılaştırılması

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ABSTRACT

This study aimed to compare the health-related fitness parameters of swimmers in the general and special preparation periods. Thirty-six swimmers participated in study voluntarily. Before and after general and after special preparation, measurements of the swimmers' endurance, strength, flexibility, body composition, and respiratory parameters were taken. The pre and post-tests were conducted at two-month intervals before and after general preparation, as well as after special preparation. After the initial measurements, swimmers undertook the general training program for eight weeks, followed by repeated measurements. Following this, speed-based special training was continued for eight weeks, after which the measurements were repeated. Data was analyzed using the SPSS 24.0. As the data displayed normal distribution, we performed a repeated measures variance analysis to compare all parameters among swimmers across three different periods. Significant differences were found in the body composition (lean body weight pre-general 36.79±3.97kg, post-general 37.25±3.96kg, post-special 37.73±3.88kg), respiratory function (FVC pre-general 3.30±0.56L, post-general 3.44±0.55L, post-special 3.59±0.54L), flexibility (pre-general 26.00±7.74cm, post-general 26.44±6.94cm, post-special 27.51±7.79cm), hand grip strength (pre-general 42.35±12.58kg, post-special 51.33±11.71kg), and isokinetic shoulder strength (ΔAverage power≈4W, ΔAverage peak torque≈2Nm) ($p<.05$). Speed-focused training during the special preparation period can improve health-related fitness parameters.

Keywords: Swimming, general preparation period, special preparation period, fitness parameters

ÖZ

Çalışmanın amacı, genel ve özel hazırlık dönemlerindeki yüzücülerin sağlıkla ilgili fitness parametrelerini karşılaştırmaktır. Araştırmaya otuz altı yüzücü gönüllü olarak katılmıştır. Genel hazırlıktan önce, sonra ve özel hazırlıktan sonra yüzücülerin dayanıklılık, kuvvet, esneklik, vücut kompozisyonu ve solunum parametrelerinin ölçümleri alınmıştır. Ön ve son testler, genel hazırlıktan önce, sonra ve özel hazırlıktan sonra iki aylık aralıklarla yapılmıştır. İlk ölçümlerden sonra yüzücüler sekiz hafta boyunca genel antrenman programını uygulamış ve ardından ölçümler tekrarlanmıştır. Bunu takiben, hıza dayalı özel antrenman sekiz hafta boyunca sürdürülmüş ve ardından ölçümler tekrarlanmıştır. Veriler SPSS 24.0 kullanılarak analiz edilmiştir. Veriler normal dağılım gösterdiğinden, üç farklı dönemde yüzücüler arasındaki tüm parametreleri karşılaştırmak için tekrarlanan ölçümler varyans analizi yapılmıştır. Vücut kompozisyonu (yağsız vücut ağırlığı genel öncesi 36.79±3.97kg, genel sonrası 37.25±3.96kg, özel sonrası 37.73±3.88kg), solunum fonksiyonu (FVC genel öncesi 3.30±0.56L, genel sonrası 3.44±0.55L, özel sonrası 3.59±0.54L), esneklik (genel öncesi 26.00±7.74cm genel sonrası 26.44±6.94cm özel sonrası 27.51±7.79cm), el kavrama gücü (genel öncesi 42.35±12.58kg özel sonrası 51.33±11.71kg) ve izokinetik omuz gücü (ΔOrtalama güç≈4W, ΔOrtalama pik tork≈2Nm) ($p<.05$). Özel hazırlık döneminde hız odaklı antrenman, sağlıkla ilgili fitness parametrelerini iyileştirebilir.

Anahtar Kelimeler: Yüzme, genel hazırlık dönemi, özel hazırlık dönemi, fitness parametreleri

Geliş Tarihi/Received 18.09.2024
Kabul Tarihi/Accepted 24.04.2025
Yayın Tarihi/Publication Date 20.06.2025

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Cite this article: Odabaş, İ., & Kıstak Altan, B. (2025). Comparison of swimmers' health-related fitness parameters in general and special preparation periods. *Research in Sport Education and Sciences, 27*(2), 88-98.

Introduction

Swimming is a highly prevalent sport among all age groups, and the mastery of this skill is generally regarded as crucial for living. Swimmers require well-coordinated movements of their upper and lower extremities to move through water (Peyton & Krabak, 2023). Swimming provides various health benefits, including enhancing general fitness, cardiovascular endurance, muscular strength, flexibility, coordination, balance, and other motor skills. Furthermore, swimming education encourages children's socialization (Silva et al., 2020). The development of health-related fitness parameters in swimming can notably impact the performance of adolescent swimmers. Endurance, strength, flexibility, body composition, and respiratory function have been identified in certain investigations as influential factors (Fiori et al., 2022; Muthusamy et al., 2022), although other studies have arrived at different conclusions (Gokhan et al., 2011; McNarry et al., 2020). For instance, Fiori et al. (2022) analysed 3 macrocycles in a 47-week season to assess swimmers' changes in anthropometrics and stroke mechanics (n=11 girls; 8 boys). Results showed a Δ12.5% decrease in body weight and a Δ3.8% decrease in height from the beginning to the end of the season. These findings suggest that long-term training can have a significant impact on the physical characteristics of swimmers (Fiori et al., 2022). In a separate study, it was found that the anthropometric features of 22 male swimmers (mean age of 14.52±0.77 years) had an 82% effect on the performance of the 200 m freestyle swim (Nasirzade et al., 2015). Additionally, Bond et al. discovered that anthropometric characteristics had a 63.8% impact on the performance of the 100 m freestyle swim, and this effect considerably explained the variation (Bond et al., 2015).

There is a significant impact on swimming performance attributed to the act of breathing whilst in the water. This impact is associated with the high oxygen flow rate of competent swimmers. It has been observed that individuals possessing elevated oxygen capacity and endurance levels demonstrate superior performance in aquatic competitions. Pulmonary function tests represent a means of evaluating this capacity in swimmers (Rosser-Stanford et al., 2019). Sable et al. (2012) claimed that swimming exercises have an impact on lung volume and that swimmers should use all respiratory muscles, including the diaphragm while breathing in and out of water.

Flexibility is one of the factors that affects performance in swimming. In achieving the desired motor skill in sports, flexibility holds an important place and serves as a core element of training (Cañas-Jamett et al., 2020). Loss of flexibility can hinder the efficiency of movement and increase the risk of sports injuries. Joint range of motion and mobility are important for swimming and other branches of sports (Nikšić et al., 2020). Therefore, it is essential to maintain joint functionality for optimal athletic performance and injury prevention. Inan and Saygin found a significant improvement in the swimming performance of female swimmers in the 50-meter race as their flexibility increased (p<.05) (Inan & Saygin, 2019). In contrast to the findings of previous studies, Gokhan et al. (2011) reported that swimming did not result in any improvement in flexibility.

Maximal handgrip strength is commonly employed in clinical settings as an indicator of the health and integrity of upper motor neurons and motor unit function. Handgrip strength denotes the capacity of the fingers and hand to generate muscle force (Kim et al., 2018). Athletes' strength performance is assessed using handgrip strength. The study reports the dimensional and anatomical features of the human hand, such as size and shape, impact grip formation, and strength. It was concluded that a longer finger and hand surface to grip an object leads to less fatigue during the grip (Nag et al., 2003). Additionally, the study found that swimming training had a significant positive impact on hand grip strength (Ceylan, 2021). Cicek et al. (2018) reported higher grip strength in the right and left hands of swimmers compared to sedentary individuals.

Isokinetic shoulder strength exercise involves the constant-speed contraction and relaxation of shoulder muscles while changing the angle of movement. This form of exercise is particularly beneficial for strengthening shoulder muscles in swimming (Gaudet et al., 2018). Strong shoulders enable the swimmer to regulate the paddle's angle as it enters the water and obtain a stronger grip on the water from the point where the arm enters the water, leading to the swimmer being able to apply more force to the water and thus swim faster (Matthews et al., 2017; Vila Dieguez & Barden, 2022). It is also crucial for the swimmer to position their shoulders correctly when their arm enters the water. Maintaining the correct shoulder position can reduce strain on the shoulders and upper back muscles while enhancing a swimmer's performance in the water (Matsuura et al., 2023; Gonjo et al., 2020).

The annual training periodization for adolescent swimmers is categorized into preparation, competition, and transition

periods. The preparation period is divided into two segments: general and special. The goal of the preparation period is to enhance endurance, strength, and mobility while achieving the fundamental technical model. During the general preparation period training, the objective is to enhance the tempo of oxygen consumption and lactate evacuation of circulatory and respiratory functions, leading to increased oxygen supply to the muscles. Additionally, this section focuses on augmenting muscle strength and joint flexibility. In the special preparation period, swimmers should further develop the oxygen consumption and lactate evacuation rates of slow twitch muscle fibers. Swimmers should aim to enhance their stroke length without sacrificing stroke tempo when competing. It is advisable to plan training sessions to boost both the strength and flexibility of muscles and joints. Throughout this period, it is essential to evaluate changes in elements like sprint speed, muscle strength, and joint flexibility (Maglischo, 2018).

A literature review found studies investigating swimmers' health-related fitness parameters, including endurance, strength, flexibility, body composition, and lung capacity (FVC, FEV1, FVC/FEV1, PEF, MVV). However, studies comparing athletes' answers regarding endurance, strength, flexibility, body composition, and respiratory parameters in general and special preparation periods in swimming training are quite limited.

Therefore, the uniqueness of this study lies in measuring these parameters three times to determine whether there are any differences based on period. If there are differences in health-related fitness parameters between the general and special preparation periods, the study aims to examine whether the addition of speed-based training during the special preparation period can explain these differences. The aim of this study was to compare health-related fitness parameters of swimmers during general and special preparation periods, including endurance, strength, flexibility, body composition and lung capacity.

Methods

Subjects

The G-Power analysis (G-Power 3.1.9.4) determined an optimal sample size of 36 at 95% power and 10% type I error levels. Thirty-six swimmers aged 12-14 years (mean age: 13.08±0.81 years) took part voluntarily, fulfilling the requirements of residing in Istanbul, belonging to private swimming clubs, and holding athletic licenses for at least 3 years. Criterion sampling method was used for participation in the research group. Research model is experimental method. Approval was obtained from the Ethics Committee for Non-Interventional Clinical Research at Haliç University for conducting the study (25/04/2023-116). Prior to the commencement of the study, all participating swimmers and their families provided informed voluntary consent/assent by signing the appropriate forms.

Data Collection

Body Composition, Body Weight, Height, and Arm Length: During the swimmers' body weight measurement, participants were required to be barefoot and in swimsuits, standing still and upright without any support. For height measurement, participants were instructed to keep their heads upright, gaze forward, and heels together. Body weight, height, percentage of body fat, lean body weight, waist-to-hip ratio, and body mass index values were obtained using the Gaia Kiko Bioelectric Impedance, which measures bioelectric impedance (Wang et al., 2024). Arm length was measured using a Holtain horizontal stadiometer (Hoechstmass, Germany) fixed to the wall, with an accuracy of ±1 mm.

Subcutaneous Fat Thickness: We measured the subcutaneous fat thickness of swimmers in seven regions using a Holtain skinfold caliper (Holtain Ltd, Bryberian, UK) with a precision of 0.2 mm and a pressure of 10 g/mm. The regions measured were subscapular, triceps, biceps, chest, abdominal, suprailiac, and calf. An expert held the skinfold area, and a single person measured it with two fingers from 1 cm behind. The result was recorded three seconds after the caliper was placed. The swimmers' subcutaneous fat thickness was measured from seven regions using a Holtain skinfold caliper (Holtain Ltd, Bryberian, UK) with an accuracy of 0.2 mm and a pressure of 10 g/mm. All Anthropometric evaluations were performed by an experienced expert according to the Anthropometric Standardization Guide. Measurements were made in the morning while the athletes were at rest.The regions measured were subscapular, triceps, biceps, chest, abdominal, suprailiac, and calf (Cerqueira et al., 2022).

Respiratory Function Assessment: We conducted a respiratory function assessment using a COSMED-Pony FX portable

spirometer. All participants completed the test by exhaling with maximum effort. Following the breathing volume connected to the spirometer via a mouthpiece, participants were instructed to take several breaths while seated and with their noses clamped shut. All measurements were made after participants were accustomed to this type of breathing. Swimmers conducted the pulmonary function tests once. A passive rest period of 1 minute was given to the swimmers between the forced vital capacity and maximal voluntary ventilation tests. The study measured parameters such as forced vital capacity (FVC), forced expiratory volume (FEV1), forced expiratory volume to forced vital capacity ratio (%FEV1/FVC), peak flow velocity (PEF), and maximal voluntary ventilation (MVV). Forced vital capacity measures the amount of air expelled quickly and forcefully with a maximal exhalation after a maximal inhalation. Forced expiratory volume is the amount of air expelled in the first second of the test. Peak flow velocity is assessed during rapid expiration after maximal inhalation. Maximal voluntary ventilation was measured by rapid and forceful inhalation and exhalation for 12 seconds in a seated position to determine the volume of air (l/min) that swimmers can take in within 60 seconds (Honório et al., 2019).

Sit-and-Reach Test: The participants positioned the soles of their feet on a flexible bench while keeping their knees straight. The distance in centimeters was measured at the furthest point where both hands reached the bar on the stand. Each participant performed the sit-and-reach test twice, and the best score was recorded (Cañas-Jamett et al., 2020).

Hand Grip Strength: The hand grip strength of the swimmers was assessed using a Baseline hydraulic hand dynamometer that can measure between 5.0 and 100.0 kg with a precise accuracy of 0.1 kg. Participants were instructed to stand with their feet shoulder-width apart and their elbows fully extended, looking straight ahead during the measurement. The dynamometer was calibrated to fit the hand size of the volunteers prior to the grip strength assessment. The dynamometer had to be held in a comfortable hand position (not in flexion or extension), with the index finger at a 90-degree angle. Participants were instructed to exert their maximum force while squeezing the handle for three seconds. They were directed to avoid holding their breath and shaking the dynamometer during the test. The grip strength of both hands of the volunteers was measured three times, and the highest recorded value in kilograms (kg) was documented. A minimum of one-minute breaks were allowed between each trial (Kim et al., 2018).

Isokinetic Shoulder Strength and Endurance: We conducted isokinetic shoulder strength measurements using the Computerised Biodex System 4 Pro™ dynamometer from Biodex Medical Systems Inc., New York. Before each measurement, we programmed the test protocol into the system and calibrated it. We adjusted the seat height so that the swimmer was in an upright position and the acromion head and lever arm were in alignment before beginning the test. The swimmer was secured to the seat using pelvic and trunk belts. The length and direction of the lever arm holding device were adjusted for maximal extension and flexion movements of the swimmer. The device's user manual was referred to for positioning and aligning the joints of the swimmer. The swimmer's gender, age, body weight, and height were documented while noting their dominant side and any injuries. To eliminate the effect of gravity, the swimmer's arm and device weight were measured in horizontal and vertical positions. Prior to commencing the measurement, the swimmers were briefed on the test and instructed on the appropriate behaviors to exhibit or avoid during the test. Subsequently, the designated swimmer completed a single trial to enable familiarisation with the device. Following the trial, and with the guidance of the device's signal, the swimmer completed three repetitions at an angular speed of 60°/s, and ten repetitions at an angular speed of 180°/s, on both the right and left sides. All swimmers received equal motivational speeches and verbal warnings during the test, supplemented by increased visual motivation provided by monitoring their own graphs on the computer screen. A rest break of 60 seconds was granted between each measurement. Finally, average power and average peak torque values for the right and left flexion-extension muscle groups of the swimmers at both angular velocities were recorded (Wiażewicz and Eider, 2021; Sheha et al., 2014).

Before the measurements throughout the study, training that would affect the performance of the swimmers positively/negatively was avoided and the swimmers were not allowed to take any food until 2 hours before the measurements. The research was carried out at Haliç University, Faculty of Sports Sciences, Performance Laboratory. The research group participated in the measurements in groups on the measurement days within the framework of predetermined hours. After obtaining the personal information of the swimmers, the swimmers' arm length, body composition, body weight, height, and subcutaneous fat thickness were measured respectively. After these measurements, the swimmers were given a 1-minute passive rest. After this rest, pulmonary function tests and hand grip strength were measured. Swimmers were given 1 minute passive rest between these measurements. Finally, isokinetic shoulder strength

was measured. All of these measurements were performed in three different periods. These tests were performed two months apart before and after general preparation and two months apart after special preparation. After the first measurements, the swimmers performed their general training program for eight weeks (Figure 1). Afterwards, the measurements were repeated. After the second measurements, the swimmers continued with speed-based special training for eight weeks (Figure 2). After the special training period, the measurements were repeated. During the general and special preparation period, the micro cycle was prepared as a peak. The content of the workouts was prepared according to A Coach's Guide To Energy Systems as stated in Swimming World July 2021 Issue. Speed-based workouts were added to the training performed in the special period. The implementation of the research is given in Figure 3.

		Total Set Distance (m)	Heart Rate (% of maximal)
Warm-up	Warm-up	800 – 1200	
Main			
Monday (PM)	Endurance 1	1600 – 2400	70-80
Tuesday (PM)	Endurance 2	1600 – 2400	80-90
Wednesday (PM)	Endurance 1	1600 – 2400	70-80
Thursday (PM)	Endurance 1	1600 – 2400	70-80
Friday (PM)	Endurance 2	1600 – 2400	80-90
Saturday (AM)	Endurance 3	1200 – 2000	90-100
Sunday	Off		
Cool-down	200m any stroke	200	

Figure 1.
General term training program

		Total Set Distance (m)	Heart Rate (% of maximal)
Warm-up	Warm-up	800 – 1200	
Main			
Monday (PM)	Endurance 1 + Sprint 2	1600 – 2400 + 200 – 600	70-80 + 100
Tuesday (PM)	Endurance 2 + Sprint 3	1600 – 2400 + 100 – 400	80-90 + 100
Wednesday (PM)	Endurance 1 + Sprint 1	1600 – 2400 + 600 – 1200	70-80 + 95-100
Thursday (PM)	Endurance 1 + Sprint 2	1600 – 2400 + 200 – 600	70-80 + 100
Friday (PM)	Endurance 2 + Sprint 3	1600 – 2400 + 100 – 400	80-90 + 100
Saturday (AM)	Endurance 3 + Sprint 1	1200 – 2000 + 600 – 1200	90-100 + 95-100
Sunday	Off		
Cool-down	200m any stroke	200	

Figure 2.
Special term training program

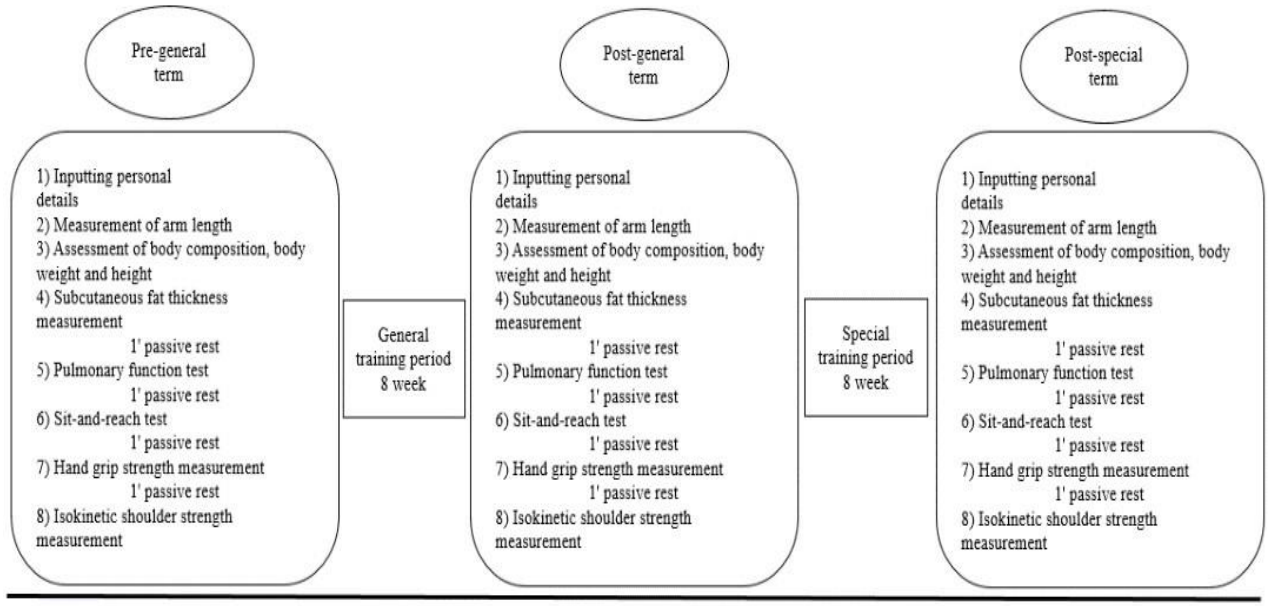

Figure 3.
Research implementation

Data Analysis

Data were analyzed using IBM SPSS version 24.0 (IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.) statistical program. The suitability of the data for normal distribution was determined by Skewness and Kurtosis values. Skewness and Kurtosis values were found to be between "-1.5" and "+1.5" and in this direction, it was accepted that the data showed normal distribution (Tabachnick et al., 2013). The comparison of parameters of body composition, respiration, flexibility, strength, and endurance of the swimmers according to three different periods (before, after general preparation, and after special preparation) was analyzed by repeated measures variance. As a result of Mauchly's Test of Sphericity test, if the p-value was greater than .05, Sphericity Assumed test was used; if the p-value was less than .05, Wilks' Lambda test was used. Post-hoc Bonferroni test statistics and a Pairwise Comparisons table were used to find out which of the parameters with significant results was different from the others. Confidence interval was accepted as $p<.05$.

Results

The mean and standard deviation values of the parameters regarding the swimmers' body composition and the differences between measurements are displayed in Table 1. Table 1 highlights statistically significant differences in measurements of arm length, lean body weight, waist-to-hip ratio, body weight, height, and skinfold thickness for the biceps and chest ($p<.05$). Additionally, significant differences were discovered in pairwise measurements of arm length, lean body weight, and height. Significant differences were observed in the waist/hip ratio between the pre-general and post-general as well as in body weight between the post-special vs pre-general and post-general. Additionally, variations were detected in biceps skinfold thickness between the pre-general vs post-general and post-special, and in chest skinfold thickness between the post-general vs pre-general and post-special ($p<.05$). There were no significant statistical differences between the measurements of the percentage of body fat, body mass index, subscapular, triceps, abdominal, suprailliac, and calf skinfold thickness ($p>.05$).

Table 1.
Mean and standard deviation values of body composition parameters of swimmers and differences between measurements

	Pre-general	Post-general	Post-special	Difference (*p*-values)	Pre-general vs Post-general (*p*-values)	Pre-general vs Post-special (*p*-values)	Post-general vs Post-special (*p*-values)
Arm Length (cm)	158.71±6.90	160.27±6.89	161.08±6.86	*.001**	*.001**	*.001**	*.004**
Percentage of Body Fat (%)	16.12±5.89	15.46±5.92	15.76±6.21	*.077*			
Lean Body Weight (kg)	36.79±3.97	37.25±3.96	37.73±3.88	*.001**	*.002**	*.001**	*.019**
Waist-to-Hip Ratio	0.70±0.04	0.69±0.04	0.69±0.04	*.001**	*.004**		
Body Mass Index (kg/m^2)	19.28±2.07	19.08±2.00	19.27±1.97	*.069*			
Body Weight (kg)	47.56±7.31	47.73±7.04	48.83±7.04	*.001**		*.001**	*.001**
Height (cm)	156.64±6.56	158.21±6.33	158.93±6.27	*.001**	*.001**	*.001**	*.008**
Subscapular (mm)	9.41±4.86	8.91±3.87	8.93±3.67	*.372*			
Triceps (mm)	12.28±4.48	12.32±4.09	12.50±4.34	*.620*			
Biceps (mm)	6.43±1.84	5.79±1.63	5.93±1.70	*.002**	*.002**	*.034**	
Chest (mm)	8.52±4.08	7.81±3.42	8.31±3.45	*.003**	*.049**		*.022**
Abdominal (mm)	14.68±7.24	13.89±6.09	14.22±5.92	*.273*			
Suprailiac (mm)	9.16±4.86	8.81±3.64	9.01±3.51	*.408*			
Calf (mm)	12.32±3.85	12.39±3.82	12.53±4.14	*.776*			

**p<.05*

The mean and standard deviation values for parameters related to pulmonary function, flexibility, and hand grip strength of the swimmers, along with differences between measurements, have been tabulated in Table 2. The table indicates statistically significant variations in FVC, FEV1, PEF, and MVV values between different measurements. Further, differences were observed in dominant (right)-nondominant (left) hand grip strength, FEV1, and PEF, between the post-special vs pre-general and post-general. There were variances in flexibility measurements between the pre-general and post-special (*p<.05*). However, no significant statistical dissimilarities were observed in the measurements of FVC/FEV1 values (*p>.05*).

Table 2.
Mean and standard deviation values of body composition parameters of swimmers and differences between measurements

	Pre-general	Post-general	Post-special	Difference (*p*-values)	Pre-general vs Post-general (*p*-values)	Pre-general vs Post-special (*p*-values)	Post-general vs Post-special (*p*-values)
FVC (L)	3.30±0.56	3.44±0.55	3.59±0.54	*.001**	*.002**	*.001**	*.001**
FEV1 (L)	2.68±0.50	2.82±0.48	2.98±0.51	*.004**		*.004**	*.012**
FVC/FEV1	80.86±10.48	82.08±9.38	83.00±9.73	*.610*			
PEF (L/s)	4.12±1.32	4.60±1.19	5.17±1.34	*.002**		*.001**	*.014**
MVV (L/min)	92.31±17.10	101.60±18.18	108.71±15.57	*.001**	*.004**	*.001**	*.015**
Sit-and-Reach Test (cm)	26.00±7.74	26.44±6.94	27.51±7.79	*.005**		*.002**	
Dominant Hand Grip Strength (kg)	42.35±12.58	40.83±8.36	51.33±11.71	*.001**		*.001**	*.001**
Non-dominant Hand Grip Strength (kg)	39.42±12.79	38.61±8.76	50.56±11.58	*.001**		*.001**	*.001**

**p<.05;* FVC: Forced Vital Capacity; FEV1: Forced Expiratory Volume; %FEV1/FVC: Forced Expiratory Volume to Forced Vital Capacity Ratio; PEF: Peak Flow Velocity; MVV: Maximal Voluntary Ventilation

The average and standard deviation values of the parameters linked to the isokinetic shoulder strength of the swimmers and the disparities between the measurements are presented in Table 3. Analysis of this table reveals variations between measurements in 60°/s right-left flexion-extension mean power, 180°/s right-left flexion mean power, 180°/s left extension mean power, 60°/s right-left flexion mean peak torque and 180°/s left flexion-extension mean peak torque. Differences were observed in the mean power parameters during 60°/s left flexion and 180°/s right-left flexion between the pre-general and post-special. Furthermore, differences were found in the mean power during 60°/s right flexion-extension, 60°/s left extension, 180°/s right-left flexion, and 180°/s left extension as well as in the mean peak torque during 60°/s right-left flexion and 180°/s left flexion-extension between the post-general and post-special (*p<.05*). There were no statistically significant differences found in the measurements of mean power for 180°/s right extension, peak torque for 60°/s right extension and left extension, and peak torque for 180°/s right flexion and right extension (*p>.05*).

Table 3.
Mean and standard deviation values of parameters related to isokinetic shoulder strength of swimmers and differences between measurements

	Pre-general	Post-general	Post-special	Difference (p-values)	Pre-general vs Post-general (p-values)	Pre-general vs Post-special (p-values)	Post-general vs Post-special (p-values)
60°/s R-FLX Avg Power (W)	18.17±4.63	17.06±4.22	19.38±5.03	*.001**			*.001**
60°/s L-FLX Avg Power (W)	17.73±5.49	17.83±4.70	19.22±6.03	*.011**		*.019**	
60°/s R-EXT Avg Power (W)	21.74±5.78	20.64±5.23	22.33±6.06	*.047**			*.036**
60°/s L-EXT Avg Power (W)	21.37±5.37	20.21±5.34	21.51±5.83	*.024**			*.035**
180°/s R-FLX Avg Power (W)	33.66±10.20	32.78±8.97	37.65±11.65	*.001**		*.009**	*.001**
180°/s L-FLX Avg Power (W)	31.03±11.53	30.07±11.50	33.62±12.70	*.003**		*.040**	*.008**
180°/s R-EXT Avg Power (W)	41.14±11.20	42.43±11.67	43.97±12.92	*.148*			
180°/s L-EXT Avg Power (W)	39.10±11.09	38.06±10.87	41.54±12.27	*.035**			*.024**
60°/s R-FLX Avg Peak Torque (Nm)	29.68±7.18	28.50±6.29	31.83±7.11	*.005**			*.004**
60°/s L-FLX Avg Peak Torque (Nm)	28.04±7.50	27.73±6.56	29.94±7.76	*.020**			*.022**
60°/s R-EXT Avg Peak Torque (Nm)	34.21±7.86	32.59±6.32	34.09±8.30	*.122*			
60°/s L-EXT Avg Peak Torque (Nm)	36.09±8.46	34.16±7.50	35.43±8.85	*.144*			
180°/s R-FLX Avg Peak Torque (Nm)	23.22±6.13	22.66±5.47	24.69±7.49	*.074*			
180°/s L-FLX Avg Peak Torque (Nm)	22.17±6.63	20.68±5.73	23.74±7.12	*.001**			*.003**
180°/s R-EXT Avg Peak Torque (Nm)	27.81±6.15	27.41±6.06	28.33±6.71	*.527*			
180°/s L-EXT Avg Peak Torque (Nm)	30.88±6.64	28.96±6.37	30.86±6.56	*.028**			*.030**

**p<.05;* Avg: Average; FLX: Flexion; EXT: Extension; R: Right; L: Left

Discussion

The study aimed to compare health-related fitness parameters (including endurance, strength, flexibility, body composition, and lung capacity) of swimmers during general and special preparation periods. The results showed significant differences in body composition (including arm length, lean body weight, waist-to-hip ratio, body weight, height, biceps, and chest skinfold thickness), respiratory function, flexibility, and hand grip strength. Differences were discovered in isokinetic shoulder strength, with statistically significant effects in 60°/s right-left flexion-extension mean power, 180°/s right-left flexion mean power, 180°/s left extension mean power, 60°/s right-left flexion mean peak torque, and 180°/s left flexion-extension mean peak torque values (*p<.05*). Our investigation found that these differences were mainly between the post-special and pre-general or post-general periods.

Several studies in the literature have investigated the health-related fitness parameters of swimmers (Oliveira et al., 2021; McNarry et al., 2020). For instance, it was demonstrated by Dos Santos et al. (2021) that body fat percentage plays a vital role in determining the 50 m freestyle swimming performance, Oliveira et al. (2021) demonstrated that all anthropometric and body composition variables, except for body fat percentage, facilitate biological maturation and have a favorable correlation with performance. Lima-Borges et al. (2022) reviewed the relationship between anthropometric variables and performance in swimmers competing in various styles and acknowledged that anthropometric variables have an impact on swimming performance. Our study found results in line with the existing literature. We discovered that the body composition values of swimmers during the special preparation period differed from those observed in the general preparation period. This suggests that speed-based swimming training during the special preparation period has a positive effect on body composition.

In this study, the respiratory functions (FVC, FEV1, PEF, and MVV) of swimmers saw an improvement following a period of special preparation speed-based training. Additionally, Muthusamy et al. (2022) reported a significant improvement in the respiratory functions of swimmers after four weeks of swimming training and various respiratory muscle exercises. Okrzymowska et al. (2019) found that swimming training improved respiratory function among swimmers. Similarly, Ozgul et al. (2015) recorded positive effects on respiratory functions among swimmers aged 10-13 years who underwent swimming exercises with breathing exercises.

Efficient swimming movements rely on increased flexibility and mobility in the upper extremities. Niksic et al. (2020) demonstrated that a motor predictor system incorporating flexibility variables significantly impacted criterion variables in swimming training during a regression analysis. Supporting this study, previous research has demonstrated a connection between flexibility and performance in freestyle swimming (Inan & Saygin, 2019; Alaydin & Kamuk, 2020). Willems et al. (2014) reported that swimmers with greater flexibility had faster stroke and foot movements due to mechanical advantages. However, Geladas et al. (2005), Gokhan et al. (2011), Cicek et al. (2018), and Kistak et al. (2019) have suggested that swimming proficiency does not impact flexibility values. Our research demonstrates that young swimmers attained the highest flexibility

outcome during the special preparation training phase, which endorses existing literature showing that flexibility has an effect on swimming performance.

Propulsion is a key factor in achieving peak swimming performance. Research has shown a positive correlation between hand grip strength and swimming performance (Geladas et al., 2005; Cronin et al., 2017). However, Alshdokhi et al. (2020) suggest that the relationship between hand grip strength and swimming performance is still unclear. Furthermore, some authors argue that hand grip strength does not impact performance. For instance, Inan and Saygin (2019) found no significant correlation between hand grip strength and swimming performance over 50m or 400m distances ($p>.05$). McNarry et al. (2020) similarly failed to identify any changes in grip strength among swimmers during a six-month training program. Finally, Alaydin and Kamuk (2020) observed no variance in hand grip strength as related to swimming performance. Unlike previous studies, Ucar and Cimen-Polat (2023) documented an improvement in hand grip strength for swimmers in an eight-week period. In our own research, we observed a consistent development in hand grip strength for swimmers during each period, with the most significant improvements occurring after special preparation period training.

Excessive shoulder injuries in swimming are linked to the inability to sustain movement patterns, leading to continuous stress on tender tissues that exacerbates with fatigue due to declines in range of motion. It is essential to maintain movement patterns to avoid injuries to delicate tissues and enhance shoulder resilience in swimming. Research has shown that rotator muscle fatigue can negatively affect shoulder stability, cause injury, and increase the risk of future shoulder pathologies (Lynch et al., 2010; Nadobnik & Wiażewicz, 2021). To determine asymmetries in swimmers' bodies, medical professionals measure the dominant and non-dominant shoulder strength at varying angular velocities and use asymmetric indices for calculations (Sanders et al., 2012). For instance, Chang et al. highlighted that excessive strength imbalance between the right and left shoulder in swimmers, if exceeding 15%, results in a deviation from swimming in a straight line, due to the shoulder strength discrepancy (Chang et al., 2013). A comprehensive analysis of scientific studies on strength capacity in swimming demonstrates that the shoulder girdle muscles' strength is crucial for swimmers' athletic proficiency. It has been asserted that robust strength training is a crucial aspect in attaining superior swimming performance (Nadobnik & Wiażewicz, 2021). This study employed flexion-extension mean power and peak torque measurements of swimmers at two distinct angular velocities to investigate the importance of shoulder strength in swimming. In the present study, it was observed that the average flexion-extension power and peak torque values achieved at both angular velocities improved following speed-based training during the specialized preparation period.

Conclusion and Recommendations

To summarize, the training conducted during both generalized and specialized preparation phases had an impact on the body composition, respiratory function, flexibility, hand grip strength, and isokinetic shoulder strength of swimmers. Variations in body composition, respiratory function, flexibility, hand grip strength, and isokinetic shoulder strength were discovered among swimmers during both general and special preparation periods. Improvements in fitness parameters linked to health were observed during both phases. However, the most significant progress was made following the special preparation period. As a result, incorporating speed-based training in the special preparation phase could have a positive impact on health-related fitness parameters.

Etik Komite Onayı: Bu çalışma için etik komite onayı Haliç Üniversitesi'nden (Tarih: 25 Nisan 2023, Karar No: 116) alınmıştır.
Hasta Onamı: Çalışmaya katılan tüm katılımcılardan sözlü onam alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir-İ.O, B.K.A.; Tasarım- İ.O, B.K.A.; Denetleme- İ.O, B.K.A.; Kaynaklar- İ.O, B.K.A.; Veri Toplanması ve/veya İşlemesi- İ.O, B.K.A.; Analiz ve/veya Yorum- İ.O, B.K.A.; Literatür Taraması- İ.O, B.K.A.; Yazıyı Yazan- İ.O, B.K.A.; Eleştirel İnceleme- İ.O, B.K.A.

Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Halic University (Date: April 25, 2023, Decision Number: 116).
Informed Consent: Verbal consent was obtained from all the participants.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept - I.O, B.K.A.; Design- I.O, B.K.A.; Supervision- I.O, B.K.A.; Resources- I.O, B.K.A.; Data Collection and/or Processing- I.O, B.K.A.; Analysis and/or Interpretation- I.O, B.K.A.; Literature Search- I.O, B.K.A.; Writing Manuscript- I.O, B.K.A.; Critical Review- I.O, B.K.A.; Other- I.O, B.K.A.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATURK UNIVERSITY PUBLICATIONS

Research Article *Araştırma Makalesi* DOI: 10.62425/rses.1578912

Investigation of The Effect of Mindfulness-Based Self-Efficacy on Attitudes Towards Artificial Intelligence Technology Among Sports Consumers

Spor Tüketicilerinde Bilinçli Farkındalık Temelli Öz Yeterliğin Yapay Zeka Teknolojilerine Yönelik Tutuma Etkisinin İncelenmesi

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ABSTRACT

This study aims to investigate the effects of mindfulness-based self-efficacy on attitudes towards artificial intelligence technologies in sports consumers in terms of various socio-demographic variables. 409 undergraduate students studying in the field of sports sciences in the Marmara region, selected through a convenience sampling method, participated in the study. Data were analyzed using the SPSS 29.0.1.0 (171) program. The findings show that there are significant differences in mindfulness-based self-efficacy and attitudes towards artificial intelligence technologies based on socio-demographic factors. In addition, the study found that mindfulness-based self-efficacy has a positive effect on attitudes towards artificial intelligence technologies. It is seen that artificial intelligence technologies are rapidly spreading in the field of sports and the acceptance of these technologies varies depending on the methods that can be applied and emotional states. As a result, the findings shed light on the development of improvements to encourage more positive perceptions regarding the acceptance of new technologies in the sports industry.

Keywords: Technology in sports, artificial ıntelligence, conscious awareness, 5.0 in sports ındustry

ÖZ

Bu çalışmada, spor tüketicilerinde çeşitli sosyo-demografik değişkenler açısından bilinçli farkındalık temelli öz yeterliklerinin yapay zeka teknolojilerine yönelik tutumlarına etkisinin incelenmesi amaçlanmıştır. Araştırmaya Marmara bölgesinde spor bilimleri alanında öğrenim gören, kolay örnekleme yöntemi ile seçilen 409 lisans öğrencisi katılmıştır. Veriler SPSS 29.0.1.0 (171) programı kullanılarak analiz edilmiştir. Bulgular, sosyo-demografik faktörlere dayalı olarak bilinçli farkındalık temelli öz yeterlik ve yapay zeka teknolojilerine yönelik tutumlarda anlamlı farklılıklar olduğunu göstermektedir. Ayrıca, araştırma sonucu bilinçli farkındalık temelli öz yeterliğin yapay zeka teknolojilerine yönelik tutum üzerinde olumlu etkiye sahip olduğu tespit edilmiştir.

Yapay zeka teknolojilerinin spor alanında hızla yaygınlaştığı ve bu teknolojilerin kabulünün uygulanabilen yöntemlere ve duygusal durumlara bağlı olarak değiştiği görülmektedir. Sonuç olarak bulgular, spor endüstrisinde yeni teknolojilerin kabulüne ilişkin daha olumlu algıları teşvik etmek için iyileştirmelerin geliştirilmesine ışık tutmaktadır.

Anahtar Kelimeler: Sporda teknoloji, yapay zeka, bilinçli farkındalık, endüstri 5.0'da spor

Geliş Tarihi/Received 04.11.2024
Kabul Tarihi/Accepted 29.04.2025
Yayın Tarihi/Publication Date 20.06.2025

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Cite this article: Karakuş, O., Yorulmazlar, M. M., & Özsoy, D. (2025). Investigation of the effect of mindfulness-based self-efficacy on attitudes towards artificial intelligence technology among sports consumers. *Research in Sport Education and Sciences, 27*(2), 99-107.

Introduction

Today, sports as a major social dynamic attracts the attention of a wide range of people and is increasingly organized (Ölçücü et al., 2012). One of the most innovative contributions of technology is seen in the fields of sports science and sports industry. Technology is effectively used in the equipment of sports fields and in the development of sports products. These developments directly contribute to the increase of athlete performance, the breaking of new records and the increase in the quality of sports activities (Atasoy & Kuter, 2005; Haake, 2009; Şentürk & Özer, 2022). Artificial intelligence, which has become increasingly widespread in the field of sports in recent years, has become a field that has various applications and represents a technological approach. Artificial intelligence can be used effectively in many areas in the sports world, such as data analysis, performance evaluation, training programming, and strategy development (McCabe & Trevathan, 2008).

Conscious awareness; Focusing on the present, regulating attention, orienting towards life, being open and accepting constitute the basic elements of conscious awareness. These elements enable the individual to experience the moment more deeply and respond more clearly to what is happening around him (Germer et al., 2005; Kabat-Zinn, 2003; Mackenzie et al., 2005). The human mind often wanders between regrets of the past and worries about the future. Conscious awareness is based on approaching the present moment with curiosity, intentionality, acceptance and compassion. This attitude supports the person to stay in the moment and achieve mental peace (Thera, 2001).

Mindfulness is a simple method for overcoming difficulties and pain in our lives. This skill allows us to react less to momentary events and helps us deal with them more consciously. Mindfulness is a skill that involves relating to all our experiences, positive, negative and neutral, and thus helps us increase well-being. This concept is often associated with Buddhism and is expressed by the word "Sati", whose origins date back 2500 years. The word Sati means remembering, awareness and attention (Garmer, 2004). Conscious awareness has long had an important place in Eastern philosophy. Kabat-Zinn's studies at the Conscious Awareness Center at MIT (Massachusetts Institute of Technology) enabled this concept to be adopted as a separate approach in the field of psychotherapy (Teasdale et al., 2000). Conscious awareness helps individuals see and accept everything as it is, allowing them to experience the richness of every moment of life (Özdoğan & Çelik, 2022). Bandura defined self-efficacy as the individual's belief in the skills and behaviors he will use in response to events that affect his life. Self-efficacy reflects the individual's confidence in his own skills to achieve a goal and his belief in his ability to control these skills (Bandura, 1997).

Albert Bandura's social cognitive theory emphasizes that there is a strong relationship between how individuals think, feel, and behave, especially when faced with difficult situations. Perception of self-efficacy has an important role in this process. Self-efficacy refers to an individual's belief that he or she can be successful at a particular subject. Individuals with high self-efficacy are more open-minded and more likely to consider different alternatives to solve problems. For example, individuals with low self-efficacy may avoid activities that make them anxious or only choose activities in which they will be successful. However, individuals with high self-efficacy participate in activities more willingly and perform better. As conscious awareness increases, individuals become aware of how they evaluate themselves and when self-criticism and self-judgment occur. They can control thoughts about past negative experiences or possible future negativities. In this way, limiting beliefs and judgmental attitudes decrease and individuals become able to handle the current situation independently of past and future connections. This contributes to increasing their self-efficacy (Bandura, 1977).

Mindfulness-based self-efficacy is defined as a person's ability to maintain nonjudgmental awareness when faced with a variety of situations. This involves the individual's ability to accept and be aware of any situation as it is, which can lead to a more emotionally and mentally healthy experience (Chang et al., 2004). Self-efficacy based on conscious awareness can be defined as the belief in being able to act with conscious awareness, with a non-judgmental and accepting attitude, and the individual's feeling of competence in the face of events (Atalay et al., 2017).

The rapid development of artificial intelligence technologies manifests itself effectively in the sports industry, as in many sectors (Yıldız et al., 2021). The impact of artificial intelligence on sports is increasing and has significant growth potential. Sports teams and organizations are taking advantage of the advantages offered by artificial intelligence to get ahead of their competitors. Just as wearable devices are used to monitor and analyze the performance of athletes, new technologies are also being developed to protect the health of athletes. For example, artificial intelligence solutions that can detect long-term concussions with high accuracy enable athletes to monitor their health status more effectively. Additionally, by recommending mentally strong players for teams, AI-based platforms can help identify players who are not only talented but can truly reach their potential. These advances can present great opportunities for franchises willing to invest in artificial intelligence in the sports industry and stand out as an important step in the future (Inbenta, 2017).

This research aims to examine the effect of mindfulness-based self-efficacy on attitudes towards artificial intelligence technologies. The findings to be obtained will contribute to placing artificial intelligence technologies on a more solid and conscious basis in the world of sports. In particular, the development of more conscious, responsible and positive attitudes towards technology by sports consumers, athletes and coaches will support the efficient and ethical use of these technologies. Revealing how mindfulness-based self-efficacy shapes individuals' perceptions of artificial intelligence is of great importance in terms of improving both individual performance and health. Mindfulness-based self-efficacy enables individuals to more consciously manage their awareness of and reactions to technological developments both in themselves and in their environment. Individuals with such a level of self-efficacy not only see artificial intelligence technologies as a tool; they also tend to use the opportunities offered by these technologies in a more efficient, controlled and ethical manner. In this respect, the research aims to fill an important gap at both theoretical and practical levels by contributing to the psychological basis of technology integration in the field of sports.

Methods

This study utilizes a survey model based on a descriptive approach. This model aims to examine the relationships between variables and understand how these variables are related to each other (Karasar, 2018).

Research Group

409 undergraduate students studying sports sciences in the Marmara region, selected by convenience sampling method, participated in the research. Convenience sampling technique is a non-probability-based method used to collect data from accessible subjects during the data collection process. In other words, researchers use available subjects until they reach the sample they want (Coşkun et al., 2017).

Ethical approval for this study was obtained from Yalova University Human Research Ethics Committee and the ethical approval process was completed on March 14, 2024 with protocol number 2024/16. Participants were given detailed information about the name and subject of the study and were assured that their personal information would only be used for scientific purposes. Participants were clearly informed that they had the right to withdraw from the study at any stage.

Data Analysis

Data were analyzed using SPSS 29.0.1.0 (171) software. The demographic information of the participants was analyzed using descriptive statistics. The reliability of the cognitive flexibility inventory was evaluated using Cronbach's alpha coefficient. When the skewness and kurtosis values of the sample group were examined, it was seen that the data did not exhibit a homogeneous distribution within the range of ± 1.5, so the hypotheses were tested with nonparametric analyses (Tabachnik & Fidell, 2013). Nonparametric test techniques were used for non-normally distributed measurements. Research results were interpreted with non-parametric tests such as Kruskal-Wallis and Mann-Whitney U tests to evaluate the differences between groups. Regression analysis was conducted to investigate the effect of mindfulness-based self-efficacy on attitude towards AI technologies in sports consumers.

Data Collection Tools

Personal Information Form

To gather socio-demographic information of the participants, the personal information form included the following questions: age, gender, habits of using technological devices during sports, and the frequency of exercise.

Mindfulness-Based Self Efficacy Scale-Revised (MSES-R): Turkish Adaptation Study

The scale was developed by Cayoun, et al., (2012). It was adapted into Turkish by Atalay et al., (2017). In the Turkish adaptation of the scale, items 1, 2, 3, 4, 6, 7, 8, 11, 12, 14, 15, 16, 17, 18, 21 and 22 were reverse coded (1=5, 2=4, 3=3, 4=2, 5=1) and the other items were calculated as marked by the participants.

- Emotion Regulation: 1, 4, 6, 7, 12, 18
- Emotional Balance: 5, 10, 13, 19
- Social Skills: 2, 3, 20
- Distress Tolerance: 8, 16, 17
- Taking Responsibility: 11, 21, 22
- Interpersonal Activity: 9, 14, 15

The score obtained from the scale is obtained by summing all items. The higher the score, the higher the level of mindfulness-based self-efficacy of individuals.

Supplementary Material – Turkish Version of the General Attitudes to Artificial Intelligence Scale

The scale assessment is as follows: Positive attitudes towards AI are calculated by summing items 1 to 12 of the scale. Negative attitudes towards AI are obtained by inverting and summing items 13 to 20 of the scale. These methods are used to measure participants' positive and negative attitudes towards AI.

Scale scoring is as follows: The score range for positive attitudes towards AI is between 12 and 60. For negative attitudes towards AI, the score range is between 8 and 40. These score ranges are used to measure participants' attitudes towards AI.

Results

The Cronbach's alpha reliability coefficient was obtained as 0.827. The Kolmogorov-Smirnov test yielded a result of 0.000, and consequently, Mann-Whitney U and Kruskall-Wallis analyses were applied. Regression analysis was conducted to investigate the effect of mindfulness-based self-efficacy on attitude towards AI technologies in sports consumers.

Table 1.
Result of kolmogorov- smirnov test

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
AIMEAN	.052	409	.009
MSES-RMEAN	.095	409	<.001

AIMEAN: Mean of the General Attitudes to Artificial Intelligence Scale
MSES-RMEAN: Mean of the Mindfulness-Based Self-Efficacy Scale.

Since it was *p*:.001 (*p*<.005), it was determined that the data did not show normal distribution.

Table 2.
Mann-Whitney U test results by gender variable

Test Statistics[a]

	Emotion Regulation Mean	Emotional Balance Mean	Social Skills Mean	Tolerate Distress Mean	Taking Responsibility Mean	Interpersonal Activity Mean	AI Positive Attitude Mean	AI Negative Attitude Mean
Mann-Whitney U	18683.500	20496.000	18858.500	17175.000	20222.000	15645.500	18572.000	18204.500
Wilcoxon W	45248.500	36606.000	34968.500	43740.000	36332.000	42210.500	34682.000	34314.500
Z	-1.609	-.075	-1.474	-2.903	-.309	-4.204	-1.700	-2.012
Asymp. Sig. (2-tailed)	.108	.940	.140	.004	.757	<.001	.089	.044

a. Grouping Variable: Gender

The sub-dimensions in the table are the sub-dimensions of the scale of General Attitudes to Artificial Intelligence Scale: AI (Artificial Intelligence) Positive Attitude Mean, AI (Artificial Intelligence) Negative Attitude Mean.

Significant differences were obtained according to the mean scores of sports consumers' mindfulness-based self-efficacy and artificial intelligence for gender variable. When we look at the sub-dimensions of the scale related to mindfulness-based self-efficacy scale; a significant difference was obtained in the sub-dimension of tolerance of distress and interpersonal activity sub-dimension (p<.05). In the sub-dimension of tolerance to distress, it was found that the scoring of male participants was higher than that of females. In line with this result, it can be said that men can tolerate distress more than women. In the interpersonal effectiveness sub-dimension, female participants scored higher than male participants. In this context, it can be concluded that women are more effective in interpersonal effectiveness than men. When the scores of the scale sub-dimensions of attitudes towards artificial intelligence technologies were analyzed, it was found that male participants had higher negative attitude scores than female participants. In line with this result, it is seen that male participants in this research group have a more negative attitude towards artificial intelligence technologies than female participants.

Table 3.
Mann-Whitney U test results on regular exercise status

Test Statistics[a]

	Emotion Regulation Mean	Emotional Balance Mean	Social Skills Mean	Tolerate Distress Mean	Taking Responsibility Mean	Interpersonal Activity Mean	AI Positive Attitude Mean	AI Negative Attitude Mean
Mann-Whitney U	17947.000	16899.000	17544.000	17769.500	18124.000	18823.000	17783.500	19444.500
Wilcoxon W	51358.000	28375.000	50955.000	51180.500	51535.000	52234.000	51194.500	30920.500
Z	-1.332	-2.245	-1.699	-1.496	-1.187	-.574	-1.472	-.030
Asymp. Sig. (2-tailed)	.183	.025	.089	.135	.235	.566	.141	.976

a. Grouping Variable: The status of regular exercise

The sub-dimensions in the table are the sub-dimensions of the scale of General Attitudes to Artificial Intelligence Scale: AI (Artificial Intelligence) Positive Attitude Mean, AI (Artificial Intelligence) Negative Attitude Mean.

When the statistical results for the participants' regular exercise status variable were examined, a significant difference was obtained in the mood regulation sub-dimension of the Conscious awareness-based self-efficacy scale. People who exercise regularly have higher emotional balance scores than those who do not exercise regularly.

Table 4.
Kruskal-Wallis test results according to the frequency of participation in recreational activities

Test statistics[a,b]

	Emotion Regulation Mean	Emotional Balance Mean	Social Skills Mean	Tolerate Distress Mean	Taking Responsibility Mean	Interpersonal Activity Mean	AI Positive Attitude Mean	AI Negative Attitude Mean
Kruskal-Wallis H	8.546	4.044	.650	8.117	2.832	6.275	8.678	8.857
df	1	1	1	1	1	1	1	1
Asymp. Sg.	.003	.044	.420	.004	.092	.012	.003	.003

a. Kruskal Wallis Test

b. Grouping Variable: Participation in Recreational Activites

In the table are the sub-dimensions of the scale of General Attitudes to Artificial Intelligence Scale: AI (Artificial Intelligence) Positive Attitude Mean, AI (Artificial Intelligence) Negative Attitude Mean.

A significant difference was obtained in the emotional balance sub-dimension of the sub-dimensions of the participants' Conscious awareness-based self-efficacy scale. As a result of the Kruskal Wallis Test, the average emotional balance score of those who frequently participated in recreational activities was higher than those who rarely and moderately participated. In addition, the average scores of the participants towards artificial intelligence technologies were found to be higher in those who frequently participate in recreational activities than in those who rarely and moderately participate in these technologies.

Table 5

Test results of the effect of mindfulness-based self-efficacy on artificial intelligence technologies

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.317	1	2.317	6.403	.012[b]
	Residual	147.295	407	.362		
	Total	149.613	408			

a. Dependent Variable: AIMEAN

b. Predictors: (Constant), MSES-R Mean

The regression model is generally significant (p = 0.012 < 0.05).

The model explains a portion (2.317/149.613) of the variance in the dependent variable AIMEAN. This indicates that the model can meaningfully explain the dependent variable (AIMEAN) using the independent variable (MSES-R Mean).

These findings indicate that your regression model has a significant effect on AIMEAN and that the model significantly explains the dependent variable using the independent variable (MSES-R Mean).

Table 6

Test results of coefficients on the effect of mindfulness-based self-efficacy on artificial intelligence technologies

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.160	.238		9.061	<.001
	MSES-R Mean	.218	.086	.124	2.530	.012

a. Dependent Variable: AIMEAN

MSES-R Mean: The mean of Mindfulness-Based Self Efficacy Scale-Revised Scale.

Model Significance: The model is significant overall (p<.001), indicating that MSES-R Mean has a significant effect on AI Mean.

According to the analysis result; (Constant): <.001. This is the significance level of the constant and is also known as the p-value. A value of <.001 indicates that the constant is highly significant.

(MSES-R Mean): 0.012. This is the significance level of the MSES-R Mean. A value of 0.012 indicates a significant effect on the independent variable of MSES-R Mean.

As a result, in this regression analysis, the MSES-R Mean variable has a significant and positive effect on AIMEAN.

According to the findings of this study, it has been determined that Mindfulness-Based Self-Efficacy has a positive effect on attitudes towards artificial intelligence technologies. This result shows that increasing conscious awareness and self-efficacy levels contributes to individuals' adoption of artificial intelligence technologies more positively.

Discussion

Artificial intelligence has an increasing impact on professional (Atasoy et al., 2021). AI has an increasing impact on professional and social life (McCabe & Trevathan, 2008). Technological developments have also affected the sports sector and transformed the practices in this field (Tekin & Karakuş, 2018). Artificial intelligence, which has become rapidly widespread in the sports world in recent years, is radically changing sports technologies with its various applications. In areas such as data analysis, performance evaluation, training planning and strategy development, artificial intelligence makes significant contributions to athletes and coaches in optimizing their decision-making processes. This technological advancement has become an indispensable tool for those who want to increase sports performance and gain a high level of competitive advantage (McCabe & Trevathan, 2008).

In the relevant literature, it is seen that new and comprehensive studies are urgently needed to improve the awareness

levels of individuals with conscious awareness. Increasing research on this subject will both contribute to the personal development of individuals and enable the raising of more conscious and aware individuals at the social level (Demir, 2015).

Shapiro et al., (2005), investigated the effects of the Mindfulness-Based Stress Reduction Program (MBSR) on healthcare professionals. As a result of the 8-week program, participants' levels of stress, psychological distress and professional burnout decreased; It was determined that their self-compassion and life satisfaction increased.

It can be said that studies based on the concept of general self-efficacy have some limitations. However, when we look at the research conducted in this field both at home and abroad, it is noted that general self-efficacy is related to concepts such as mental health, basic psychological needs, self-regulation, optimism and self-esteem, which can have positive effects on the individual. Additionally, when the literature is examined, it is seen that the concept of "self-efficacy based on conscious awareness" is a new concept. For this reason, it is noteworthy that research addressing this concept holistically is limited (Kaya, 2021).

The benefits of mindfulness practices have been researched by many scientists over the years and have begun to be included in various interventions in western psychology. In particular, Mindfulness-Based Stress Reduction intervention, according to Kabat-Zinn's studies, positively affects the way the brain processes difficult emotions under stress, shifting activation in certain regions of the prefrontal cortex from right-sided activation to left-sided activation towards greater emotional balance. This intervention also contributes to positive immune system changes associated with changes in the brain. In addition, it is effective in issues such as controlling desires and regulates fear-based reactions to perceived threats (Aktepe & Tolan, 2020). In this context, the effect of conscious awareness-based self-efficacy on sports consumers' attitudes towards artificial intelligence technologies is very important. This effect can help us understand how athletes and teams perceive AI-enabled technologies and to what extent they adopt these technologies. Investigating this relationship in the sports industry may contribute to our better understanding of the potential effects of both mindfulness and artificial intelligence technologies on sports performance and management.

Studies with a high level of evidence in the literature show that mindfulness-based interventions are effective in reducing anxiety problems (Green & Bieling, 2012; Hofmann et al., 2010). In this context, in the sports industry; In order to reduce concerns about artificial intelligence technologies, people's anxiety problems can be supported through conscious awareness-based training.

In line with this research, the concept of self-efficacy based on mindfulness, considering the concerns experienced by consumers in the sports industry; It can be evaluated as a functional, problem-solving, effective and efficiency-enhancing concept.

Conclusion and Recommendation

In this research, sports consumers' mindfulness-based self-efficacy and attitudes towards artificial intelligence technologies were examined among various variables and the effect of mindfulness-based self-efficacy on their attitudes towards artificial intelligence technologies.

Research result; Significant differences were obtained according to gender, regular exercise status and frequency of participation in recreational activities. In addition, it was concluded that mindfulness-based self-efficacy has a positive effect on attitudes towards artificial intelligence technologies.

Significant differences were obtained according to the mean scores of sports consumers' mindfulness-based self-efficacy and artificial intelligence for gender variable. When we look at the sub-dimensions of the scale related to mindfulness-based self-efficacy scale; a significant difference was obtained in the sub-dimension of tolerance of distress and interpersonal activity sub-dimension (p<.05).

In the sub-dimension of tolerance to distress, it was found that the scoring of male participants was higher than that of females. In line with this result, it can be said that men can tolerate distress more than women. In the interpersonal effectiveness sub-dimension, female participants scored higher than male participants. In this context, it can be concluded that women are more effective in interpersonal effectiveness than men. When the scores of the scale sub-dimensions of attitudes towards artificial intelligence technologies were analyzed, it was found that male participants had higher negative attitude scores than female participants. In line with this result, it is seen that male participants in this research group have a more negative attitude towards artificial intelligence technologies than female participants.

When the statistical results for the participants' regular exercise status variable were examined, a significant difference was obtained in the mood regulation sub-dimension of the Conscious awareness-based self-efficacy scale. People who

exercise regularly have higher emotional balance scores than those who do not exercise regularly.

This finding suggests that regular exercise has a positive effect on mood regulation. It reveals that individuals who exercise regularly are more successful in their mood regulation skills and thus have higher emotional balance scores. This highlights that exercise is important not only for physical health, but also for psychological well-being.

A significant difference was obtained in the emotional balance sub-dimension of the sub-dimensions of the participants' Conscious awareness-based self-efficacy scale. As a result of the Kruskal Wallis Test, the average emotional balance score of those who frequently participated in recreational activities was higher than those who rarely and moderately participated. In addition, the average scores of the participants towards artificial intelligence technologies were found to be higher in those who frequently participate in recreational activities than in those who rarely and moderately participate in these technologies.

Recreational activities usually take place in natural and social environments, and participants establish more direct and physical connections with nature, social groups or themselves through these activities. These individuals may be more resistant to digital and automated technologies, such as artificial intelligence, because these technologies can represent a departure from natural and social interactions.

It shows that recreational activities can positively affect emotional balance, but at the same time, these individuals' attitudes towards technology may be resistance towards technology.

According to the findings of this study, it has been determined that Mindfulness-Based Self-Efficacy has a positive effect on attitudes towards artificial intelligence technologies. This result shows that increasing conscious awareness and self-efficacy levels contributes to individuals' adoption of artificial intelligence technologies more positively.

Mindfulness improves individuals' ability to live in the moment and be open to current experiences. This can help them be more open to and accept new and innovative technologies more easily. Individuals with high levels of self-efficacy, on the other hand, have more confidence in using artificial intelligence technologies and can use these technologies effectively, thanks to their beliefs about performing a certain task. Additionally, mindfulness can help individuals become less resistant to new technologies by reducing stress and anxiety. Less stress and anxiety can positively impact individuals' attitudes towards AI technologies.

Consequently, increasing levels of conscious awareness and self-efficacy can encourage the adoption and effective use of artificial intelligence technologies. Dissemination of these skills through training programs and awareness campaigns can positively shape individuals' attitudes towards technology.

In this context, increasing mindfulness-based self-efficacy promotes the acceptance and use of artificial intelligence technologies in the sports industry. Athletes' and coaches' deepening trust and understanding of technology may enable more widespread integration of technology in areas such as sports performance, training management and health monitoring. As a result, increasing mindfulness-based self-efficacy in the sports industry can contribute to athletes and coaches improving their performance and health by ensuring the effective and responsible use of artificial intelligence technologies. At this point, it can be emphasized that further studies will form an important basis for a more in-depth understanding of the effects and use of technology in the field of sports.

Etik Komite Onayı: Bu çalışma için etik komite onayı Yalova Üniversitesi'nden (Tarih: 14 Mart 2024, Protokol No: 2024/16) ile alınmıştır.
Hasta Onamı: Çalışmaya katılan tüm katılımcılardan sözlü onam alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir;O.K, D.Ö, M.M.Y; Tasarım; O.K; Denetleme; O.K, M.M.Y; Kaynaklar; O.K; Veri Toplanması ve/veya İşlemesi; O.K, D.Ö; Analiz ve/ veya Yorum; O.K,D.Ö; Literatür Taraması, O.K; Yazıyı Yazan; O.K,M.M.Y,D.Ö; Eleştirel İnceleme; O.K,M.M.Y.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Yalova University (Date: March 14, 2024, Protocol No: E2024/16).
Informed Consent: Verbal consent was obtained from all the participants.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept-O.K., D.Ö., M.M.Y.; Design-O.K; Supervision-O.K., M.M.Y.; Resources-O.K.; Data Collection and/or Processing-O.K., D.Ö.; Analysis and/or Interpretation-O.K., D.Ö; Literature Search-O.K.; Writing Manuscript-O.K., M.M.Y., D.Ö; Critical Review-O.K., M.M.Y.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATURK UNIVERSITY PUBLICATIONS

Research Article *Araştırma Makalesi* DOI: 10.62425/rses.1587070

The Relationship Between Smartphone Use and Postural Disorders: An Investigation on University Students

Akıllı Telefon Kullanımı ve Postür Bozukluğu Arasındaki İlişki: Üniversite Öğrencileri Üzerine Bir İnceleme

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ABSTRACT

The purpose of the present study is to investigate the correlation between students' degrees of smartphone addiction and postural disorders at a sports sciences faculty. The research employs a "relational survey model," selected from survey models, as the study design. The sample group comprises 275 voluntary students enrolled in Bartın University's Faculty of Sports Sciences during the fall semester of the 2024–2025 academic year. A personal information form created by the researchers and the Smartphone Addiction Scale-Short Form (SAS-SF) were among the instruments used to collect data. To assess postural disorders, the study utilized the Posture Screen application, available on iOS and Android platforms, which has demonstrated reliability and validity for this purpose. With the assumption that the data follow a normal distribution, the SPSS 26.0 software package was used to conduct frequency, percentage, t-test, and Pearson correlation analyses. The results of the t-test showed that there was no significant difference between the gender variable and the Smartphone Addiction Scale-Short Form (SAS-SF). The t-test results, however, showed a significant difference between the gender variable and posture measurements in the head-shoulder-chest variables. There was no discernible correlation found between smartphone addiction and assessments of posture. Based on these findings, it is suggested that university students exhibit an average level of smartphone addiction, which may negatively impact postural disorders. In this context, it is recommended university students limit smartphone use and avoid sedentary lifestyles by engaging in physical activities.

Keywords: Smartphone use, postural disorder, university students

ÖZ

Araştırmanın amacı, spor bilimleri fakültesi öğrencilerinin akıllı telefon bağımlılık düzeyleri ile postür bozuklukları arasındaki ilişkiyi incelemektir. Araştırma modeli olarak tarama modelleri arasından "ilişkisel tarama modeli" kullanılmıştır. Araştırma grubunu, 2024-2025 güz yarıyılında Bartın Üniversitesi Spor Bilimleri Fakültesinde öğrenim gören 275 gönüllü öğrenci oluşturmaktadır. Veri toplama aracı olarak, araştırmacılar tarafından hazırlanan kişisel bilgi formu, Akıllı Telefon Bağımlılığı Ölçeği-Kısa Formu (ATBÖ-KF) kullanılmıştır. Postür bozukluklarının belirlenmesi için güvenirlik ve geçerliği bulunan IOS ve Android tabanlı Posture Screen uygulaması kullanılmıştır. Verilerin analizinde normal dağılım oluşturması ön görülmesiyle SPSS 26.0 paket programıyla frekans, yüzde istatistiksel analiz olarak t-testi ve Pearson korelasyon testleri kullanılmıştır. Araştırmanın bulgularında, cinsiyet değişkeni ve ATBÖ arasında t-testi sonuçlarına göre anlamlı farklılık tespit edilmemiştir. Cinsiyet değişkeni ve postür ölçümleri arasında baş-omuz-göğüs değişkenleri arasında t-testi sonuçlarına göre anlamlı farklılık tespit edilmiştir. Akıllı telefon bağımlılığı ile postür ölçümleri arasında anlamlı ilişki tespit edilmemiştir. Bu bilgiler doğrultusunda üniversite öğrencilerinin akıllı telefon bağımlılığının ortalama düzeyde olduğu ve bu durumun postürel bozuklukları olumsuz etkileyebileceği düşünülmektedir. Bu bağlamda üniversite öğrencilerinin, akıllı telefon kullanımın sınırlandırılması ve hareketsiz yaşam biçimden uzaklaşarak fiziksel aktivite içerikli etkinliklere katılım sağlaması gerektiği söylenebilir.

Anahtar Kelimeler: Akıllı telefon kullanımı, postür bozukluğu, üniversite öğrencileri

Note: This study was presented as an oral presentation at the 8th International Academic Sports Research Congress.

Geliş Tarihi/Received 17.11.2024
Kabul Tarihi/Accepted 21.04.2025
Yayın Tarihi/Publication Date 20.06.2025

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Cite this article: Yaşartürk, F., Aydın, R., & Genç, A. (2025). The relationship between smartphone use and postural disorders: An investigation on university students. *Research in Sport Education and Sciences, 27*(2), 108-119.

Introduction

In recent years, the increasing use and addiction to smartphones has emerged as one of the most critical global health issues of our time. Although smartphone usage rates are high across nearly all age groups, studies indicate that this level is even higher among university students compared to other populations (Lepp et al., 2015; Samaha & Hawi, 2016). By 2029, the number of smartphone users, predominantly young individuals, is expected to reach 6.4 billion (O'Dea, 2022; Al-Dhafer et al., 2023; Statista, 2024). According to Olson's (2022) meta-analysis, smartphone addiction is prevalent in China, Saudi Arabia, Malaysia, Brazil, South Korea, the Islamic Republic of Iran Canada, and Turkey. According to data from the Turkish Statistical Institute (TÜİK, 2021), smartphones in Turkey are checked approximately every half hour, with an average of 3 hours spent daily on social media. Another study reported that, between 2018 and 2020, daily smartphone use averaged 3 hours and 35 minutes in the U.S. and France. In Switzerland, it was found that over 50% of young adults use smartphones for at least 2 hours a day, checking their phones more than 20 times daily (Jacquier-Bret & Gorce, 2023).

University students frequently use smartphones for communication, socializing, daily tasks, and entertainment. These devices, with features like high-resolution cameras, easy access to emails and messages, navigation apps, social media platforms, mobile games, portability, lightweight design, and fast data processing capabilities, simplify daily life but also foster addiction among users (Cha & Seo, 2018; Van Deursen et al., 2015). Smartphones, through the online content and applications they offer, can provide diverse leisure time experiences (Zhang & Wu, 2020; Yaşartürk et al., 2022; Kırkbir & Zengin, 2022). Smartphone use is often engaged in during leisure periods and has been shown to generate positive psychological effects on individuals, such as a sense of satisfaction and happiness (Tunç-Çağlayan, 2020; Ayhan & Özel, 2020; Akay et al., 2022). Today, smartphones have become an indispensable part of individuals' daily lives, and it has been observed that the level of addiction to these devices is increasing, particularly among university students (Kuss & Griffiths, 2015). The literature indicates that frequent smartphone use among university students is significantly associated with an increase in neck and upper extremity pain (Hanphitakphong et al., 2021; Cha et al., 2022; Saeed et al., 2024). Moreover, prolonged smartphone use has been reported to contribute to muscle imbalances and certain structural disorders of the spine (Odole et al., 2020; Khan et al., 2024; Lee & Jeon, 2024). Although smartphones offer convenience in various areas of daily life, they are closely associated with a sedentary lifestyle, weight gain, stress, sleep problems, and depression. Furthermore, in cases of addiction, prolonged immobility in a fixed position can lead to muscle fatigue and various musculoskeletal disorders (Lee & Park, 2011; Selvaganapathy et al., 2017; Mustafaoğlu et al., 2021).

During prolonged use of smartphones, users often hold the mobile device below eye level with their head tilted forward, leading to incorrect sitting postures, head, neck and back pain, as well as abnormal alignment and posture disorders (Park et al., 2015; Jung et al., 2016; Alsalam et al., 2019; Lin et. al., 2020) Postural disorders may cause tension, pain and various health problems in the musculoskeletal system as a result of the disruption of the normal anatomical alignment of the body, usually associated with excessive sitting, incorrect sitting positions, incorrect ergonomics, lack of physical activity or long-term use of technological devices. Longterm usage of smartphones, effects the formation of posture disorders such as kyphosis, lordosis, and scoliosis (Wang et al., 2020). Poor posture, especially due to the use of smart mobile devices, can cause the neck to bend forward and spinal diseases such as kyphosis to develop. Therefore, studies have proven that users who integrate smartphone use intensively into their lives often exhibit forward head posture syndrome, causing musculoskeletal discomfort and pain as a result of the head-neck position being bent forward (Park et al., 2015; Daniel et al., 2022; Bomen & Kulkarni, 2022).

By identifying the risk factors for smartphone addiction, this study seeks to add to the body of knowledge about the impact of smartphone use on university students' physical health while also examining the relationship between smartphone use and posture disorders.

Methods

Research Model

The "relational screening model" will be utilized as the research model. This type of model seeks to ascertain whether two or more variables exist and how much they have changed it (Karasar, 2020; Büyüköztürk et al., 2020).

Research Group

The study research group consists of 275 volunteer students (144 female and 131 male, average age 20.9) studying at Bartın University Faculty of Sports Sciences in the 2024-2025 fall semester. Ethics committee approval for this study was obtained from Bartın University (Date: October 9, 2024, Decision No: 1, 12th meeting, Protocol No: 2024-SBB-0781).

Data Collection Tools

The study employed measurements of height, weight, and the index of body mass in addition to a personal information form and a smartphone addiction scale.

Smartphone Addiction Scale-Short Form (SAS-SF)

The Smartphone Addiction Scale-Short Form (SAS-SF) is a 10-item scale developed by Kwon et al. (2013) to assess the risk of smartphone addiction among adolescents. The Turkish adaptation was conducted by Noyan et al. (2015). The scale is rated on a six-point Likert scale, with items scored from 1 to 6, yielding a total score ranging from 10 to 60. Higher scores indicate a higher risk of addiction. In the Korean sample, cutoff scores were specified as 31 males and 33 females. The original version's internal consistency and concurrent validity are supported by a Cronbach's alpha coefficient of 0.91 (Kwon et al., 2013)

Height, Weight, and Body Mass Index (BMI) Measurement

University students' heights were measured using a SECA stadiometer, while their weights were recorded in kilograms using a Premier digital scale. Values of BMI were calculated using the Pollack Formula and recorded in kg/m² (WHO, 2008).

PostureScreen Mobile (Posture Analysis Software)

The "PostureScreen Mobile" software was used to analyze the postures of university students. Photos of participants taken from the front, back, right, and left were recorded on a compatible tablet, and the software analyzed their proximity to ideal posture in centimeters. In this program, an ideal posture is defined as a value of 0, with values deviating from zero indicating poor posture and a zero value representing good posture (Studnicska, 2018; Tokgöz & Aydın, 2022).

Data Analysis

Software called 26.0 (IBM SPSS Corp., Armonk, NY, USA) was used to analyze the data collected for this investigation. To ensure reliable and valid analysis, preliminary data cleaning procedures were conducted, including the examination of missing data, correction of erroneous entries, and identification of outliers (Can, 2020). To assess the assumption of normality, skewness and kurtosis values were examined, with a threshold of ±1 considered acceptable for normal distribution (Büyüköztürk, 2020; Field, 2009). Upon confirming the normality assumption, parametric tests were employed. To test the study's hypotheses, various analyses were conducted. First, linear correlations between variables were ascertained using Pearson correlation analysis. Connection's direction and intencity, no matter if it is positive or negative, between two continuous variables are determined as a result of this analysis (Field, 2009). Differences between independent variables were examined using an independent samples t-test additionally. In order to find disparities between the male and female participants in this research study, the t-test—a technique for determining if the mean differences between two groups are statistically significant was utilized. Field (2009) The findings' reliability was assessed using a significance level of $p<.05$. In addition, to evaluate the internal consistency of the scale utilized in the study, the Cronbach's Alpha reliability coefficient was computed.

Results

Accordingly, the normality test of the SAS-SF used in this study was carried out, and the following values were obtained for skewness and kurtosis .267 and .653, respectively. These are within the acceptable range since they fall between ±1. This then means that the skewness and kurtosis distributions of this scale are normal (Field, 2009; Büyüköztürk, 2020). Also, the Cronbach's Alpha of the scale was found to be .901, which signifies very good internal consistency.

Table 1.
Descriptive statistics of students' age, height, weight, and BMI measurements

Variables	Gender	$\bar{X}$	S	Min.	Max.	Median	Mode
Age	Female	20.66	1.425	18	24	21	21
	Male	21.16	2.018	18	35	21	20
Height	Female	164.75	6.212	150	184	165	160
	Male	177.31	8.031	155	194	177	170
Weight	Female	59.58	10.331	42	100	58	60
	Male	76.77	12.835	45	130	75	70
BMI	Female	21.946	3.625	16.0	37.6	21	20.0
	Male	24.344	3.156	16.6	36.0	24	21.5

BMI= Body Mass Index

The mean values and standard deviations for the study participants' age, height, weight, and Body Mass Index (BMI) are shown in Table 1.

Table 2.
Mean and standard deviation values for postural variables

Variables	$\bar{X}$	S	Variables	$\bar{X}$	S
Head	—	—	Lateral Angulations Right	1.312	1.74
Anterior Translations	0.289	1.271	Posterior Translations	0.283	0.253
Anterior Angulations	1.78	2.088	Posterior Angulations	0.327	0.876
Lateral Translations Right	1.495	0.969	Lateral Translations Left	2.725	1.514
Lateral Angulations Right	10.55	6.057	Lateral Angulations Left	6.204	3.384
Posterior Translations	0.465	0.348	**Chest**	—	—
Posterior Angulations	0.472	1.178	Anterior Translations	0.41	0.312
Lateral Translations Left	1.035	0.782	Posterior Translations	0.354	0.303

The study participants' head, shoulder, and chest postural measurements' mean values and standard deviations are shown in Table 2. There are indications of postural misalignment among the participants, as the table shows variations in the mean values from the optimal postural angle of 0 degrees.

Table 3.
Results of the t-test conducted between the smartphone addiction scale-short form (SAS-SF) and gender

Variables	Groups	N	$\bar{X}$	S	sd	t	*p*
SAS-SF	Female	144	32.556	1.119	273	-.541	.589
	Male	131	33.313	1.201			

SAS-SF= Smartphone Addiction Scale-Short Form

To ascertain whether the SAS-SF scores of male and female students differed significantly, the independent samples t-test was used. Table 3 indicates that there is no significant gender difference in the SAS-SF scores ($t(273) = -.541$, $p>.05$).

Table 4.
T-test results between posture measurements and gender

Variables	Groups	n	$\bar{X}$	S	sd	t	*p*
Head							
1= Anterior Translations	Female	144	.196	.192	273	-1.268	.206
	Male	131	.39	1.829			
2= Anterior Angulations	Female	144	1.932	2.106	273	1.261	.208
	Male	131	1.614	2.063			
3= Lateral Translations Right	Female	144	1.098	.696	224.093	-7.742	.000**
	Male	131	1.932	1.038			
4= Lateral Angulations Right	Female	144	8.319	5.407	273	-6.933	.000**
	Male	131	13.003	5.795			
5= Posterior Translations	Female	144	.386	.318	273	-4.021	.000**
	Male	131	.551	.36			
6= Posterior Angulations	Female	144	.362	1.015	242.693	-1.604	.110
	Male	131	.592	1.327			
7= Lateral Translations Left	Female	144	.772	.542	209.736	-6.126	.000**
	Male	131	1.325	.896			
8= Lateral Angulations Left	Female	144	6.085	4.711	273	-3.968	.000**
	Male	131	8.532	5.512			
Shoulder							
9= Anterior Translations	Female	144	.252	.215	234.527	-3.582	.000**
	Male	131	.366	.299			
10= Anterior Angulations	Female	144	.608	1.251	272.450	1.189	.235
	Male	131	.44	1.088			
11= Lateral Translations Right	Female	144	.635	.489	273	-2.520	.012*
	Male	131	.787	.511			
12= Lateral Angulations Right	Female	144	1.45	1.79	273	1.387	.167
	Male	131	1.16	1.676			
13= Posterior Translations	Female	144	.263	.231	273	-1.357	.176
	Male	131	.305	.275			
14= Posterior Angulations	Female	144	.322	.883	273	-.084	.933
	Male	131	.331	.872			
15= Lateral Translations Left	Female	144	2.133	1.147	233.246	-7.323	.000**
	Male	131	3.375	1.604			
16= Lateral Angulations Left	Female	144	5.374	3.057	259.446	-4.379	.000**
	Male	131	7.117	3.5			
Chest							
17= Anterior Translations	Female	144	.339	.271	249.894	-4.042	.000**
	Male	131	.488	.336			
18= Posterior Translations	Female	144	.29	.238	225.926	-3.739	.000**
	Male	131	.426	.35			

***p<.001*; **p<.05*

Table 4 examines whether there are significant differences in head, shoulder, and chestposture measurements based on gender using an independent samples t-test. In the analyses conducted on the head region regarding genders, significant differences were observed in some measurements. In the Lateral Translations Right measurement, it was found that males ($\bar{X}$=1.932) had higher average scores than females ($\bar{X}$=1.098), and this difference was statistically significant (t(224.093)=-7.742, *p*<.001). Similarly, in the Lateral Angulations Right measurement, males' averages ($\bar{X}$=13.003) were significantly higher than females' averages ($\bar{X}$=8.319) (t(273)=-6.933, *p*<.001). In the Posterior Translations measurement, males' average scores ($\bar{X}$=.551) also showed a significant difference compared to females ($\bar{X}$=.386) (t(273)=-4.021, *p*<.001). Significant differences in favor of females were observed in the Lateral Translations Left and Lateral Angulations Left measurements, where males' averages ($\bar{X}$=1.325 and $\bar{X}$=8.532) were higher than females' averages ($\bar{X}$=.772 and $\bar{X}$=6.085) (t(209.736)=-6.126, *p*<.001; t(273)=-3.968, *p*<.001).

In the analysis of the shoulder region, significant differences were found in some measurements between male and female students. In the Anterior Translationsmeasurement, it was found that males had higher average scores ($\overline{X}$=.366) compared to females ($\overline{X}$=.252), and this difference was statistically significant (t(234.527)=-3.582, p<.001). Additionally, in the Lateral Translations Right measurement, males' averages ($\overline{X}$=.787) were significantly higher than females' averages ($\overline{X}$=.635) (t(273)=-2.520, p<.05). Significant differences in favor of females were also found in the Lateral Translations Left and Lateral Angulations Left measurements, where males' average scores ($\overline{X}$=3.375 and $\overline{X}$=7.117) were significantly higher than females' averages ($\overline{X}$=2.133 and $\overline{X}$=5.374) (t(233.246)=-7.323, p<.001; t(259.446)=-4.379, p<.001).

In the analysis of the chest region, the Anterior Translations measurement showed that males had higher average scores ($\overline{X}$=.488) than females ($\overline{X}$=.339), and this difference was statistically significant (t(249.894)=-4.042, p<.001). Similarly, in the Posterior Translations measurement, it was found that males had significantly higher average scores ($\overline{X}$=.426) than females ($\overline{X}$=.29) (t(225.926)=-3.739, p<.001).

Table 5.
Correlation values between posture measurements and Smartphone Addiction Scale-Short Form

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Head																			
1= Anterior Translations	1																		
2= Anterior Angulations	-.039	1																	
3= Lateral Translations Right	.022	-.085	1																
4= Lateral Angulations Right	.015	-.138*	.906**	1															
5= Posterior Translations	.150*	.115	.103	-.024	1														
6= Posterior Angulations	-.005	.190**	-.060	-.107	.124*	1													
7= Lateral Translations Left	.049	-.107	.494**	.465**	.031	-.186**	1												
8= Lateral Angulations Left	.017	-.101	.369**	.428**	-.041	-.184**	.918**	1											
Shoulder																			
9= Anterior Translations	.094	-.015	.126*	.082	.102	.152*	.138*	.070	1										
10= Anterior Angulations	.002	.059	-.027	-.077	.142*	.136*	-.055	-.078	-.105	1									
11= Lateral Translations Right	-.002	-.023	.020	-.024	-.021	.055	.003	-.050	.009	.070	1								
12= Lateral Angulations Right	-.059	-.039	-.152*	-.156**	-.070	.013	-.082	-.084	.006	.037	.867**	1							
13= Posterior Translations	.133*	.096	.050	-.005	.129*	.105	-.043	-.114	.053	.096	.045	-.014	1						
14= Posterior Angulations	-.021	.004	-.020	-.030	.131*	.101	-.032	-.011	-.160**	.179**	-.073	-.076	.210**	1					
15= Lateral Translations Left	-.086	-.115	.148*	.066	.194**	.084	.018	-.092	.122*	-.033	.147*	.012	-.001	-.034	1				
16= Lateral Angulations Left	-.106	-.142*	-.011	-.025	.083	.065	-.057	-.111	.046	-.060	.085	.039	-.056	-.038	.898**	1			
Chest																			
17= Anterior Translations	-.026	-.017	.132*	.127*	.183**	.078	.060	.032	.147*	-.018	-.034	-.106	-.005	.045	.146*	.086	1		
18= Posterior Translations	-.045	.047	.111	.095	.023	.067	.041	.006	.095	-.057	.065	.008	.282**	.060	.198**	.151*	.063	1	
19= Smartphone Addiction Scale	-.032	-.062	-.014	-.010	.022	.063	.067	.057	.017	.016	-.094	-.066	.094	.102	-.010	.045	-.071	.107	1

***p<.001*; **p<.05*

The findings of the correlation between the Smartphone Addiction Scale (SAS-SF) and the measurements of students' head, shoulders, and chest posture are shown in Table 5. Upon examining the results, no significant relationship was found between SAS-SF and the posture measurements.

Additionally, it was observed that there are low, medium, and high levels of positive and negative relationships between the head, shoulder, and chest posture measurements at the $p<.05$ and $p<.01$ levels (Field, 2009).

Discussion

There was no discernible variation in the participants' overall mean scores on the smartphone addiction scale based on their gender. Güngör & Koçak's (2020) study on university students' smartphone addiction and academic procrastination behavior did not find any significant differences based on gender. Similarly, Kuyucu (2017) did not find any gender-related differences in his research on smartphone addiction and use among youth. In his study on the life satisfaction and smartphone addiction of adolescents, Bostan & Kalyon (2024) did not find any significant gender differences. Gezgin et al. (2017) also stated in their study that gender does not affect on smartphone addiction which has reached the conclusion that smartphone addiction can be seen at similar levels between genders and that the integration of technology into social life will cause similar addiction tendencies in both genders. Demirci et al. (2015) and Chen et al. (2020) stated that especially the intensive use of digital platforms by both genders can lead to addiction tendencies at similar levels regardless of gender. Kwon et al. (2013) and Cocoradă et al. (2018) reveal that, rather than gender, smartphone addiction can be associated more with other variables such as usage habits, personality traits and social environment. Similar to our research, no significant difference was identified based on the gender variable in the studies that were reviewed in the literature. (Bianchi & Phillips, 2005; Noyan et al., 2015; Liu et al., 2016; Minaz & Çetinkaya Bozkurt, 2017; Alkın, 2018; Çuhadar et al., 2020). In contrast, Göymen & Ayaş (2019) and Çakır & Oğuz (2017) found a significant difference according to gender, stating that the above case varied according to the purposes of women's smartphone use and was higher in their favor. In this respect, studies in the literature show that gender may not be a determining factor in smartphone addiction. In particular, the fast-increasing accessibility and widespread use of digital technologies would support such addictive tendencies being similarly observed across all groups, regardless of any demographic factors. Particularly, the fast-increasing accessibility and wide use of digital technologies support that such addiction tendencies may be similarly observed in all groups, irrespective of any demographic variables.

Based on the results of the t-test, gender and the head-shoulder-chest (posture) variables were shown to differ significantly. University students' neck flexion angles when standing, sitting without arm support, and sitting with arm support did not differ significantly, according to a 2019 study by Alfaitouri et al. that looked at the impact of smartphone use on neck flexion angle. However, it was found that men had higher neck flexion angles than women. Similarly, in a study by Adesola et al. (2020), which examined smartphone use and posture disorders among 200 male and 200 female students, no significant differences were found statistically between smartphone use and posture disorders. In a study by Chen (2024) examining the impact of smartphone use on different postural positions by gender, it was found that women place more strain on their neck and shoulder muscles throughout the day compared to men, contributing to increased discomfort in these areas. In another study, young female users were found to have greater cervical lordosis depth and lumbar lordosis depth averages during smartphone use compared to men (Barczyk-Pawelec, 2024). Additionally, in a different study involving 15 women and 15 men, the physical effects of smartphone use in three different postures (standing, supported sitting, unsupported sitting) were examined, and it was found that women exhibited greater cervical erector spinae muscle activity compared to men while using smartphones in a standing position (Chen & Chan, 2024). This is believed to lead to more pain and musculoskeletal issues in the lumbar and cervical regions. In a study by Kim et al. (2013) involving 18 healthy smartphone users, it was found that exposure to smartphones for 300 seconds or more could lead to changes in cervical and lumbar spine posture and proprioception in women, with negative effects. In Cochrane's (2019) research, the short-term effects of smartphone use on university students were examined, and it was highlighted that smartphone use had significant negative effects on shoulder protraction, thoracic kyphosis, lateral neck flexion, and pelvic obliquity, particularly among female students. In a similar vein, Lee et al. (2016) observed that using a smartphone when standing and for brief periods of time reduced the neck flexion angle when compared to sitting posture. They also hypothesized that future physical issues could result from higher smartphone use. In contrast, Betsch et al. (2021) discovered that thoracic kyphosis, body tilt, and lumbar lordosis increased when standing and walking while using smartphones. They also noted that texting with one or two hands caused an increase in spinal rotation. Based on the time spent using smartphones, university students exhibited significantly more head-down posture (more than 30 degrees) when using their smartphones compared to when they were not using them. In keeping with research that indicates gender does not play a role in the development of postural disorders, it can be said that factors like raising people's ergonomic awareness, encouraging good posture, and promoting physical activity in daily life are important in preventing and treating these disorders.

Upon reviewing the literature, our findings align with several studies suggesting that smartphone use can have adverse

effects on posture, while also conflicting with some findings in the literature (Lee, 2016; Han et al., 2019). Similar to our work, another study compared dependent and non-dependent smartphone user groups in terms of joint position perception, neck range of motion (ROM), head posture, and muscle endurance. According to the study's findings, no significant differences were found between the groups in terms of flexor muscle endurance, joint position error, shoulder angle, and sagittal head angle (Torkamani et al., 2023). In addition, it is emphasized that the relationship between smartphone addiction and posture disorders is not clear and that posture disorders should be examined in a broader context (Arooj et al., 2022). Although there is no direct relationship between smartphone use and posture disorder, as stated by Kuo et al. in 2019, a relationship does exist with musculoskeletal pain. Kim & Kim, 2015 stated that either no correlation existed at all or was an extremely low one in relation to smartphone addiction and its influence upon posture disorders. However, other research has also shown that the severity of musculoskeletal complaints is correlated with the length of time spent using a smartphone (Jung et al., 2016). According to Xie et al. (2021) research, postural disorders and neck and shoulder pain both rise with the amount of time spent using smartphones. In another study that investigated the smartphone addiction and posture disorders in the cervical area of adolescents, head anteriorization was increased during the use of smartphones in the lateral view and a relationship was observed between the smartphone addiction and head anteriorization (Fontenele et al., 2024). As a similar perspective, Alabdulwahab et al. (2017) emphasized that longterm usage of smartphones can lead to posture disorders, especially in the neck area.

Conclusion and Recommendation

Regarding this, it might be said that smartphone addiction does not directly affect posture; or the disorders of posture may be influenced by many different factors rather than smartphone addiction. It is also not concluded that smartphone addiction alone can be directly associated with disorders of posture or that it contributes to posture disorders. Objections can be raised that besides addiction to smartphones, the level of physical activity, conditions of ergonomics, and genetic predisposition may also play an important role in disorders of posture. More specifically, it can be elaborated that to protect and cure the postural problems of people, they have to consider a number of elements like the pattern of doing ergonomic practices, the pattern of doing physical activity, or using technology.

Etik Komite Onayı: Bu çalışma için etik komite onayı Bartın Üniversitesi'nden (Tarih: 09 Ekim 2024, Karar No: 1, 12 numaralı toplantı, Protokol No: 2024-SBB-0781) alınmıştır.
Hasta Onamı: Çalışmaya katılan tüm katılımcılardan sözlü onam alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir; F.Y., R.A., A.G.; Tasarım; F.Y., R.A., A.G.; Denetleme-; F.Y., A.G.; Kaynaklar; F.Y., R.A.; Veri Toplanması ve/veya İşlemesi; R.A., A.G.; Analiz ve/ veya Yorum; F.Y., R.A., A.G.; Literatür Taraması; F.Y., A.G.; Yazıyı Yazan; F.Y., R.A., A.G.; Eleştirel İnceleme; F.Y., R.A., A.G.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval for this study was obtained from Bartın University (Date: October 9, 2024, Decision No: 1, 12th meeting, Protocol No: 2024-SBB-0781).
Informed Consent: Verbal consent was obtained from all the participants.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept- F.Y., R.A., A.G.; Design- F.Y., R.A., A.G.; Supervision- F.Y., A.G.; Resources- F.Y., R.A.; Data Collection and/or Processing- R.A., A.G.; Analysis and/or Interpretation- F.Y., R.A., A.G.; Literature Search- F.Y., A.G.; Writing Manuscript- F.Y., R.A., A.G.; Critical Review- F.Y., R.A., A.G.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Research Article *Araştırma Makalesi* DOI: 10.62425/rses.1590865

The Effect of Recreational Awareness on Attitude Towards Sport Tourism

Rekreasyonel Farkındalığın Spor Turizmine Yönelik Tutuma Etkisi

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ABSTRACT

This research examined the impact of recreational awareness levels among undergraduate students in the recreation department on attitudes towards sports tourism. The research involved constructing a model to evaluate the influence of recreational awareness sub-dimensions on the sub-dimensions of attitude towards sports tourism. A total of 209 undergraduate students enrolled in the Recreation Department of Kütahya Dumlupınar University, who were selected through a convenience sampling method, participated in the research. The participants completed the personal information form, the Recreational Awareness Scale and the Scale of Attitude Towards Sports Tourism Scale. The research data were analyzed using SPSS 22 and Smart PLS 4 software. "Partial Least Squares Structural Equation Modeling" (PLS-SEM) was the preferred analysis method. In this context, the measurement and structural models were evaluated. According to the research findings, students in the recreation department demonstrate high recreational awareness and hold positive attitudes towards sports tourism. Examining the results obtained from testing the hypotheses indicates that all sub-dimensions of recreational awareness have had a significantly positive effect on the economic contribution sub-dimension of the attitude towards sports tourism. Conversely, it was determined that the social/success and personal development sub-dimensions of recreational awareness positively affected the job opportunities sub-dimensions of attitude towards sports tourism. Furthermore, the personal contribution sub-dimension of attitude towards sports tourism was significantly affected by the personal contribution sub-dimension of recreational awareness, and the organization sub-dimension of attitude towards sports tourism was significantly affected by the social/success sub-dimension of recreational awareness.

Keywords: Recreation, recreational awareness, sport tourism

ÖZ

Bu araştırmada rekreasyon bölümü lisans öğrencilerinin rekreasyonel farkındalık düzeylerinin spor turizmine yönelik tutumları üzerindeki etkisi incelenmiştir. Araştırmada rekreasyonel farkındalık alt boyutlarının, spor turizmine yönelik tutumun alt boyutları üzerindeki etkisini değerlendirmek için bir model oluşturulmuştur. Araştırmaya kolayda örnekleme yöntemiyle belirlenen Kütahya Dumlupınar Üniversitesi Rekreasyon bölümünde öğrenim gören toplam 209 lisans öğrencisi katılmıştır. Katılımcılar kişisel bilgi formunu, Rekreasyonel Farkındalık Ölçeğini ve Spor Turizmine Yönelik Tutum Ölçeğini doldurmuştur. Araştırma verileri, SPSS 22 ve Smart PLS 4 yazılımları kullanılarak analiz edilmiştir. "Kısmi En Küçük Kareler Yapısal Eşitlik Modellemesi" (KEKK-YEM), araştırmada tercih edilen analiz yöntemi olmuştur. Bu kapsamda ölçüm modeli ve yapısal model değerlendirilmiştir. Araştırmanın bulgularına göre, rekreasyon bölümü öğrencileri, yüksek rekreasyonel farkındalığa ve spor turizmine yönelik olumlu tutumlara sahiptir. Hipotezlerin test edilmesine yönelik sonuçlara bakıldığında, rekreasyonel farkındalığın tüm alt boyutları, spor turizmine yönelik tutumun ekonomik katkı alt boyutunu anlamlı ve pozitif olarak etkilemiştir. Öte yandan, rekreasyonel farkındalığın sosyal/başarı ve kişisel gelişim alt boyutlarının, spor turizmine yönelik tutumun iş fırsatları alt boyutunu olumlu yönde etkilediği, spor turizmine yönelik tutumun kişisel katkı alt boyutunun, rekreasyonel farkındalığın kişisel katkı boyutundan anlamlı bir şekilde etkilendiği ve spor turizmine yönelik tutumun ise organizasyon alt boyutunun, rekreasyonel farkındalığın sosyal/başarı alt boyutundan etkilendiği tespit edilmiştir.

Anahtar Kelimeler: Rekreasyon, rekreasyonel farkındalık, spor turizmi

Geliş Tarihi/Received 25.11.2024
Kabul Tarihi/Accepted 29.05.2025
Yayın Tarihi/Publication Date 20.06.2025

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Cite this article: Ak, S., & Araboğa, Y. (2025). The effect of recreational awareness on attitude towards sport tourism. *Research in Sport Education and Sciences, 27*(2), 120-131.

Introduction

Recreation can be defined as activities in which people engage freely and derive satisfaction outside of the period during which they fulfil their compulsory needs in human life (Hazar, 2009). In recent years, the confluence of advancing technology, population growth, an increased standard of living, enhanced transportation options, urbanization and a growing emphasis on a healthy lifestyle has compelled individuals to alter their priorities, leading to a greater demand for recreational activities (Torkildsen, 1992). Moreover, it has been demonstrated that participation in recreational activities leads to beneficial changes in individuals' lives across various psychological, sociological and physical domains (Deneau et al., 2019). Furthermore, it has been proposed that the changes brought about by these activities can improve the quality of life of individuals and facilitate the fulfilment of their diverse aspirations and needs (Brajša-Žganec et al., 2011).

Recreational activities include events in which individuals of all ages and genders can freely participate. It can include actions that allow women, children, young people, the elderly, the disabled and sick individuals to participate (Çakır, 2017). Participation in recreational activities for children and young people is important, especially for their individual development. These activities can affect young people's physical, social, cultural and psychological development. As Tütüncü et al. (2011) posit, the period of university education is not an optimal time for young individuals to develop themselves through exclusive engagement with academic pursuits. Ensuring social, cultural, and academic development during the university years is essential for many individuals. The recreational habits that young individuals will acquire during their university education will impact their future lives. Therefore, organizing various events to encourage university students to participate in recreational activities is essential. University students need to have recreational awareness to benefit from the advantages of recreational activities and to participate in these activities.

The concept of "awareness", which relates to consciousness, is typically associated with human beings (Hisli Şahin & Yeniçeri, 2015). Awareness is a cognitive process that enables learning and individual mental perception (Koç et al., 2022). Consequently, mindfulness is an effective tool in planning and implementing recreational activities, as it facilitates the identification of individuals' recreational needs (Barnett, 2005). Recreational awareness can be defined as individuals' awareness of activities that facilitate physical and spiritual renewal, enabling them to relieve fatigue arising from their efforts to overcome the difficulties they face in daily life (Robinson, 1992). Recreational awareness can be defined as the individual's recognition of recreational activities' benefits, even without direct participation (Ayyıldız Durhan et al., 2022). It is thought that individuals' awareness of the benefits that recreational activities will bring to them may positively affect their participation in these activities. In addition, being aware that they can participate in these activities can positively affect the individual's pleasure and satisfaction from life (Geven & Yaşartürk, 2024). Recreational awareness can be examined through three sub-dimensions: pleasure/fun, social/success and self-improvement. In defining these dimensions, Dumazeider's "entertainment" and "self-improvement", which are the three primary functions of leisure time, and Bammel and Bammel's personal community theory sub-dimensions of "social success" were utilized (Ekinci & Özdilek, 2019).

The concept of recreation is broad, encompassing many activities individuals engage in to fulfil their needs. These needs may include self-realization, satisfaction, relaxation and self-improvement (Özdemir Akgül & Güneş, 2019). All activities undertaken during periods of leisure are classified as recreational activities. Therefore, tourism can be considered a recreational activity, just like everything individuals do in their free time (Tütüncü et al., 2019). Moreover, sporting activities, such as tourism, can also be regarded as recreational activities. Consequently, enhancing the collaboration between tourism, which occupies a significant position in industrial activities, and sports, a social phenomenon, will facilitate the advancement of both industries (Kurtzman & Zauhar, 2003).

The term "sports tourism" refers to leisure activities involving travel to various destinations. Individuals leave their hometowns to participate in or observe sports events and explore sports-related attractions (Chang et al., 2020). Activities classified as sports tourism include paragliding, tennis, surfing, mountaineering, rafting, basketball, volleyball, and football (Taştan & Kızılırmak, 2019). Major international sporting events, such as the Olympics, World Cups, car races, and national leagues and competitions, significantly encourage travel (Turgut, 2023). More than just a leisure activity, sports play a crucial role in promoting a healthy lifestyle, inspiring individuals to engage in activities like tennis, golf, sailing, and swimming, which are also recognized as viable sources of revenue for the hospitality industry (Usta, 2014).

Sports consist of the actions of individuals acting through their motives. The role of large sports organizations in motivating individuals is a significant factor (Hacıcaferoğlu et al., 2022). Motives represent a fundamental aspect of motivation, constituting a crucial area of knowledge. Motivation, which enables individuals to act, is an important source that shapes attitudes (Güleç, 2006). Evaluating individual and social benefits demonstrates the significance of attitudes towards sports tourism for individuals, institutions and societies (Hacıcaferoğlu et al., 2022). Furthermore, sports tourism, a form of alternative tourism with beneficial effects on human health, also allows individuals to gain insight into diverse cultures and countries. Sports tourism allows individuals to engage in sporting activities, either actively or passively, and travel to other countries. Moreover, sports tourism has the potential to generate employment opportunities for its participants, thereby positively impacting the lives of individuals in numerous ways. From this perspective, the attitudes of individuals towards sports tourism are also a crucial consideration. Consequently, the sub-dimensions of "job opportunities", "personal contribution", "economic contribution", and "organization" are assessed in the examination of attitudes towards sports tourism (Tezcan Kardaş & Sadık, 2018).

Most university students are young people who engage extensively in tourism activities, both as tourists and as employees, due to the dynamic nature of their age group. Furthermore, students pursuing a degree in sports sciences focusing on recreation are also engaged in numerous sporting organizations. These individuals, actively engaged in sports tourism, may have developed a specific attitude towards it. Moreover, the evidence indicates that these individuals are active participants in recreational activities, which may have influenced their recreational awareness. It is, therefore, essential to examine the attitudes of students in the recreation department who have developed recreational awareness and are receiving education in sports sciences towards sports tourism. A literature review reveals that although studies examining recreational awareness and attitudes towards sports tourism exist, these variables have been discussed separately. Thus, no study has been identified that considers these variables in conjunction. This research aims to contribute to the existing literature and the practice of those working in this field by analyzing the relationship between the levels of recreational awareness and the attitudes towards sports tourism of students enrolled in a recreation department course. Furthermore, by analyzing the sub-dimensions of the variables separately in determining the relationship between recreational awareness and attitudes towards sports tourism of recreation department students, this research will make an essential contribution to the existing literature on this topic.

Methods

Ethics committee approval for this research was obtained from Kütahya Dumlupınar University (Date: April 02, 2024, Number: E-67750228-050.04-285590). Verbal consent was obtained from all the participants.

Research Model and Hypotheses

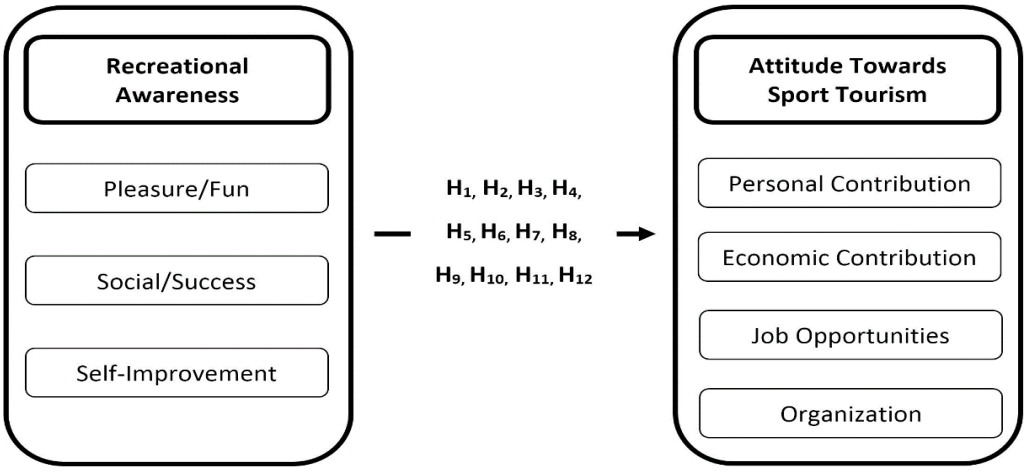

Figure 1.
Research Model

The model created to determine the effects of recreational awareness sub-dimensions on attitudes towards sports tourism is presented in Figure 1. As seen in Figure 1, 12 hypotheses were determined by the model established in the research. The

determined research hypotheses are presented below:

- **Hypothesis H_1:** The pleasure/fun sub-dimension of recreational awareness positively affects the personal contribution sub-dimension of attitude towards sports tourism.
- **Hypothesis H_2:** The pleasure/fun sub-dimension of recreational awareness positively affects the economic contribution sub-dimension of attitude towards sports tourism.
- **Hypothesis H_3:** The pleasure/fun sub-dimension of recreational awareness positively affects the job opportunities sub-dimension of attitude towards sports tourism.
- **Hypothesis H_4:** The pleasure/fun sub-dimension of recreational awareness positively affects the organization sub-dimension of attitude towards sports tourism.
- **Hypothesis H_5:** The social/success sub-dimension of recreational awareness positively affects the personal contribution sub-dimension of attitude towards sports tourism.
- **Hypothesis H_6:** The social/success sub-dimension of recreational awareness positively affects the economic contribution sub-dimension of attitude towards sports tourism.
- **Hypothesis H_7:** The social/success sub-dimension of recreational awareness positively affects the job opportunities sub-dimension of attitude towards sports tourism.
- **Hypothesis H_8:** The social/success of recreational awareness positively affects the organization sub-dimension of attitude towards sports tourism.
- **Hypothesis H_9:** The self-improvement sub-dimension of recreational awareness positively affects the personal contribution sub-dimension of attitude towards sports tourism.
- **Hypothesis H_{10}:** The self-improvement sub-dimension of recreational awareness positively affects the economic contribution sub-dimension of attitude towards sports tourism.
- **Hypothesis H_{11}:** The self-improvement sub-dimension of recreational awareness positively affects the job opportunities sub-dimension of attitude towards sports tourism.
- **Hypothesis H_{12}:** The self-improvement of recreational awareness positively affects the organization sub-dimension of attitude towards sports tourism.

Research Instrument

Per the research objective and hypotheses, a questionnaire was constructed to evaluate recreational awareness and attitudes towards sports tourism. The 41-item scale with three factors from Ekinci and Özdilek (2019) was used to measure participants' levels of recreational awareness. The pleasure/fun sub-dimension comprised ten items, the social/success sub-dimension 18 items, and the self-improvement sub-dimension 13 items. Cronbach's Alpha coefficient of the scale was calculated as 0.973 for this research. The 14-item scale with four factors (Tezcan Kardaş & Sadık, 2018) assessed the participants' attitudes towards sports tourism. The personal contribution sub-dimension comprised five items, the economic sub-dimension four items, the job opportunities sub-dimension three items, and the organization sub-dimension two items. For this research, Cronbach's Alpha coefficient of the scale was calculated as 0.936. Participants rated their agreement with each item on a five-point Likert scale, from 1 "strongly disagree" to 5 "strongly agree". They also completed a personal information form on gender, age, and grade, ensuring a comprehensive understanding of the participant demographics.

Sampling and Data Collection

The research population consisted of 394 undergraduate students enrolled in the Faculty of Sport Sciences, Department of Recreation at Kütahya Dumlupınar University. Due to time constraints and limited accessibility, a sampling method was utilized in this research. The sample was drawn using the convenience sampling method, a non-probability sampling technique designed to ensure the inclusion of all relevant participants. The identification of participants continued until the desired sample size was achieved. Accordingly, the minimum required sample size for a population of 394 individuals was calculated to be 195, using a 95% confidence level and a 5% margin of error (Ural & Kılıç, 2018). In this context, 209 individuals were surveyed between April 20 and May 31, 2024. Table 1 provides a detailed overview of the participant profile, offering insights into the individual characteristics of those involved in the research.

Data Analysis

The research model was tested using "Partial Least Squares Structural Equation Modeling" (PLS-SEM). The selection of PLS-SEM was predicated on its capacity to examine intricate models. Furthermore, PLS-SEM is optimally suited to addressing measurement models and single-item structures, thereby circumventing the challenges associated with identification. Additionally, PLS-SEM is recognized as a suitable technique for analyses involving small sample sizes (Hair et al., 2017; 2022).

The research data were initially coded using the SPSS 22 (IBM SPSS Corp., Armonk, NY, USA) software and subsequently evaluated as a research measurement and structural model using the Smart PLS 4 software. In the analysis phase, internal consistency and reliability, convergent validity, discriminant validity, structural model assessment and structural equation model results using the derived sampling are presented in tabular forms in the findings section.

Results

A consideration of the participant's demographic information indicates that 70.3% of the subjects were male, 46.4% were between the ages of 21 and 23, and 29.7% were in their senior year.

Table 1.
Respondent profile

Variables		n	%
Gender	Male	147	70.3
	Female	62	29.7
Age	18-20 age	67	32.1
	21-23 age	97	46.4
	24 age and above	45	21.5
Grade	Freshman year	60	28.7
	Sophomore year	47	22.5
	Junior year	40	19.1
	Senior year	62	29.7
TOTAL		**209**	**100,0**

Assessment of the Validity and Reliability of the Scales

A measurement model was constructed to determine the scales' construct validity and reliability. Furthermore, the scales were assessed regarding their internal consistency, convergent validity, and discriminant validity. The composite reliability (CR) and Cronbach's Alpha coefficients were calculated to assess the internal consistency and reliability. Average variance extracted (AVE) values and factor loadings were employed to investigate convergent validity. To ascertain the discriminant validity of the scales employed, both the criterion put forth by Fornell and Larcker (1981) and the Heterotrait Monotrait Ratio (HTMT) criterion were subjected to evaluation. Furthermore, the cross-loadings of the indicators on the scales were subjected to a detailed examination.

Table 2.
Results of the measurement model

Variables and Items			Mean	Factor Loading	Cronbach's Alpha	CR	AVE
Recreational Awareness	**Pleasure/Fun**	ra1	4.488	0.940	0.963	0.962	0.720
		ra2	4.392	0.784			
		ra3	4.325	0.819			
		ra4	4.344	0.739			
		ra5	4.378	0.782			
		ra6	4.344	0.878			
		ra7	4.234	0.831			
		ra8	4.249	0.931			
		ra9	4.230	0.949			
		ra10	4.445	0.802			
	Social/Success	ra11	4.239	0.694	0.972	0.971	0.653
		ra12	4.234	0.857			
		ra13	4.225	0.747			
		ra14	4.407	0.807			
		ra15	4.378	0.656			
		ra16	4.349	0.660			
		ra17	4.282	0.821			
		ra18	4.273	0.826			
		ra19	4.249	0.986			
		ra20	4.301	0.786			
		ra21	4.273	0.757			
		ra22	4.306	0.885			
		ra23	4.282	0.744			
		ra24	4.368	0.714			
		ra25	4.297	0.905			
		ra26	4.258	0.886			
		ra27	4.244	0.978			
		ra28	4.215	0.731			
	Self-Improvement	ra29	4.321	0.895	0.963	0.962	0.662
		ra30	4.311	0.843			
		ra31	4.340	0.845			
		ra32	4.306	0.735			
		ra33	4.354	0.769			
		ra34	4.325	0.726			
		ra35	4.392	0.784			
		ra36	4.349	0.845			
		ra37	4.306	0.628			
		ra38	4.349	0.881			
		ra39	4.335	0.766			
		ra40	4.364	0.928			
		ra41	4.301	0.879			
Attitude Towards Sport Tourism	**Personal Contribution**	st2	4.120	0.871	0.945	0.944	0.771
		st3	4.292	0.938			
		st5	4.172	0.791			
		st8	4.206	0.973			
		st11	4.234	0.804			
	Economic Contribution	st9	4.263	0.928	0.939	0.940	0.797
		st10	4.225	0.941			
		st12	4.230	0.896			
		st13	4.225	0.798			
	Job Opportunities	st6	4.263	0.832	0.925	0.928	0.811
		st7	4.230	0.942			
		st14	4.258	0.924			
	Organization	st1	4.187	0.969	0.971	0.971	0.943
		st4	4.148	0.973			

An examination of Cronbach's Alpha coefficients calculated for the factors in Table 2 reveals that these coefficients range from 0.925 to 0.972, with the CR values ranging from 0.928 to 0.971. The factor loadings demonstrated a range of 0.653 to 0.943. It is expected that Cronbach's Alpha, factor loadings, and CR values should be ≥0.70, and AVE values should be ≥0.50 (Hair et al., 2017; 2022). Even though the factor loadings for items 11, 15, and 16 from the social/success sub-dimension and item 37 from the self-improvement sub-dimension in the recreational awareness scale fell below the 0.70 threshold, these items were not excluded from the scale. This resulted from the calculated CR and AVE values exceeding the threshold values. It was, therefore, concluded that the alignment between the factor loadings and AVE values was sufficient for convergent validity.

Table 3.
Discriminant validity assessment (Fornell ve Larcker criterion)

	EC	JO	O	PC	PF	SI	SS
Economic Contribution (EC)	0.893						
Job Opportunities (JO)	0.559	0.901					
Organization (O)	0.568	0.506	0.971				
Personal Contribution (PC)	0.552	0.463	0.577	0.878			
Pleasure/Fun (PF)	0.373	0.257	0.192	0.237	0.848		
Self-Improvement (SI)	0.422	0.436	0.245	0.320	0.482	0.814	
Social/Success (SS)	0.421	0.420	0.291	0.265	0.469	0.627	0.808

By the methodology proposed by Fornell and Larcker (1981), the square root of the AVE values should exceed the correlations between the constructs under examination. The values presented in parentheses in Table 3 represent the square root values of the AVE. As evidenced by the table, the square root values of the AVE exceed the correlation coefficients.

Table 4.
Discriminant validity assessment (HTMT criterion)

	EC	JO	O	PC	PF	SI	SS
Economic Contribution (EC)							
Job Opportunities (JO)	0.564						
Organization (O)	0.568	0.510					
Personal Contribution (PC)	0.557	0.464	0.576				
Pleasure/Fun (PF)	0.370	0.255	0.190	0.233			
Self-Improvement (SI)	0.420	0.435	0.242	0.316	0.481		
Social/Success (SS)	0.417	0.418	0.287	0.258	0.467	0.625	

The HTMT proposed by Henseler et al. (2015) should be less than 0.90 for theoretically similar constructs and less than 0.85 for theoretically different constructs. As the HTMT coefficients presented in Table 4 fall below the specified threshold values, it can be concluded that the requisite discriminant validity has been achieved.

Finally, upon examining the cross-loadings of the scale indicators, it was determined that the factor loadings of the construct must exceed those of all other constructs (Hair et al., 2022). In this research, all values were found to satisfy the criteria above.

Test of Hypotheses

To test the research hypotheses, the Consistent PLS-SEM algorithm was initially applied to calculate the Variance Inflation Factor (VIF) and the R^2. Subsequently, PLSpredict analysis was conducted to assess the predictive power (Q^2). After that, Consistent PLS-SEM Bootstrapping was performed, and through derivative resampling, 10,000 subsamples were drawn from the sample to calculate β, Sd, t value and p-value.

As previously stated by Hair et al. (2022), the variance inflation factor (VIF) coefficients should remain below the threshold of 5 to mitigate issues related to multicollinearity among variables. As shown in Table 5, all VIF coefficients are below 5, indicating no linearity problem exists between the variables. The R^2 values demonstrate that personal contribution is explained by 12%, economic contribution by 24%, job opportunities by 23% and organization by 9%. It was observed that all attitudes exhibited low levels of determination. Conversely, the Q^2 predictive values exceeded 0, indicating that the model demonstrates considerable predictive power (Hair et al., 2022).

Table 5.
Research model coefficients

Predictor(s)	Outcome(s)	VIF	R^2	Q^2
Pleasure/Fun	Personal Contribution	1.386	0.115	0.072
Social/Success		1.752		
Self-Improvement		1.779		
Pleasure/Fun	Economic Contribution	1.386	0.241	0.190
Social/Success		1.752		
Self-Improvement		1.779		
Pleasure/Fun	Job Opportunities	1.386	0.226	0.177
Social/Success		1.752		
Self-Improvement		1.779		
Pleasure/Fun	Organization	1.386	0.093	0.055
Social/Success		1.752		
Self-Improvement		1.779		

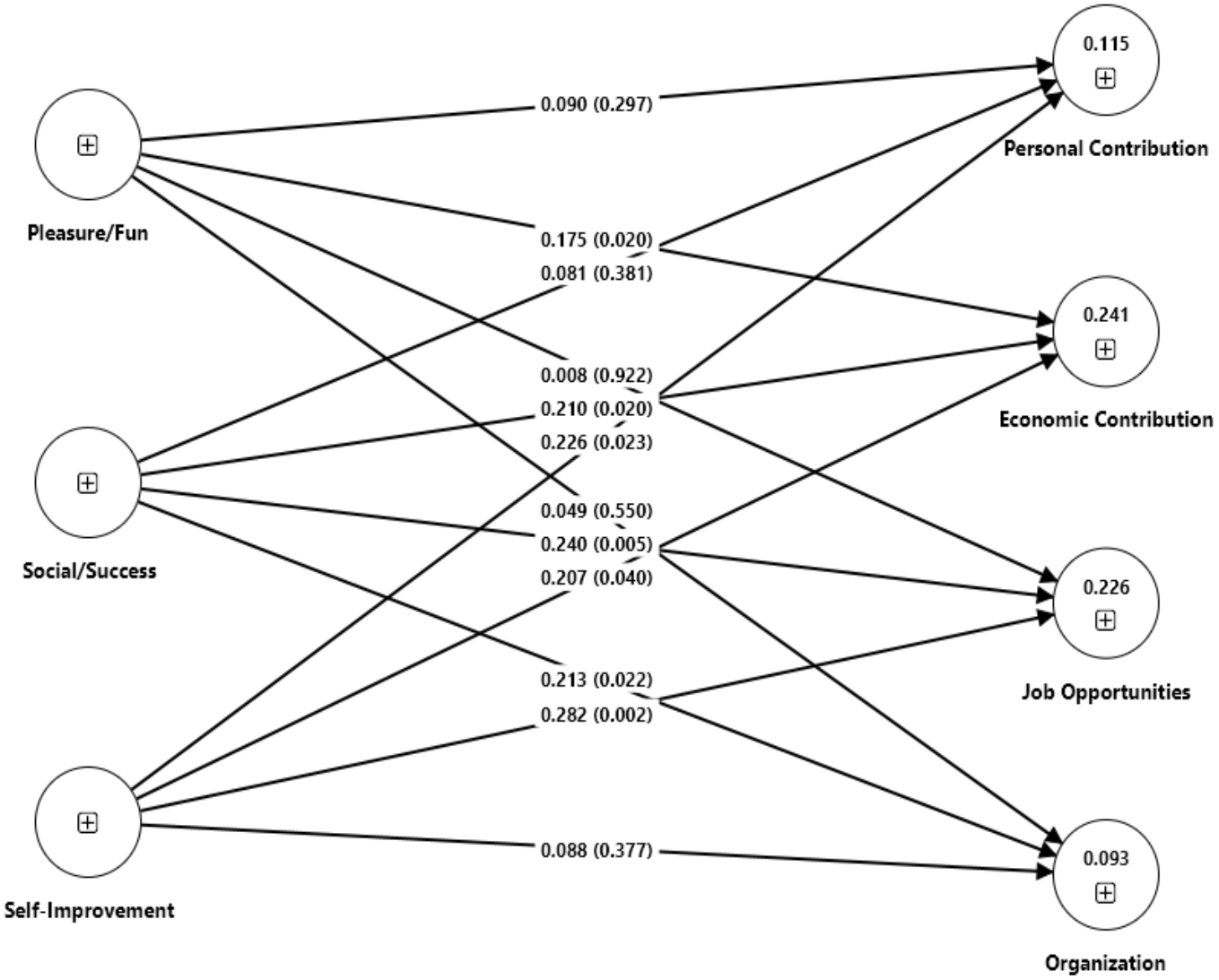

Figure 2.
Research Model Result

Table 6.
Results of structural equation model analysis

	Hypotheses	β	Sd	t value	p-value	Results
H_1	Pleasure/Fun -> Personal Contribution	0.090	0.091	0.086	1.042	Not supported
H_2	Pleasure/Fun -> Economic Contribution	0.175	0.075	2.328	0.020*	Supported
H_3	Pleasure/Fun -> Job Opportunities	0.008	0.083	0.098	0.922	Not supported
H_4	Pleasure/Fun -> Organization	0.049	0.083	0.598	0.550	Not supported
H_5	Social/Success -> Personal Contribution	0.081	0.093	0.875	0.381	Not supported
H_6	Social/Success -> Economic Contribution	0.210	0.090	2.331	0.020*	Supported
H_7	Social/Success -> Job Opportunities	0.240	0.085	2.831	0.005**	Supported
H_8	Social/Success -> Organization	0.213	0.093	2.285	0.022*	Supported
H_9	Self-Improvement -> Personal Contribution	0.226	0.100	2.267	0.023*	Supported
H_{10}	Self-Improvement -> Economic Contribution	0.207	0.101	2.053	0.040*	Supported
H_{11}	Self-Improvement -> Job Opportunities	0.282	0.092	3.084	0.002**	Supported
H_{12}	Self-Improvement -> Organization	0.088	0.100	0.883	0.377	Not supported

**: p<.05; **: p<.01*

As a result of the structural equation model analysis, it was determined that pleasure/fun sub-dimension had a significant positive effect on the economic contribution (ß=0.175, *p*=.020) but did not have a significant effect on the personal contribution (ß=0.090, *p*=1.042), job opportunities (ß=0.008, *p*=.922) and organization (ß=0.049, *p*=.550) sub-dimensions. Therefore, hypothesis **H_2** is supported, while hypotheses **H_1, H_3** and **H_4** are not supported. The social/success sub-dimension has a significant positive effect on the economic contribution (ß=0.210, *p*=.020), job opportunities (ß=0.240, *p*=.005) and organization (ß=0.213, *p*=.022). However, no significant effect is observed on the personal contribution (ß=0.081, *p*=.381). Therefore, hypotheses **H_6, H_7** and **H_8** are supported, while hypothesis **H_5** is not supported. The self-improvement sub-dimension has a significant positive effect on the personal contribution (ß=0.226, *p*=.023), economic contribution (ß=0.207, *p*=.040) and job opportunities (ß=0.282, *p*=.002), but no significant effect on the organization (ß=0.088, *p*=.377). Therefore, hypotheses **H_9, H_{10}** and **H_{11}** are supported, while hypothesis **H_{12}** is not supported.

Discussion

The findings of this research demonstrate that students enrolled in the recreation department exhibit a high level of recreational awareness. These findings are consistent with those reported in other studies conducted on university students by Üstün and Aktaş Üstün (2020), Ayyıldız Durhan et al. (2022), Güzel Gürbüz et al. (2022), Satılmış et al. (2022), and İnan et al. (2024). Furthermore, the findings of Geven and Yaşartürk (2024) indicate that students enrolled in recreation departments within sport sciences faculties demonstrate heightened levels of recreational awareness compared to students in other academic disciplines. This finding supports the elevated levels of awareness observed in the present research. Conversely, examining recreational awareness regarding its constituent sub-dimensions reveals that pleasure/fun is the most prominent sub-dimension. This finding is consistent with the conclusions of several previous studies (Koç et al., 2022; Akçakese & Demirel, 2024). Moreover, the finding that the social/success sub-dimension is rated lower than other sub-dimensions is to the conclusions of numerous studies in the literature (Üstün & Aktaş Üstün, 2020; Ayyıldız Durhan et al., 2022; Koç et al., 2022; Akçakese & Demirel, 2024).

The results of the research indicate that the attitudes of undergraduate students in the Recreation Department towards sports tourism are predominantly favorable. Following a thorough review of the extant literature, it has been determined that the present result is parallel to the findings of various studies conducted on university students (Özdemir & Yücel, 2021; Hacıcaferoğlu et al., 2022; Turgut, 2023). Moreover, an analysis of the attitude towards sports tourism regarding its constituent sub-dimensions reveals that the job opportunities sub-dimension is the most highly rated. This finding is consistent with the results of other studies in the literature (Özdemir & Yücel, 2021; Karaoğlu, 2023; Turgut, 2023). Conversely, the findings concur with those of other studies in the literature, indicating that the lowest sub-dimension is the organization (Özdemir & Yücel, 2021; Hacıcaferoğlu et al., 2022; Karaoğlu, 2023; Turgut, 2023).

This research aims to ascertain the influence of recreational awareness levels among undergraduate students of the recreation department on their attitudes towards sports tourism. To this end, a model has been devised to evaluate the impact of recreational awareness on attitudes towards sports tourism, considering the various sub-dimensions. As no study has previously analyzed the relationship between recreational awareness and attitudes towards sports tourism, some

evaluations can be made regarding hypothesis tests, considering the limitations in studies with which the findings obtained regarding hypothesis tests can be compared.

Recreational awareness positively affects the economic contribution sub-dimension of attitude towards sports tourism in all sub-dimensions. As recreational awareness increases, so does awareness of the economic benefits of sports tourism. Individuals with a high level of recreational awareness are more inclined to support initiatives such as increased investment in sports tourism, marketing studies, and providing a greater diversity of products. This finding is partially consistent with research conducted by Ayyıldız Durhan et al. (2022), which indicates that recreational awareness influences the purchasing behaviors related to recreational products within the context of the relationship between recreation, sports, and tourism.

Except for the pleasure/fun sub-dimension, all sub-dimensions of recreational awareness (the social/success and self-improvement sub-dimensions) positively influence the job opportunities sub-dimension of the attitude towards sports tourism. These effects represent the most significant effects within the model. This situation may have been shaped by the notion that undergraduate students of the recreation department may be directly or indirectly involved in the employment opportunities created by the growth of sports tourism activities.

The personal contribution sub-dimension of attitude towards sports tourism is significantly affected only by the personal development sub-dimension of recreational awareness. This phenomenon can be attributed to the potential of sport tourism and recreational activities to enhance self-confidence and improve time management skills. When the related concepts are evaluated from a personal perspective, it can be assumed that the observed outcomes are consistent with the expected results in the context of the results.

The organization sub-dimension of the attitude towards sports tourism is significantly influenced by the social/success sub-dimension of recreational awareness. This outcome may be associated with social/success awareness, which prioritizes social benefit and social satisfaction to encourage the development of activities and organizations for sports tourism at national and international levels.

Conclusion and Recommendation

This research indicated that students in the recreation department demonstrated high recreational awareness and positive attitudes towards sports tourism. The results of the hypothesis tests indicated a correlation between the recreational awareness levels of undergraduate students in the recreation department and their attitudes towards sports tourism, as measured by the sub-dimensions. These findings contribute significantly to the existing literature on this topic. This research is valuable because it is the first to analyze the relationship between recreational awareness and attitudes towards sports tourism.

It is also essential to consider the limitations of this research when evaluating the results. Firstly, the data obtained through questionnaires may not fully reflect the behaviors of individuals. Conversely, this research was conducted on students in the Recreation Department at Kütahya Dumlupınar University, Faculty of Sport Sciences. Further studies on this subject at different universities and with different demographic groups may facilitate the conveyance of results from a broader perspective. Additionally, an avenue for further research could be to examine the differences between undergraduate students of recreation departments and those of recreation management departments in the relationship between recreational awareness and sports tourism. Furthermore, investigating the attitude towards sports tourism, particularly e-sports tourism, which has gained popularity recently, could yield insightful findings.

For undergraduate students in the field of recreation to cultivate more constructive attitudes towards sports tourism while acquiring recreational awareness throughout their academic careers, the theoretical and practical integration of sports tourism courses into the curricula of recreation departments in an effective and contemporary manner can facilitate positive strides towards sports tourism on a macro level.

Etik Komite Onayı: Bu çalışma için etik komite onayı Kütahya Dumlupınar Üniversitesi'nden (Tarih: 2 Nisan 2024, No: E-67750228-050.04-285590) alınmıştır.
Katılımcı Onamı: Çalışmaya katılan tüm katılımcılardan sözlü onam alınmıştır
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Konsept – S.A.; Y.A.; Tasarım – S.A.,Y.A.; Denetim – S.A.,Y.A.; Kaynaklar – S.A.,Y.A.; Malzemeler – S.A.,Y.A.; Veri Toplama ve/veya İşleme – S.A.,Y.A.; Analiz ve/veya Yorum – S.A.,Y.A.; Literatür Taraması – S.A.,Y.A.; Yazma – S.A.,Y.A.; Eleştirel İnceleme – S.A.,Y.A.; Diğer – S.A.,Y.A.
Çıkar Çatışması: Yazarların beyan edecekleri herhangi bir çıkar çatışması yoktur.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Kütahya Dumlupınar University (Date: April 2, 2024, Number: E-67750228-050.04-285590).
Informed Consent: Verbal consent was obtained from all the participants.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept - S.A.,Y.A.; Design - S.A.,Y.A.; Supervision - S.A.,Y.A.; Resources - S.A.,Y.A.; Materials - S.A.,Y.A.; Data Collection and/or Processing - S.A.,Y.A.; Analysis and/or Interpretation - S.A.,Y.A.; Literature Search - S.A.,Y.A.; Writing Manuscript - S.A.,Y.A.; Critical Review - S.A.,Y.A.; Other – S.A.,Y.A.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Research Article *Araştırma Makalesi* DOI: 10.62425/rses.1597643

The Evaluation of Physical Performance Test Parameters of Alpine Snowboarders with Competition Scores

Alpine Snowboard Branşı Sporcularının Fiziksel Performans Test Parametrelerinin Yarışma Sonuçları ile Değerlendirilmesi

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ABSTRACT

The aim of the study is to analyze and compare the relationship between anaerobic power, isokinetic leg muscle strength and balance parameters and competition results of snowboarding athletes competing in national team selections. The study included 12 athletes (male and female) in the snowboarding branch with mean age of males and females of 20±1.29-20±1.41 years, mean height of 174.43±6.75-160.4±5.41 cm, mean body weight of 67.40±6.11-57.08±4.83 kg, body mass index of 22.17±1.88-22.22±1.95 kg/m2, and body fat percentage of 10.08±3.7-20.19±4.18. The heights of the athletes were measured using a Holtain (UK) stadiometer and their body weights were determined using BC, 418 Tanita (Japan). Anaerobic power and capacity tests were performed through the Wingate test, and IsoMed 2000® isokinetic strength device was used for strength measurements. Balance tests were performed with six different types of Sportkat 4000 device. The relationship between anaerobic capacity, isokinetic muscle strength, balance parameters and competition results was determined via Spearman correlation test. The study revealed highly significant correlations between the participants' anaerobic power and lower extremity muscle strength and the competition results *($p<.05$).* No significant relationship was observed between the participants' balance parameters and the competition results ($p>.05$). The study concluded that certain physical performance of snowboarding athletes with different competition scores is related to anaerobic capacity and lower extremity muscle strength. It is thought that evaluating motoric characteristics in the national team selection criteria would be a correct decision. In the development of athletes' performance, their knowledge levels regarding anaerobic capacity, muscle strength and balance parameters should be increased.

Keywords: Anaerobic power, balance, muscle strength, snowboard

ÖZ

Bu çalışma, milli takım seçmelerinde yarışan snowboard sporcularının anaerobik güç, izokinetik bacak kas kuvveti ve denge parametreleri ile yarışma sonuçları arasındaki ilişkiyi incelemek ve karşılaştırmaktır. Araştırmaya snowboard branşı kapsamında erkek ve kadınların sırasıyla yaş ortalamaları 20±1,29-20±1,41 yıl, boy uzunluğu ortalamaları 174,43±6,75-160,4±5,41 cm, vücut ağırlığı ortalamaları 67,40±6,11-57,08±4,83 kg, beden kitle indeksleri 22,17±1,88-22,22±1,95 kg/m^2, vücut yağ yüzdesi 10,08±3,7-20,19±4,18 ortalamalarına sahip olan 12 (erkek-kız) sporcu dahil edilmiştir. Sporcuların boyları, Holtain (UK) stadiometre ile ölçülmüş, vücut ağırlıkları BC, 418 Tanita (Japan) ile belirlenmiştir. Anaerobik güç ve kapasite testi Wingate testi kullanılarak yapılmış, kuvvet ölçümleri için IsoMed 2000® izokinetik kuvvet cihazı kullanılmıştır. Denge testleri ise altı farklı türde Sportkat 4000 cihazı ile gerçekleştirilmiştir. Anaerobik kapasite, izokinetik kas kuvveti, denge parametreleri ile yarışma sonuçları arasındaki ilişki Spearman korelasyon testi ile belirlendi. Katılımcıların anaerobik güç ve alt ekstremite kas kuvveti ile yarışma sonuçları arasında önemli ölçüde anlamlı korelasyonlar bulunmuştur *($p<.05$).* Katılımcıların denge parametreleri ile yarışma sonuçları arasında anlamlı ilişki bulunamamıştır *($p>.05$).* Çalışmada, farklı yarışma puanlarına sahip snowboard branşı sporcularının belirli fiziksel performanslarının anaerobik kapasite ve alt ekstremite kas kuvveti ile ilişkili olduğu sonucuna varılmıştır. Milli takım seçme kriterlerinde motorik özelliklerin değerlendirilmesinin doğru bir karar olacağı düşünülmektedir. Sporcuların performanslarının geliştirilmesinde, anaerobik kapasite, kas kuvveti ve denge parametreleri hakkındaki bilgi düzeylerinin artırılması gerekmektedir.

Anahtar Kelimeler: Anaerobik güç, denge, kas kuvveti, snowboard

Geliş Tarihi/Received 07.12.2024
Kabul Tarihi/Accepted 01.05.2025
Yayın Tarihi/Publication Date 20.06.2025

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Cite this article: Aktaş, B. S., Kıyıcı, F., & Kaşali, K. (2025). The evaluation of physical performance test parameters of alpine snowboarders with competition scores. *Research in Sport Education and Sciences, 27*(2), 132-142.

Introduction

The sport of snowboarding has grown in popularity as both a recreational winter activity as well as a prominent Olympic sport. Both forms are comprised of one of three different disciplines within the sport: freestyle, alpine, and snowboard-cross. In recent years, the increased professionalism and substantial growth of snowboarding as a global sport has increasingly attracted the interest of exercise physiologists and sport scientists. Given the small (but growing) number of studies that have been published, the research analyzing the physiological and performance characteristics and requirements of snowboarding remains limited. The studies conducted thus far have indicated different requirements of physiological and physical traits dependent upon the specific discipline of snowboarding in question (Vernillo et al., 2018).

As an athletic sport, snowboarding challenges the limits of both physical and technical abilities. The more we understand the physiological demands faced by elite snowboarders, the better we can replicate and enhance these qualities in the athletes. Understanding the muscular forces and energy systems involved in snowboarding is crucial for training prescriptions, performance enhancement, and talent identification. However, for many years, research on snowboarding has primarily focused on injuries (Ishimaru et al., 2012; Wijdicks et al., 2014). The physiological requirements in snowboarding are diverse. Athletes need strength, anaerobic fitness, coordination, and more to prevail in a contest and over an entire season. Other factors such as technique, equipment, or psychology are important as well, but this study analyzed only the physiological variables (Platzer et al, 2009). To evaluate physiological factors, fitness testing in sports is absolutely necessary. Laboratory tests are a useful tool to assess the athlete's general fitness (Platzer et al., 2009; Rimmele et al., 2007; Svensson & Drust, 2005). These data are used to monitor training and for training prescription. Tests should have a relevance to the specific sport and be able to predict performance (Battista et al., 2007; Impellizzeri, et al., 2005)

The aim of this study is to determine whether there is a relationship between the sports performance of elite snowboarders such as anaerobic power, strength and balance parameters. In this regard, the study analyzes the relationship between the gain of isokinetic leg strength, the increase in anaerobic capacity and balance parameters and evaluates the effect of performance results on competition scores. The study is accordingly expected to yield important findings to optimize the performance of athletes and make training programs more effective.

Methods

Ethics approval and consent to participate This study was approved by the institutional ethics committee of Atatürk University Ethics Commission (Date: October 24, 2024, Number: 2024-10 Protocol No: 2400346295) and was conducted at Atatürk University Athlete Performance Measurement Center in accordance with the current version of the Declaration of Helsinki. After explaining the possible risks and benefits that may be encountered during the experimental procedures, a written informed consent form indicating their voluntary participation was obtained from the participants. The participants participated in the study completely voluntarily and were free to withdraw from the study at any time without giving any reason otherwise.

The study included 12 athletes (7 males + 5 females) aged 18-20 in the snowboarding branch. Table 1 indicates the descriptive statistics of the participants. The inclusion criteria for the study were determined as being an active national athlete in their own branch, participating in national team selections, not having any known disease or health problem, and volunteering to participate in the study. Participants were informed that they should not exercise 24-48 hours before the tests and should not consume caffeine for at least 8 hours. These precautions were taken to ensure the reliability of the data obtained. Anaerobic power test and isokinetic leg strength test were applied on different days in a predetermined order. The same test order was applied to all participants, thus minimizing the effect of the order on performance.

Data collection tools

Weight and height scale: The heights of the athletes were measured with a stadiometer with ±1 mm precision (Holtain, UK). The weights of the athletes, the calculation of BMI values and body fat percentages were performed using a Tanita brand (BC, 418 Tanita, Japan) body composition analyzer with 100 gram precision.

Test of Anaerobic Power and Capacity: Measurement of Anaerobic Power Performance: Wingate anaerobic power and capacity test (WanT) was performed at the highest possible maximal voluntary pedal speed against a resistance equivalent to

7.5% of the participant's body weight for 30 seconds. The highest peak power, average power, lowest power and percentage power loss of the participants within 30 seconds were recorded from the computer software as anaerobic capacity (Özkan et al., 2011).

Determination of Isokinetic Muscle Strength: In the study, muscle strength measurement and muscle strength training of the participants were performed using the ISOMED 2000® isokinetic device. The study was performed on the knee joint flexor and extensor muscle groups in the lower extremity. After adjusting the back angle of the device, the shaft of the dynamometer was adjusted so that the pivot point would be the lateral femoral condyle. The support pad of the dynamometer was fixed on the tibia. The trunk, pelvis and hip joint were stabilized with a belt. Screws were attached to the specified areas and ROM was fixed mechanically. After the participants were connected to the device, passive knee flexion-extension was performed and the incidence of discomfort was checked. The knee flexion-extension concentric-concentric movements to be used in the evaluation protocol were determined as one set of five repetitions at 60°/s angular velocity on the dominant leg, and one set of fifteen repetitions at 240°/s and 300°/s angular velocities (Kocahan et al., 2017).

Balance Test: The static and dynamic balance tests of the participants will be measured using the Sportkat 4000 brand device. Both static and dynamic balance tests were performed in a total of 6 different ways: right foot, left foot and double foot.

Performance Analysis in Sports: National team selection results of athletes in the same category were obtained from the snowboard database on the Turkish Ski Federation website (Tanyeri et al., 2017)

Data Analysis

SPSS-26 was used to analyze the data obtained from the study. The obtained data are shown as mean and standard deviation. Visual (histogram, probability graphs) and analytical (Kolmogorov-Smirnov test) methods were used to determine whether the obtained data had a normal distribution. The distribution of the data was evaluated with the Shapiro-Wilk test and Spearman correlation analysis was applied for data that did not show normal distribution. The relationship between anaerobic capacity, isokinetic muscle strength, balance parameters and competition scores were determined by Spearman correlation test. The correlation level was classified as negligible (r =0-0.3), low (r =0.31-0.50), medium (r =0.51-0.70), strong (r =0.71-0.90) and very strong (r =0.91-1.0) (Mukaka, 2012). Statistical significance level was accepted as *(p*<.05).

Results

Table 1.
Descriptive information of athletes

		N	X ±SS	Min.	Maks.
Male	Age (year)	7	20±1.29	18	20
	Height (cm)	7	174.43±6.75	165	184
	Weight (kg)	7	67.40±6.11	59	76
	BMI (kg/m²)	7	22.17±1.88	20	25
	BFP%	7	10.08±3.7	3	15
Female	Age (year)	5	20±1.41	18	21
	Height (cm)	5	160.4±5.41	156	169
	Weight (kg)	5	57.08±4.83	53	65
	BMI (kg/m²)	5	22.22±1.95	20	25
	BFP%	5	20.19±4.18	16	25

The descriptive characteristics of the 12 athletes participating in the study indicated that the male and female athletes had an average age of 20±1.29-20±1.41 years, a height of 174.43±6.75-160.4±5.41 cm, a body weight of 67.40±6.11-57.08±4.83 kg, a body mass index of 22.17±1.88-22.22±1.95 kg/m2, and a body fat percentage of 10.08±3.7-20.19±4.18, respectively (Table 1).

Table 2.
The relationship between anaerobic power of the atheletes and their competition scores.

Wingate	Data	Giant Slalom (sec)	Slalom (sec)	Combined (sec)
PP(W)	r	-0.559	-0.559	-.601 *
	p	.059	.059	.039
AP(W)	r	-.706 *	-.678 *	-.734 **
	p	.010	.015	.007
MP(W)	r	-.699 *	-.727 **	-.720 **
	p	.011	.007	.008
PP(W/Kg)	r	-.797 **	-.825 **	-.790 **
	p	.002	.001	.002
AP(W/Kg)	r	-0.477	-0.460	-0.502
	p	.117	.133	.096
MP(W/Kg)	r	-.759 **	-.812 **	-.766 **
	p	.004	.001	.004
PD (%)	r	0.007	0.056	-0.007
	p	.983	.863	.983

PP [W]: Peak power reached by the athlete during the test. AP [W]: Average power applied by the athlete during the test. MP [W]: Lowest power reached by the athlete during the test. PP [W/kg]: Peak power per kilogram reached by the athlete during the test. AP [W/kg]: Average power per kilogram applied by the athlete during the test. MP [W/kg]: Lowest power per kilogram reached by the athlete during the test. PD (%): Percentage power loss of the athlete during the test. *Correlation is significant at the .05 level (2-tailed), **Correlation is significant at the .01 level (2-tailed)

Table 2 demonstrates the relationships between the anaerobic power parameters of the athletes and the competition scores. The study revealed a negative moderate relationship between the peak power and combined rankings of the participants throughout the test (r_{rho}=-.601; p<.05), and a negative moderate relationship between the giant slalom/slalom rankings (r_{rho}=-0.559, r_{rho}=-0.559; p>.05), respectively. The study also indicated a negative moderate and strong correlation between the average power applied by the athletes throughout the test and their giant slalom/slalom/combined rankings (r_{rho}=-.706, r_{rho}=-678, r_{rho}=-734; p<.05), a negative moderate and strong correlation between the lowest power reached during the test and their giant slalom/slalom/combined rankings (r_{rho}=-.699, r_{rho}=-727, r_{rho}=-720; p<.05), and a negative strong correlation between the peak power per kilogram reached by the athletes throughout the test and their giant slalom/slalom/combined rankings (r_{rho}=-797, r_{rho}=-825, r_{rho}=-790; p<.05) respectively. A weak negative correlation was additionally observed between the athlete's average power per kilogram applied throughout the test and giant slalom/slalom/combined rankings, respectively (r_{rho}=-0.477, r_{rho}=-0.460, r_{rho}=-0.502; p>.05); a strong negative correlation was found between the athlete's lowest power per kilogram reached during the test and giant slalom/slalom/combined rankings, respectively (r_{rho}=-759, r_{rho}=-812, r_{rho}=-.766; p<.05). A weak positive and negative correlation was also suggested between the athlete's percentage power loss throughout the test and giant slalom/slalom/combined rankings, respectively (r_{rho}=0.007, r_{rho}=0.056, r_{rho}=-0.007; p>.05).

Table 3.
The relationship between the isokinetic leg muscle strength of the athletes and their competition scores.

Endurance	Data	Giant Slalom (sec)	Slalom (sec)	Combined (sec)
Peak Torque Flexion	r	-0.587*	-0.580*	-0.545
	p	.045	.048	.067
Peak Torque Extension	r	-0.776**	-0.783**	-0.762**
	p	.003	.003	.004
Peak Power Flexion	r	-0,567	-0,588*	-0.574
	p	.054	.044	.051
Peak Power Extension	r	-0.762**	-0.804**	-0.769**
	p	.004	.002	.003
Average Torque	r	-0.783**	-0.804**	-0.769**
	p	.003	.002	.003
Average Power	r	-0.790**	-0.832**	-0.797**
	p	.002	.001	.002
Nm/Kg	r	-0.699*	-0.713**	-0.671*
	p	.011	.009	.017
W/Kg	r	-0.748**	-0.811**	-0.755**
	p	.005	.001	.005

*Correlation is significant at the .05 level (2-tailed), **Correlation is significant at the .01 level (2-tailed)

Table 3. demonstrates the relationships between the peak torque values of the participants measured at 60°/sec angular velocity and the competition scores .There was a negative moderate relationship between peak torque flexion 60°/sec dominant giant slalom/slalom rankings, respectively (r_{rho}=-.587, r_{rho}=-.580; p<.05), a negative strong relationship between peak torque extension 60°/sec dominant giant slalom/slalom/combined rankings, respectively (r_{rho}=-.776, r_{rho}=-.783, r_{rho}=-.762; p<.05), a negative moderate relationship between peak power flexion 60°/sec dominant slalom rankings, respectively (r_{rho}=-.588; p<.05), and mean torque 60°/sec dominant giant slalom/slalom/combined rankings, respectively (r_{rho}=-.783, r_{rho}=-.804, r_{rho}=-.769;p<.05). A strong negative relationship was observed between the average power 60°/sec dominant giant slalom/slalom/combined rankings (r_{rho}=-.790, r_{rho}=-.832, r_{rho}=-.797; p<.05); the study also revealed a strong negative relationship between the force (Nm/kg) 60°/sec dominant giant slalom/slalom/combined rankings (r_{rho}=-.699, r_{rho}=-.713, r_{rho}=-.671;p<.05)and a moderate-strong negative relationship between the force (Nm/kg) 60°/sec dominant giant slalom/slalom/combined rankings (r_{rho}=-.748, r_{rho}=-.811, r_{rho}=-.755; p<.05), respectively.

Table 4.
The relationship between the isokinetic leg strength of athletes and their competition scores.

Endurance	Data	Giant Slalom (sec)	Slalom (sec)	Combined (sec)
Peak Torque Flexion	r	-0.762**	-0.804**	-0.776**
	p	.004	.002	.003
Peak Torque Extension	r	-0.720**	-0.755**	-0.706*
	p	.008	.005	.010
Peak Power Flexion	r	-0.692*	0.720**	-0.678*
	p	.013	.008	.015
Peak Power Extension	r	-0.671*	-0.699*	0.664*
	p	.017	.011	.018
Average Torque	r	-0.825**	-0.853**	-0.811**
	p	.001	.000	.001
Average Power	r	-0.790**	-0.839**	-0.783*
	p	.002	.001	.003
Nm/Kg	r	-0.713**	-0.762**	-0.720**
	p	.009	.004	.008
W/Kg	r	-0.804**	-0.832**	-0.797**
	p	.002	.001	.002

*Correlation is significant at the .05 level (2-tailed), **Correlation is significant at the .01 level (2-tailed)

Table 4 demonstrates the relationships between the peak torque values of the participants measured at 240°/sec angular velocity and the competition scores. There was a strong negative correlation was found between peak torque flexion at 240°/s and the rankings in the dominant giant slalom/slalom/combine events, respectively (r_{rho}=-.762, r_{rho}=-.804, r_{rho}=-.776; p<.05). and a strong negative correlation between peak torque extension at 240°/s and the rankings in the dominant giant slalom/slalom/combine events, respectively (r_{rho}=-.720, r_{rho}=-.755, r_{rho}=-.706; p<.05). A moderately strong negative correlation between peak power flexion at 240°/s and the rankings in the dominant slalom event, respectively (r_{rho}=-.692, r_{rho}=-.720, r_{rho}=-.678; p<.05) and a strong negative correlation between average torque at 240°/s and the rankings in the dominant giant slalom/slalom/combine events, respectively (r_{rho}=-.825, r_{rho}=-.853, r_{rho}=-.811; p<.05) were also observed. In addition, the study revealed a strong negative correlation between average power at 240°/s and the rankings in the dominant giant slalom/slalom/combine events, respectively (r_{rho}=-.790, r_{rho}=-.839, r_{rho}=-.783; p<.05); a strong negative correlation between force (Nm/kg) at 240°/s and the rankings in the dominant giant slalom/slalom/combine events, respectively (r_{rho}=-.713, r_{rho}=-.762, r_{rho}=-.720; p<.05); a strong negative correlation between force (Nm/kg) at 60°/s and the rankings in the dominant giant slalom/slalom/combine events, respectively (r_{rho}=-.804, r_{rho}=-.832, r_{rho}=-.797; p<.05).

Table 5.

Relationship between athletes' balance parameters and competition scores.

		Data	Giant Slalom (sec)	Slalom (sec)	Combined (sec)
Dynamic Balance	Double	r	0.063	0.133	0.070
		p	.846	.681	.829
	Left	r	0.000	-0.014	-0.042
		p	1.000	.966	.897
	Right	r	0.259	0.350	0.315
		p	.417	.265	.319
Static Balance	Double	r	-0.329	-0.350	-0.343
		p	.297	.265	.276
	Left	r	-0.140	-0.098	-0.161
		p	.665	.762	.618
	Right	r	0.126	0.168	0.133
		p	.697	.602	.681

Table 5 demonstrates the relationships between the balance parameters of the participants and the competition scores. A positive and low correlation between the dynamic balance (double-left-right) parameters and giant slalom/slalom/combined rankings, respectively (r_{rho}=0.063, r_{rho}=0.133, r_{rho}=0.070, r_{rho}=0.000, r_{rho}=0.259, r_{rho}=0.350, r_{rho}=0.315 *p*>.05), and a positive and low correlation between the dynamic balance (left) parameters and slalom/combined rankings, respectively (r_{rho}=-0.014, r_{rho}=-0.042) were observed. The study also revealed a negative low correlation between the static balance (double-left) parameters and slalom/giant slalom/combined rankings (r_{rho}=-0.329, r_{rho}=-0.350, r_{rho}=-0.343, r_{rho}=-0.140, r_{rho}=-0.098, r_{rho}=-0.161; *p*>.05), and a positive low correlation between the static balance (right) parameters and giant slalom/slalom/combined rankings (r_{rho}=0.126, r_{rho}=0.168, r_{rho}=0.133; *p*>.05), respectively.

Discussion

This study aims to analyze the relationship between anaerobic power, isokinetic muscle strength and balance parameters of snowboarders competing in national team selections and competition scores. The study suggests a possible significant relationship between performance tests and competition scores. In other words, the success of athletes in competitions is believed to be related to certain physical performance parameters (power, strength, balance). The findings revealed a relationship between anaerobic power and isokinetic muscle strength of snowboarders and their competition scores.

When the scientific literature on the anthropometric characteristics of elite snowboarders is examined, the focus is especially on the athletes' height, body mass, and body fat percentage. According to relevant literature, the average height and body mass of elite male skill-based snowboarding athletes range from 172.6 to 178.4 cm and 63.4 to 73 kg, respectively (Back et al., 2014). In a study conducted on elite Austrian male snowboarders, the reported values were (75.4±9.9 kg) (Gathercole et al., 2015). It was reported that the average body fat percentage in elite male Italian snowboarders was between 12%-14% (Vernillo et al., 2015). In the study titled effect of acute fatigue and training adaptation on countermovement jump performance in elite snowboard cross athletes, it was reported that the height of the female athletes was 165.7±4.4 cm and their body weight was 64.4 ± 4.5 kg, respectively (Gathercole et al., 2015). The analysis of the descriptive characteristics of female athletes concluded that their height was 160.4±5.41 cm and their body weight was 57.08±4.83 kg, respectively. No valid research data is currently available to assess whether elite female snowboarding athletes' height and body mass follow similar patterns. Thus, further research on the anthropometric characteristics of female snowboarding athletes is necessary to gain a better understanding of their impact on performance. Based on scientific research, the body fat percentages of elite men and women snowboarding athletes are about 10.6–13.8% and 14.9–19.8%, respectively (Wang et al., 2023). Elite snowboarding athletes often have a significantly lower body fat percentage compared to recreational athletes (Meyer et al., 2004). For snowboarding athletes, having greater muscle mass is more beneficial than carrying fat tissue (Tanyeri et al., 2017). In our study, it was found that male and female athletes had an average body fat percentage of 10.08±3.7-20.19±4.18,

respectively. Compared to fat tissue, greater muscle mass is more advantageous for meeting the demands of competition. Therefore, snowboarding athletes should prioritize building muscle mass in their training to support weight gain and reduce body fat. The study suggested that several differences resulted from genetic factors, training levels, nutritional habits and different developmental periods although the anthropometric characteristics of the participants were close to each other. Anthropometric characteristics highlight the potential significance of physique (body composition) for the performance of snowboarders. Body composition characteristics are used by athletes to manage the demands arising from reactive and fast turns and changing edges and to overcome obstacles. However, the study included only a small selection of anthropometric variables. Therefore, there is inadequate amount of a more comprehensive data set on the anthropometric characteristics of elite snowboarders and further research with a more comprehensive number of participants is recommended to thoroughly determine and optimize the anthropometric characteristics that are important for the performance of elite snowboarders.

A wide range of laboratory tests have been used to optimize training loads for athletes (Carey et al., 2003; Higa et al., 2007). However, there are limited studies on the effects of training on the anaerobic capacity of snowboarders (Klous et al., 2014; Platzer et al., 2009). Elite snowboarders have been observed to have significantly higher anaerobic power (Żebrowska et al., 2012). Another study reached the conclusion that the short-term, high-intensity ATP-PC anaerobic energy system played a significant role in the US national snowboarding team (Platzer et al., 2009). The tests indicated that anaerobic metabolism played a dominant role in world-class snowboarders (Kipp, 1998). The anaerobic power of Australian snowboarding athletes was assessed using the 30-second Wingate test, which established elite performance criteria of 16.5 w/kg for men and 13.5 w/kg for women in terms of peak anaerobic power (Hogg, 2003). In a study, it was observed that the anaerobic performance of elite snowboarders was as follows: peak power PP (W) reached during the test as 859.17±111.44, peak power per kilogram PP (w/kg) as 12.68±1.67, average power AP (w) as 593.58±46.81, lowest power MP (w/kg) reached during the test as 362.71±36.82, and percentage power loss PD (%) as 57.63±1.79 (Ozan et al., 2020). Żebrowska et al. conducted the 30-second Wingate test on 10 alpine snowboarding athletes (5 men and 5 women) and reported peak power values of 13.0 ± 1.0 w/kg for men and 10.3 ± 0.2 w/kg for women, along with average power values of 9.7 ± 0.2 w/kg for men and 7.7 ± 0.2 w/kg for women (Żebrowska et al., 2012). In another study, 18-25 years old intercollegiate male athletes found peak power 951 w, relative peak power 11.65 (w/kg) average power 686 W, average power 8.47 w/kg. In the same study wingate anaerobic test power comparisons for women were found to be PP (w) 598, PP (w/kg) 9.59, AP (w) 445, AP (w/kg) 7.16 (Zupan et al., 2009). Our study shows that maximum power per kilogram (PP w/kg) and average power (MP w/kg) stand out as strong determining factors in giant slalom, slalom and combined race performance. These results show that power outputs per kilogram in particular play a major role in performance in ski races. Also the study revealed a negative correlation between the peak power, average power, lowest power, peak power per kilogram, lowest power per kilogram reached by the athletes during the anaerobic power test and the national team selection results. The negative correlation between the anaerobic power parameters and the competition scores means that the quality of athletes' competition scores depends on the increase of their anaerobic power levels. The negative correlation indicates that there is an inverse relationship between the two variables. In the study, it means that the competition scores (results obtained in the competition) of the athletes with high anaerobic power are lower. As a result, anaerobic power is considered to be suitable performance determinant in terms of snowboarding.

Humans tend to use preferentially one side of the body in voluntary motor acts (Carpes et al., 2010). In sports scenarios, lateral preference can influence aspects related to force production due to long term adaptations from repeated use (Shoepe et al., 2003). Accordingly, bilateral asymmetries have been reported in sports with predominant unilateral movements, such as snowboard, soccer (Cheung et al., 2012; Vernillo et al., Pisoni et al., 2016). Muscular strength and power in snowboarders have mainly been assessed in the lower limb muscles, especially the quadriceps. This is likely due to the fact that injuries, particularly those affecting the knee, are common among elite snowboarders (Bakken et al., 2011; Torjussen et al., 2005). Early research found a strong correlation between muscular power, as measured by isokinetic leg press, and snowboarding performance among members of the Austrian snowboarding team (Platzer et al., 2009; Vernillo et al., 2015). Consequently, muscle strength and power are crucial factors in snowboarding competition. It is seen that average torque and average power values stand out as the strongest determining factors on giant slalom, slalom and combined race performance. Peak torque extension and peak power extension values also greatly affect race performance. Power and torque values per kilogram have a significant effect on race performance, a more pronounced relationship is observed especially in the slalom discipline. These findings are thought to be of critical importance to develop 60°/s extension force and power outputs in order to increase performance in snowboard races. In addition, it is seen that 240°/s w/kg (power per kilogram) and nm/kg (torque per kilogram) values are critical factors in increasing performance in ski races. In the peak power flexion and peak power extension results of athletes at 240°/s angular velocity, there is a positive correlation in some disciplines and a negative

correlation in some disciplines. This situation suggests that these parameters may vary depending on the use of different muscle groups. The analysis of the relationship between the isokinetic strength level of snowboarders and their competition performance revealed a moderate (60-240°/sec) negative strong and moderate significant correlations between the participants' giant slalom/slalom/combined performance and knee extension and flexion isokinetic strength values. The existence of a negative strong correlation between isokinetic leg strength and competition scores suggests that the competition scores of the athletes are parallel with the level of their muscle strength. These results indicate that the general good muscle strength of snowboarders positively affects their competition performance. Focusing on leg strength and endurance in snowboarders is an indication of an increase in competition performance. In this respect, it is highlighted that isokinetic training that will be carried out by considering the peak torque and average torque values in leg muscle strength at different angular velocities is expected to be more beneficial in terms of performance development of snowboarders.

One of the key parameters representing such an interaction between the body of snowboarders and environment is the balance (Kourtzi, 2010). Balance can be categorized into two types: static balance, which refers to maintaining a specific posture with minimal movement, and dynamic balance, which involves the ability to restore stability while performing a specific posture (Winter et al., 1990). In a study, it was found that elite snowboarders' one-legged static balance test (left and right legs) was between 0.87 and 0.91 (Platzer et al., 2009). In the study conducted with Korean national snowboarders, static balance is strongly correlated ($p < 0.05$) with circumference of the left lower leg (34.49 ± 2.42 cm; $\rho = 0.68$). Center dynamic balance is negatively correlated with the circumference of the right lower leg (34.63 ± 2.38 cm; $\rho = -0.67$), whereas right dynamic balance is positively correlated with left ankle flexion (148.44 ± 5.20°; $\rho = 0.78$) (Jeon et al., 2021). In another study, it was determined that there was no significant relationship between static-dynamic balance parameters and competition (slalom-giant slalom) results. The same study revealed no significant relationship between the body weight, static balance parameters and competition (giant slalom-slalom) results of snowboarders (Arslan et al., 2019). In the present study, no significant relationship was observed between balance parameters and competition scores. In the snowboard branch, since athletes generally use unilateral loading (right or left) more, the balance values of both feet are close to each other. In addition, the fact that the participants consisted of national athletes probably yielded no significant differences in the balance skills of the athletes. Since all athletes have a high level of balance ability, it is considered that the contribution of this skill to competition performance is less noticeable.

Conclusion and Recommendation

It is seen that training aimed at developing strength and power should be emphasized more in order to increase performance in snowboard competitions. Although static and dynamic balance do not directly affect competition performance, they are important in terms of athletes' general physical endurance and their potential to reduce injury risk. Therefore, it is recommended that training programs be organized and optimized in line with these findings.

Etik Komite Onayı: Bu çalışma için etik komite onayı Atatürk Üniversitesi'nden (Tarih: 24 Ekim 2024, Karar No: 10, Protokol No: 2400346295 alınmıştır.
Hasta Onamı: Tüm katılımcılardan yazılı onam alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir-B.S.A,F.K,K.K; Tasarım- B.S.A,F.K,K.K; Denetleme-B.S.A,F.K,K.K; Kaynaklar- B.S.A,F.K,K.K; Veri Toplanması ve/veya İşlemesi; B.S.A,F.K,K.K Analiz ve/ veya Yorum- B.S.A,F.K,K.K; Literatür Taraması- B.S.A,F.K,K.K; Yazıyı Yazan- B.S.A,F.K,K.K; Eleştirel İnceleme-B.S.A,F.K,K.K
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Atatürk University (October 24, 2024, Decision Number: 10, Protocol No: 2400346295
Informed Consent: Written consent was obtained from all the participants.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept - B.S.A,F.K,K.K; Design- B.S.A,F.K,K.K; Supervision- B.S.A,F.K,K.K; Resources- B.S.A,F.K,K.K; Data Collection and/or Processing- B.S.A,F.K,K.K; Analysis and/or Interpretation-B.S.A,F.K,K.K; Literature Search- B.S.A,F.K,K.K; Writing Manuscript-B.S.A,F.K,K.K; Critical Review- B.S.A,F.K,K.K; Other- B.S.A,F.K,K.K
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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Research Article *Araştırma Makalesi* DOI: 10.62425/rses.1616868

Investigating the Psychometric Properties of the Reysen Likability Scale

Reysen Beğenilirlik Ölçeği'nin Psikometrik Özelliklerinin İncelenmesi

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ABSTRACT

The likability of an individual serves as a tactic for self-presentation and facilitating persuasion of the target audience. The perceived likability of athletes, coaches, managers, and similar figures by sports consumers is a factor that can influence sports marketing activities. In this regard, this study aimed to adapt the Reysen Likability Scale, developed to measure perceived likability, for application within Turkish culture and to test its validity and reliability. A total of 207 participants, including 64 women and 143 men, voluntarily participated in the study. A three-part questionnaire was administered, consisting of the Reysen Likability Scale developed by Reysen, the Desire for Being Liked Scale developed by Kaşıkara and Doğan, and a personal information form designed by the researchers. Confirmatory factor analysis, tests for divergent and convergent validity, composite reliability calculations, and Cronbach's Alpha coefficient were utilized to examine the structural validity and reliability of the scale. The findings confirmed the original single-factor structure with 11 items, demonstrating good fit with data collected from the Turkish sample and high internal consistency of the instrument. The study showed that Reysen Likability Scale was a valid and reliable instrument for measuring perceptions of likability in individuals within Turkish culture.

Keywords: Likability, sports, marketing, validity, reliability

ÖZ

Bir bireyin beğenilir olması kişinin kendini sunması ve hedef kitleyi ikna kolaylığı için kullanılan bir taktiktir. Sporcu, antrenör, yönetici, vb. kişilerin spor tüketicileri tarafından algılanan beğenilirliği spor pazarlama faaliyetlerini etkileyebilecek bir unsurdur. Bu doğrultuda bu çalışmanın amacı algılanan beğenilirliği ölçmek için geliştirilmiş Reysen Beğenilirlik Ölçeği'nin (RBÖ) Türk kültüründe ölçüm yapabilecek şekilde uyarlanarak geçerlik ve güvenilirlik sınamasının yapılmasıdır. Çalışmada gönüllü olarak 64 kadın ve 143 erkek olmak üzere toplam 207 kişi yer almıştır. Katılımcılara Reysen tarafından geliştirilmiş Reysen Beğenilirlik Ölçeği, Kaşıkara ve Doğan tarafından geliştirilmiş Beğenilme Arzusu Ölçeği (BAÖ) ve araştırmacı tarafından oluşturulmuş kişisel bilgi formundan oluşan üç bölümlü anket formu uygulanmıştır. Ölçeğin yapı geçerliğinin sınanması için doğrulayıcı faktör analizi, ıraksak ve yakınsak geçerliğe ilişkin testler yapılmış, güvenilirlik sınaması için kompozit güvenilirlik (CR) hesaplaması ve Cronbach'ın Alpha katsayısından yararlanılmıştır. Araştırmanın bulguları, ölçeğin özgün 11 maddelik tek boyutlu yapısını doğrulamış, Türk örneklemden toplanan veriyle iyi düzeyde bir uyumda olduğunu ve aracın iç tutarlığının yüksek olduğunu göstermiştir. Türk kültüründe bireylere ilişkin beğenilirlik algısının ölçümlenmesinde RBÖ'nün geçerli ve güvenilir bir araç olduğu ortaya konmuştur.

Anahtar Kelimeler: Beğenilirlik, spor, pazarlama, geçerlik, güvenilirlik

Geliş Tarihi/Received 10.01.2025
Kabul Tarihi/Accepted 28.03.2025
Yayın Tarihi/Publication Date 20.06.2025

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Cite this article: Bostancı, T.G., Hocaoğlu, M., & Tükenmez, A. (2025). Investigating the Psychometric Properties of the Reysen Likability Scale. *Research in Sport Education and Sciences*, 27(2), 143-149.

Introduction

The perceived likability of athletes, coaches, or sports club managers among fans and sports consumers significantly impacts sports marketing and promotional activities. As professional sports become increasingly commercialized, athletes and coaches are often regarded as cultural icons and marketable products by media and corporate sponsors (Gilchrist, 2005; Summer & Johnson Morgan, 2008). The concept of likability has gained prominence as a means to maximize the marketing value of these figures. On the other hand, in recent years, internationally recognized figures in sports have shifted from serving as brand endorsers to creating their own brands or presenting themselves as brands. This transformation necessitates maintaining their likability.

The literature describes likability as both a persuasion tactic and a self-presentation method (Cialdini, 1993; Kenrick et al., 2002). Factors associated with increased likability include physical attractiveness, similarity to oneself, compliments, and associations (Eagly et al., 1991). Numerous studies have investigated the concept of likability, acknowledging that the factors influencing an individual's likability are varied, including attributes such as a pleasant demeanor, emotional expression, knowledge, physical appearance, or age (Reysen, 2006; Geys, 2014; Hubbard, 2018; Knuppenburg & Fredericks, 2021). Different researchers have approached the measurement of this construct from various perspectives, focusing on diverse aspects to understand its complexities (Arai et al., 2013).

Reysen (2005), building on the dual-factor model of attractiveness and expertise proposed by Chaiken and Eagly (1983), conceptualized likability as a single-factor construct. Reysen also designed a model requiring respondents to assess the individual being evaluated as if they were a part of their lives. This model integrates the three elements into a single dimension under the Reysen Likability Scale (RLS). Attractiveness reflects the physical appearance and features of an individual found aesthetically pleasing, extending beyond facial features or physical structure to include facial expressions. Expertise encompasses knowledge, intelligence, and skill. The concept of being part of one's life influences individuals to assess a brand or figure as if it were embedded within their personal experiences, often driven by the degree of familiarity.

While the literature offers a wealth of research on brand image and brand likability within sports branding (Brison et al., 2015; Martínez Cevallos et al., 2020; Yun et al., 2021), there remains a relative scarcity of studies specifically examining the likability of prominent sports figures (Pratt et al., 2018; Kunkel et al., 2019).Determining the likability of individuals such as athletes or coaches, who are at the forefront of sports marketing, is crucial for advancing related marketing research and identifying individuals to be featured in sports marketing. The use of prominent sports figures in marketing campaigns represents an effective strategy for companies aiming to enhance brand visibility and stimulate sales (Kunkel et al., 2019). Therefore, measuring likability could serve as a determinant of how prominent figures in sports are perceived within marketing efforts. In this context, the purpose of this research was to assess the validity and reliability of an instrument capable of predicting how an individual's likability is perceived by others within the Turkish population. This study seeks to make a meaningful contribution to future research in sports marketing by offering the sports marketing sector a novel framework to guide and optimize their strategies and activities.

Methods

Ethical Approval

For the study, an ethics committee approval report dated 01 October 2024 and decision number 2024/92 was received from Kafkas University Non-Interventional Clinical Research Ethics Committee. All participants were included on a voluntary basis, and each signed an informed consent form, and this study was conducted in accordance with the Principles of the Declaration of Helsinki.

Study Design

A combination of descriptive and correlational research methods, along with a quasi-experimental model, was employed in this study. Surveys were used as the primary data collection method for analytical investigations. A review of theoretical frameworks and the current state of the field was conducted through online and offline library searches, and relevant literature was compiled.

Participants

The study sample consisted of 207 participants (64 women and 143 men), selected through convenience sampling, who resided in various provinces of Turkey and participated in at least one sports activity regularly, either passively or actively. The participants were aged 18 and older. The responses were drawn from 250 distributed surveys, with complete and analyzable data from 207 individuals. Surveys were administered in two separate groups (Group A, n = 103; Group B, n = 104), as detailed in subsequent sections. The sample size was determined based on the number of participants in the original study for the development of the RLS and Osborne and Costello's (2004) recommendation of a participant-to-item ratio of 10:1 for factor analysis.

Data Collection Instruments

Data were collected using a two-part survey voluntarily completed by the participants. The survey consisted of a personal information form prepared by the researchers and a standard measurement tool. Before completing the standard measurement tool, the participants were shown a photo of an individual identified as a coach/manager, depending on their assigned group. Responses were provided accordingly. The instruments were distributed to the participants electronically or in person. Furthermore, an additional measurement tool was provided to assess the criterion-based divergent validity of the scale being tested. Details of the forms and the photo are as follows:

Personal Information Form

A brief questionnaire designed by the researchers to collect demographic data such as gender, education level, and active or passive participation in sports, tailored to the study's topic.

Fixed image (photo)

Two different photos prepared by the researchers were shown to the participants before completing the scale. Each photo depicted the same individual identified as a coach/manager, presented differently: in one photo, the individual appeared in formal attire and well-groomed, while in the other, they were dressed casually and appeared untidy.

Reysen Likability Scale (RLS)

Developed by Reysen (2005) to examine and measure factors influencing perceived likability, this single-factor scale consists of 11 items. The participants rated items on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree).

Desire for Being Liked Scale (DBLS)

Developed by Kaşıkara and Doğan (2017) to measure individuals' desire to be liked by others, this scale has been validated and consists of nine items on a unidimensional, four-point Likert scale (1 = strongly disagree, 4 = strongly agree).

Scale Translation

The items of the RLS were translated into Turkish and adapted using Brislin's (1976) back-translation and pre-test methods, which rely on logical and reasonable grounds. The process involved contributions from bilingual experts proficient in both source and target languages and academicians specializing in sports marketing. The translated and adapted items were tested on a separate participant group prior to the main study to ensure clarity.

Data Analysis

The suitability of the RLS data for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The results indicated that the data were appropriate for factor analysis ($\chi^2_{(55)}$ = 2,164.51; $p < 0.01$; KMO = 0.962) (Tobias & Carlson, 1969; Kaiser & Rice, 1974). Internal consistency was tested using Cronbach's alpha and composite reliability (CR). The factor structure of the RLS was examined using confirmatory factor analysis (CFA) through covariance matrices analyzed via maximum likelihood estimation. Model fit was assessed using the following criteria: normalized chi-square (χ^2/df), root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), normed fit index (NFI), non-normed fit index (NNFI/TLI), comparative fit index (CFI), and standardized root mean square residual (SRMR). Convergent validity was evaluated through average variance extracted (AVE) calculations and comparisons of responses from the two participant groups (Groups A and B). Divergent validity, due to the unidimensional nature of the scale, was assessed by examining the relationship between responses to the RLS and DBLS using Pearson's product-moment correlation. Distributions of continuous variables were examined for kurtosis and skewness where necessary. Data analyses were conducted using SPSS (version 24) and LISREL (v8.80) statistical software.

Results

This section presents descriptive, relational, and factor-analytic findings related to the demographic characteristics of the participants and their responses to the RLS and DBLS. The findings were evaluated at a 0.05 level of statistical significance. Table 1 summarizes the demographic characteristics of the participants and their regular engagement in sports activities.

Table 1.
Demographic characteristics of the participants

		Number	Percentage
Gender	Male	143	69.1%
	Female	64	30.9%
Educational level	Pre-university	32	15.4%
	Undergraduate	125	60.5%
	Postgraduate	50	24.1%
Regular participation in sports/physical activity	Active (competitive/recreational)	33	16.0%
	Passive (spectator)	96	46.3%
	Both	78	37.7%

The single-factor structure of the original 11-item RLS and its fit to the collected data were examined using CFA. The findings are presented in Table 2 and Figure 1.

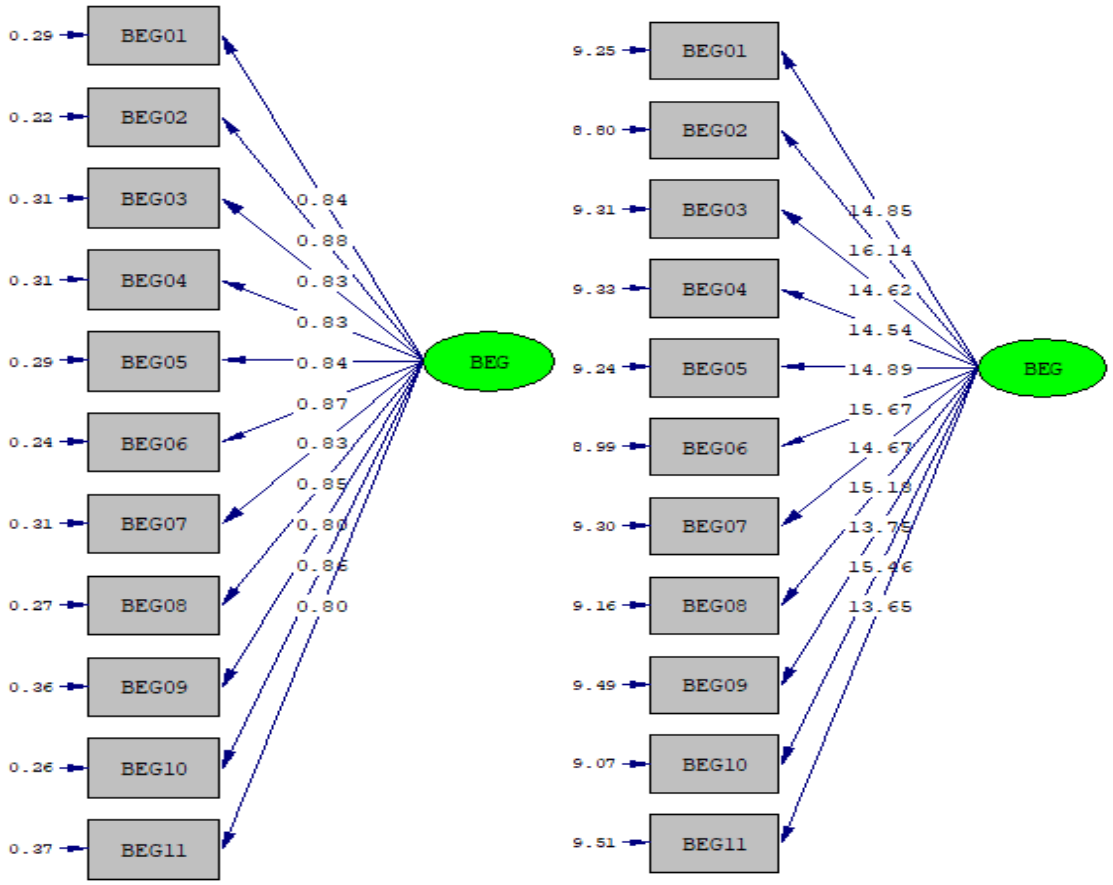

Figure 1.

Diagram of the factor structure of the RLS

RLS: *Reysen Likability Scale,* ***BEG 01-11****: RLS items*

Standardized factor loadings for the items on the RLS ranged between 0.80 and 0.87, with t-values ranging from 13.65 to 16.14, as shown in Figure 1.

Table 2.
Fit indices for the single-factor measurement model of the RLS

Model	χ^2	sd	χ^2/sd	RMSEA	GFI	SRMR	NNFI (TLI)	NFI	CFI
Single-factor model	102.23	44	2.32	0.080	0.92	0.026	0.99	0.98	0.99

RLS: Reysen Likability Scale, χ2: chi-square, sd: standart deviation, χ2/sd: normalized chi-square, RMSEA: root mean square error of approximation, GFI: Goodness-of-fit index, SRMR: Standardized root mean square residual, NNFI: non-normed fit index, NFI: normed fit index, CFI: Comparative fit index

The findings related to the fit indices of the single-factor model of the scale are summarized in Table 3. A normalized chi-square value between 2.00 and 5.00 indicates an acceptable fit (Wheaton et al., 1977; Tabachnick & Fidel, 2007). An SRMR value of 0.1 or lower and an RMSEA value of 0.08 or lower indicate an acceptable fit, while values of 0.05 or lower indicate good fit (Browne & Cudeck, 1993). CFI, NFI, and NNFI values within the range of 0.90–0.95 signify acceptable fit, whereas values in the range of 0.95–1 indicate good fit (Hu & Bentler, 1999). Based on the presented criteria, the single-factor measurement model demonstrates an acceptable level of fit.

Table 3.
Results of the t-test for convergent validity of the RLS

Group	n	Mean	SD	t	*p*
A	103	5.45	0.57	31.18	.000
B	104	3.06	0.53		

RLS: Reysen Likability Scale, SD: standard deviation

The t-test results in Table 3 show a statistically significant difference in perceived likability between the two groups (A and B), indicating that the scale meets the criterion-based requirements for convergent validity.

Table 4.
Results for divergent validity, convergent validity, and reliability of the RLS

	RLS
Correlation with DBLS	-0.060 (*p*=.394)
Convergent validity (AVE)	0.70
Composite reliability	0.96
Cronbach's alpha (α)	0.96

RLS: Reysen Likability Scale, DBLS: Desire for Being Liked Scale, AVE: average variance extracted

An AVE of 50% or higher is deemed sufficient to establish convergent validity (Yaşlıoğlu, 2017). For construct reliability and internal consistency, CR and Cronbach's alpha coefficient values above 0.7 are considered adequate (Nunnally & Bernstein, 1994, Hair et al., 2011). No correlation was observed between the RLS and DBLS (r = -0.060; *p*= .394). The findings presented in Table 4 indicate that, based on the referenced criteria, the scale met the standards for divergent and convergent validity as well as reliability.

Discussion

The fit indices of the single-factor model suggest that the measurement model aligns with acceptable fit ranges for the Turkish sample, as per established criteria in the literature (Browne & Cudeck, 1993; Hu & Bentler, 1999; Tabachnick & Fidel, 2007; Wheaton et al., 1977). Similar to the original scale, all items were loaded onto the relevant factor at satisfactory levels (λ_{min}= 0.80 > 0.40) (Hair et al., 2006). Consistent with the study by Reysen (2005), the current study tested the scale's convergent validity through criterion-based methods by analyzing the differences in scores between two participant groups (A and B). The higher perceived likability scores in Group A compared to Group B further support the scale's convergent validity. The AVE value supports the convergent validity (AVE = 0.70 > 0.50; Yaşlıoğlu, 2017).

Divergent validity was examined by analyzing the correlation coefficients between the RLS, which measures likability, and the DBLS, which measures a different construct. The lack of correlation between these two scales supports the criterion-based divergent validity of the RLS. Similarly, in Reysen's (2005) study, the divergent validity of the RLS was assessed against Goldberg's (1992) five-factor personality test, and very low correlations were observed between the RLS scores and all factors except one. The CR and Cronbach's alpha coefficients indicate that the RLS demonstrates high internal consistency and construct reliability (CR = 0.96, α = 0.96; Nunnally & Bernstein, 1994, cited in Hair et al., 2011). In conclusion, the findings establish that the RLS, with its single-factor, 11-item structure, is a valid and reliable measurement tool for assessing perceived likability in the Turkish cultural context.

Conclusion and Recommendation

This study is based on a reflective measurement model developed within the framework of classical test theory. While the indicators are similar, each addresses distinct aspects of the measured construct. It is assumed that participants' reported scores are sincere, and that observed variability is due to individual differences.

Future research could focus on cross-cultural studies, gender-based measurement invariance analyses, and similar methods to allow for more robust comparisons and a deeper understanding of the scale's effectiveness and reliability. Additionally, developing more sophisticated marketing models that incorporate likability as a key strategy for engaging and influencing target audiences in sports would enhance the field of sports marketing, offering clearer and more targeted avenues for control and strategy.

Etik Komite Onayı: Bu çalışma için etik komite onayı Kafkas Üniversitesi Üniversitesi'nden (Tarih: 01 Ekim 2024, Karar No: 7, Protokol No: 81829502.903/87) alınmıştır.
Hasta Onamı: Çalışmaya katılan tüm katılımcılardan sözlü onam alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir- MH, AT; Tasarım-TGB, MH, AT; Denetleme- TGB; Kaynaklar-TGB, MH, AT; Veri Toplanması ve/veya İşlemesi- AT; Analiz ve/ veya Yorum-MH; Literatür Taraması- TGB; Yazıyı Yazan-TGB; Eleştirel İnceleme-TGB, MH, AT
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Kafkas University University (Date: 01, Octeber 2024, Decision Number: 7, Protocol No: 81829502.903/87).
Informed Consent: Verbal consent was obtained from all the participants.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept- MH, AT; Design- TGB, MH, AT; Supervision-TGB; Resources- TGB, MH, AT; Data Collection and/or Processing- AT; Analysis and/or Interpretation- MH; Literature Search-TGB; Writing Manuscript- TGB; Critical Review- TGB, MH, AT
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Research Article *Araştırma Makalesi* DOI: 10.62425/rses.1618119

The Effects of Functional Exercise Interventions on Quality of Life and Selected Physical Fitness Parameters in Alzheimer's Patients

Alzheimer Hastalarında Fonksiyonel Egzersiz Müdahalelerinin Yaşam Kalitesi ve Seçilen Fiziksel Fitness Parametreleri

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ABSTRACT

This study investigated the effects of a 12-week functional exercise (FE) program on motor and cognitive abilities in older adults with mild to moderate dementia. A total of 200 voluntary participants were assessed, with 100 participants in the FE group (Group 1) and 100 in the control group (Group 2). Data were collected using modified versions of the Mini-Mental State Examination (MMSE), Tinetti Walking Test, Berg Balance Scale (BBS), Timed Up and Go Test (TUG), and Physical Activity Scales (IPAQ). The groups were comparable in demographic characteristics such as age (Group 1: 72.1 ± 6.2 years; Group 2: 71.8 ± 5.9 years, p>.05) and physical activity levels (both groups were predominantly sedentary). Balance scores significantly improved in Group 1 (pre: 44.3 ± 8.7; post: 54.1 ± 7.5, F=16.45, p<.001), whereas no significant change was observed in Group 2. Walking speed showed a significant increase in Group 1 (pre: 0.95 ± 0.12 m/s; post: 1.05 ± 0.14 m/s, F=5.24, p=.022). Functional mobility scores significantly improved in Group 1 (pre: 32.8 ± 6.3; post: 38.4 ± 5.6, F=8.35, p=.004). General cognitive function scores also showed a significant increase in Group 1 (pre: 21.3 ± 3.4; post: 23.1 ± 3.1, F=6.41, p=.013), while no significant change was observed in Group 2. Improvements in balance mediated walking speed (β=0.48, p<.001) and cognitive function (β=0.35, p<.001). Changes in functional mobility significantly influenced walking speed (β=0.37, p=.002). The results demonstrate the effectiveness of the FE program in enhancing motor and cognitive functions in older adults with dementia. These findings highlight the program's potential to improve quality of life and delay functional decline in this population.

Keywords: Motor performance, cognitive health, balance control

ÖZ

Bu çalışmada, hafif ile orta düzeyde demansı olan yaşlı bireylerde 12 haftalık fonksiyonel egzersiz (FE) programının motor ve bilişsel yetenekler üzerindeki etkilerini incelemiştir. Toplamda 200 gönüllü katılımcı (FE grubunda [Grup 1] 100 katlımcı, kontrol grubunda [Grup 2] 100 katılımcı) değerlendirilmiştir. Verileri toplamak için, modifiye edilerek Mini-Mental State Examination (MMSE), Tinetti Walking Test, Berg Denge Ölçeği (BDÖ) ve Timed Up and Go Test (TUG), Physical Activity Scales (IPAQ) kullanılmıştır. Gruplar, yaş (Grup 1: 72,1 ± 6,2 year; Grup 2: 71,8 ± 5,9 year, p>,05) ve fiziksel aktivite seviyeleri (her iki grupta da çoğunlukla sedanter) gibi demografik özellikler açısından benzerlik göstermiştir. Grup 1'de denge skorları önemli ölçüde iyileşmiştir (önce: 44,3 ± 8,7; sonra: 54,1 ± 7,5, F=16,45, p<,001), Grup 2'de ise anlamlı bir değişiklik gözlemlenmemiştir. Yürüyüş hızı, Grup 1'de önemli bir artış göstermiştir (önce: 0,95 ± 0,12 m/s; sonra: 1,05 ± 0,14 m/s, F=5,24, p=,022). Fonksiyonel mobilite skorları, Grup 1'de önemli ölçüde iyileşmiştir (önce: 32,8 ± 6,3; sonra: 38,4 ± 5,6, F=8,35, p=,004). Genel bilişsel fonksiyon skorları, Grup 1'de anlamlı şekilde artmıştır (önce: 21,3 ± 3,4; sonra: 23,1 ± 3,1, F=6,41, p=,013), Grup 2'de ise anlamlı bir değişiklik gözlemlenmemiştir. Denge iyileşmeleri, yürüyüş hızını (β=0,48, p<,001) ve bilişsel fonksiyonları (β=0,35, p<,001) aracılık etmiştir. Fonksiyonel mobilite değişiklikleri, yürüyüş hızını önemli ölçüde etkilemiştir (β=0,37, p=,002). Sonuçlar, FE programının, demansı olan yaşlı bireylerde motor ve bilişsel fonksiyonları geliştirmedeki etkinliğini göstermektedir. Bu bulgular, programın bu popülasyonda yaşam kalitesini iyileştirme ve fonksiyonel gerilemeyi geciktirme potansiyelini vurgulamaktadır.

Anahtar Kelimeler: Motor performans, bilişsel sağlık, denge kontrolü

Geliş Tarihi/Received 12.01.2025
Kabul Tarihi/Accepted 25.03.2025
Yayın Tarihi/Publication Date 20.06.2025

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Cite this article: Gürkan, A. C., Söyler, M., & Şensoy, C. (2025). The effects of functional exercise interventions on quality of life and selected physical fitness parameters in alzheimer's patients. *Research in Sport Education and Sciences, 27*(2), 150-165.

Introduction

Alzheimer's disease, one of the most common neurodegenerative disorders among the elderly, poses a significant public health threat worldwide (Amenta et al., 2001). As of 2023, the global prevalence of Alzheimer's disease is estimated to be approximately 47 million, and due to demographic shifts, this number is expected to increase rapidly in the coming years (Alzheimer's Disease International, 2022). Projections indicate that this increase could reach 135 million by 2050 (Alzheimer's Association, 2023). This demographic trend not only escalates the burden on healthcare systems but also significantly raises the costs associated with disease management and care (WHO, 2021). Alzheimer's disease presents broad social and economic challenges, adversely affecting both the quality of life for individuals and the resilience of healthcare infrastructures.

Alzheimer's disease is the most prevalent type of dementia syndrome, characterized as a progressive brain disorder that leads to cognitive, motor, and functional impairments over time (Blackman et al., 2020). It impacts cognitive abilities such as memory, attention, learning, and problem-solving, while also causing difficulties in daily activities and loss of independence (Sosa-Ortiz & Acosta-Castillo, 2012). Even in its early stages, Alzheimer's often limits functional capacity and reduces quality of life (Azevedo et al., 2023). Furthermore, motor and functional impairments associated with Alzheimer's, such as difficulties in walking, balance, and transfers, can manifest not only in advanced stages but also early in the disease (Campos et al., 2023). These symptoms significantly reduce mobility and independence, severely impacting overall quality of life. Current treatments primarily aim to manage symptoms rather than halt or reverse disease progression, with pharmacological interventions often associated with side effects and limited efficacy (Chen et al., 2016). This has highlighted the need for alternative approaches in disease management. In recent years, non-pharmacological interventions, particularly physical activity and exercise, have gained increasing attention for their potential benefits in managing Alzheimer's disease (Gianfredi et al., 2022). Physical activity has emerged as a promising intervention, not only for improving cognitive functions but also for enhancing motor performance. Consequently, the role of physical activity in Alzheimer's treatment has become a critical area for future research, underscoring the necessity of diversifying treatment modalities.

The role of physical activity in managing Alzheimer's disease has been a subject of growing interest due to its potential to prevent cognitive decline. Exercise can enhance brain health and motor function, mitigating motor impairments associated with Alzheimer's. Studies focusing on the relationship between physical activity and improvements in cognitive and motor functions emphasize the significance of such interventions in Alzheimer's management (Liu et al., 2022). In recent years, substantial research has highlighted the positive effects of physical activity on cognitive health. Studies have demonstrated that regular physical activity leads to significant improvements in motor skills and cognitive functions, particularly among older adults (Bossers et al., 2014). Research on individuals with Alzheimer's disease (IWD) has also increased, with findings suggesting that physical activity can slow cognitive decline and provide protective effects against disease progression (Cadore et al., 2013). Early-stage physical activity interventions have been shown to enhance brain plasticity, mitigating cognitive deficits associated with Alzheimer's (Cahn et al., 1997).

Numerous systematic reviews and meta-analyses have investigated the relationship between physical activity and Alzheimer's symptoms. These studies have explored the potential effects of exercise on motor and cognitive functions, including balance, mobility, gait, strength, and activities of daily living (ADL). However, inconsistencies in findings remain. For instance, among five reviews on balance, three reported no significant improvements from physical activity (Lucia & Ruiz, 2011), while two documented small to moderate benefits (Stephen et al., 2017). Similarly, studies on mobility report varying outcomes, with some noting significant improvements and others indicating inconsistent effects, ranging from slight negatives to substantial positives (Zhao et al., 2020). Studies on gait function generally observe small to moderate effects at normal walking speeds (Martyr et al., 2011). Conversely, physical activity appears to have a more pronounced impact on lower extremity strength. Reviews consistently report significant improvements in lower body strength, aiding in reducing fall risks and enhancing independence in ADL (Manckoundia et al., 2006). Despite ongoing research and debates, existing literature supports the potential of physical activity to mitigate Alzheimer's symptoms.

Future studies should aim for more consistent and high-quality designs to better elucidate these effects. While the number of studies exploring the benefits of physical activity in Alzheimer's disease is increasing, many suffer from methodological

heterogeneity and quality deficits. Variations in exercise types, durations, frequencies, and intervention periods contribute to inconsistent findings, complicating clear conclusions about the effects of physical activity on Alzheimer's symptoms. Moreover, small sample sizes limit the generalizability of results (Groot et al., 2016). To address these challenges, higher-quality studies with standardized methodologies are needed (Hauer et al., 2020)

Physical activity has the potential to serve as a critical strategy for managing Alzheimer's disease. However, the methodological limitations and inconsistencies in current research highlight the need for robust scientific evidence and large-scale studies. The therapeutic effects of physical activity on cognitive and motor functions may vary depending on individual characteristics, disease stage, and the specificity of exercise programs. For example, some systematic reviews and meta-analyses report no significant benefits of physical activity on general cognitive functions in Alzheimer's patients (Venturelli & Schena,2011), while others document positive impacts (Christofoletti et al., 2008). A study by Littbrand et al. (2011) noted that the cognitive effects of physical activity are comparable in magnitude to pharmacological treatments for Alzheimer's, emphasizing its potential role in therapeutic strategies.

This study aims to investigate the effects of physical activity interventions on motor and cognitive functions in individuals with Alzheimer's disease. The interventions specifically target Alzheimer-related motor deficits, aiming to improve underlying motor performance, which is intricately linked to complex cognitive processes such as sensory integration, central processing, and motor control. By addressing the strong connection between cognitive and motor functions, this research seeks to provide deeper insights into disease progression and management.

Methods

Participants

This study was conducted with a total of 200 elderly individuals. The participants were divided into two groups, each consisting of 100 individuals. The mean age of the participants was 72.1 ± 6.2 years (minimum = 68.10; maximum = 74.20) in the first group and 71.8 ± 5.9 years (minimum = 65.50; maximum = 71.10) in the second group. In terms of dementia levels, both groups comprised individuals diagnosed equally with mild and moderate dementia (50/50). Regarding physical activity levels, 70% of the individuals in the first group were active and 30% were sedentary, while in the second group, 72% were active and 28% were sedentary. The participants' physical activity levels averaged 68.90 ± 1.2 (minimum = 61.20; maximum = 74.10) in the first group and 70.20 ± 2.4 (minimum = 65.28; maximum = 75.20) in the second group.

Study Design and Participant Selection

This study was designed as a single-center, randomized controlled trial to evaluate the effectiveness of a 12-week functional exercise program on the physical health of elderly individuals in various public and private care institutions in Ankara. The study aimed to investigate the potential effects of functional exercise on physical capacity, performance, and overall health. Participants were assessed through baseline (pre-test) and final (post-test) measurements, which were used to evaluate changes in functional capacity, balance, and muscle strength. The Functional Exercise Group (FE) participated in the designated functional training program for 12 weeks, while the Control Group (CG) received no intervention. The participants were individuals experiencing age-related physical declines but still capable of walking. The selection of participants was carried out by care home staff, who identified potential candidates based on the established inclusion and exclusion criteria. Approval was obtained from family doctors to ensure the participants' health conditions were suitable for participation. Ethical approval for the study was obtained from the Çankırı Karatekin University Health Ethics Committee with the code 14 / date 25.06.2024. The study followed the ethical recommendations for research in humans as suggested by the Declaration of Helsinki. All participants were provided with detailed information about the study and gave written informed consent. The study was retrospectively registered in the national clinical trials registry and conducted in compliance with ethical standards.

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: Individuals aged 65 years and older. Individuals diagnosed with Alzheimer's disease, vascular dementia, or other primary types of dementia. Individuals with a Mini-Mental State Examination (MMSE) score

between 10-24. Individuals who can walk approximately 10 meters either with or without an assistive device. Individuals whose general health condition is approved by their family doctor. Individuals who can participate in regular training sessions for 12 weeks.

The exclusion criteria were as follows: Secondary dementia (types of dementia caused by organic diseases or traumatic brain injuries). Severe cognitive impairments or motor disorders. Other neurological diseases or acute physical illnesses. Individuals whose family or legal representatives decide to withdraw from the study.

Intervention Program and Methods

Throughout the study, the group 1 (FE) underwent a 12-week functional exercise program tailored for individuals with Alzheimer's disease. The program was designed to consider the participants' age, cognitive status, and health conditions, and it included exercises aimed at enhancing muscle strength, improving balance, increasing flexibility, and boosting physical endurance. Furthermore, the functional exercises were designed to promote greater independence in daily living activities for individuals with Alzheimer's disease. The program included various activities such as walking, balance exercises, strength-enhancing movements, and exercises designed to improve muscle flexibility. The group 2 (CG) did not receive any intervention during the study period. However, at the end of the research period, the control group was offered the same functional training program, and the participants in this group were similarly assessed. This allowed for a comparison of the physical and cognitive effects of functional training on individuals with Alzheimer's disease.

Intervention; This exercise protocol was specifically designed based on the principles of functional training, in accordance with the existing literature and findings from a pilot study (Berg et al., 2020). The integration of motor and physical tasks aims to develop the motor skills that participants will need in their daily lives. Studies in the literature have shown that such interventions lead to significant improvements in cognitive functions. The pilot study (n=19) was conducted to evaluate the feasibility of the intervention and to gather preliminary results. The literature review on exercise lasting twelve weeks aimed to provide insights into the design of suitable interventions for individuals with advanced dementia (IWD). The reviews revealed that physical activity programs for IWD patients should last at least four months, with 2-3 sessions per week, and each session lasting between 45 to 60 minutes (Smith & Johnson, 2019). Moreover, programs focusing on multiple motor skills were found to be more effective compared to interventions based on a single skill. Based on these findings, the eight-week pilot program was restructured to align with functional exercise principles, incorporating motor and cognitive tasks that simulate the various challenges participants may encounter in daily life (Berg et al., 2020).

Exercise Structure

The functional exercise (FE) program was led by two experienced instructors and conducted in a group format. The exercises were performed by participants in a seated position. Each group consisted of a maximum of ten participants, and caregivers were also included in the group to assist the instructors. The training was tailored to address the specific needs of individuals with advanced dementia (IWD), with tasks adapted based on the cognitive levels of the participants. Communication was simplified through the use of basic language and non-verbal cues, while the complexity of tasks was optimized through functional movements. Each session was carefully planned to monitor participants' progress, and all instructors received comprehensive training on the content of the FE program. A detailed guide was prepared for the instructors to ensure strict adherence to the protocol.

Session Structure: Each training session was divided into three main sections: arrival, main target section, and departure.

Arrival (5-7 minutes): Cardiovascular system-stimulating mobilization and functional warm-up exercises were performed to prepare participants for the session.

Main Target Section (35 minutes): This section consisted of motor skill tasks based on functional movement patterns. These tasks were categorized as follows:

Endurance (43%): Tasks requiring functional endurance (e.g., stair climbing, long-distance walking).

Balance (25%): Exercises aimed at improving balance in daily life (e.g., one-leg standing, slow-paced walking).

Strength (16%): Functional strength exercises (e.g., rising from a chair, bodyweight squats).

Flexibility (13%): Functional flexibility movements (e.g., picking up objects from the floor, body stretching).

Conscious Movements (3%): Tasks related to natural movements and habits (e.g., hand-arm coordination).

All exercises were performed at a moderate intensity and were designed to simulate daily activities, ensuring that participants were actively engaged in tasks similar to those encountered in their routine life.

Departure (5 minutes): The session concluded with a relaxation and muscle relaxation routine, including stretching and breathing exercises. Throughout the intervention, each participant's progress was regularly monitored, and task difficulty levels were adjusted according to their motor abilities. Tasks were customized based on individual development, and progress was made throughout the program. At the end of the program, significant improvement in participants' functional capacity was anticipated.

Data Collection and Assessment

The physical and cognitive performance of participants was evaluated at the beginning (pre-test) and at the end of the study (post-test). The following tools were used for assessments:

Mini-Mental State Examination (MMSE): Administered to assess cognitive functions.

Walking Test: Measured participants' ability to walk 10 meters, helping to evaluate overall physical capacity.

Berg Balance Scale: Assessed participants' balance abilities.

Timed Up and Go Test (TUG): Applied to measure functional mobility.

Muscle Strength Test: Evaluated participants' muscle strength and power capacity.

Physical Activity Scales: Measured participants' levels of independence in daily life activities.

These tests were repeated for both groups at the beginning and the end of the study. The changes in the physical and cognitive status of the participants after the functional training program were analyzed.

Data Collection Tools and Methods

During the data collection phase of the study, a series of standardized and validated tests were used to assess changes in participants' physical and cognitive performance. These tools were applied twice: once before the intervention (pre-test) and once after the intervention (post-test).

Cognitive Performance Evaluation Tools

Mini-Mental State Examination (MMSE): This test was used to evaluate the participants' general cognitive functions. It assesses areas such as orientation, memory, attention and calculation, recall, and language (Folstein et al., 1975). Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog): Specifically used for measuring cognitive impairments in individuals with advanced dementia (IWD). The subscales focus on critical cognitive skills for daily living, such as orientation and praxis (Folstein et al., 1975).

Physical Performance Evaluation Tools

Timed Up and Go Test (TUG): The participants' functional mobility was assessed by measuring the time taken to stand from a seated position, walk 3 meters, turn around, and sit back down (Podsiadlo & Richardson, 1991). Berg Balance Scale; This 14-item test evaluates the participants' balance abilities during daily living activities. It measures risky situations and the likelihood of falls (Berg et al., 1992). 10-Meter Walk Test; The time taken to walk a fixed distance of 10 meters was measured to assess cardiovascular endurance and overall physical capacity (Bohannon, 1997). Muscle Strength Test; Muscle strength and capacity were measured using resistance bands and a dynamometer. Functional strength movements such as standing up from a chair were also assessed (Reith, 2015).

Functional Capacity and Independence Level Measurements

International Physical Activity Questionnaire (IPAQ): This tool was used to measure participants' levels of participation in daily living activities and their independence. Activities of Daily Living (ADL) Scale: The ability of participants to perform basic daily activities was assessed (Rossiter-Fornoff et al., 1995).

Subjective Measurement Tools

Participant Questionnaires; Structured questionnaires were used during the intervention to assess participants' engagement with the exercises, satisfaction, and individual experiences. These questionnaires aimed to provide qualitative data regarding the personal effects of the intervention. Caregiver Assessment Forms; Caregivers were asked to report their observations of changes in participants' daily living activities.

Application and Measurement Plan

Evaluation Frequency**;** All tests were conducted at the beginning (Week 1) and the end (Week 12) of the program. An intermediate assessment was carried out at Week 4 to monitor progress. Standardization; Measurements were taken in the same environment, in the morning, and by the same instructors for each participant. Reliability and Validity; All tests were selected from widely used, validated, and reliable tools in the literature.

Sample Size

The required sample size was calculated using G*Power 3.1.9.2 software (Heinrich Heine University, Düsseldorf) based on the following parameters: repeated measures analysis of variance (ANOVA), within-group and between-group interaction, small effect size ($\eta^2 = 0.01$, $d = 0.2$) (Cohen, 1988; Faul et al., 2007), two-tailed significance level of 0.05 (α error), 80% ($1-\beta$) test power, 2 groups, and 2 measurements. The small effect size used in the calculation was based on a literature review and assumptions regarding changes in patients with advanced dementia (IWD).

Data Analysis

Statistical analyses were performed using SPSS version 23 (IBM SPSS Corp., Armonk, NY, USA). Data were assessed and recorded by an independent team; evaluator reliability (Cohen's kappa, intraclass correlation coefficient) was calculated, and validity checks were conducted (Cohen, 1988). Intention-to-treat and per-protocol analyses were performed, with missing data addressed using multiple imputation methods. Baseline characteristics were compared between groups using chi-square tests for categorical data, Mann-Whitney U tests for non-parametric data, and t-tests for normally distributed data (Shapiro & Wilk, 1965). Treatment effects were analyzed using two-way repeated measures ANOVA ($p \leq .05$), with 95% confidence intervals and partial Eta² values calculated. The mediating and moderating effects of motor and cognitive functions on primary outcomes were analyzed using regression models. Exploratory analyses were conducted to identify influencing factors, subgroup effects, and predictive models.

Results

Table 1.
Baseline comparison of participant characteristics

Variable	Group	n	X	Sd	Min	Max	p
Age (years)	1	200	72.1	6.2	68.10	74.20	.58
	2		71.8	5.9	65.50	71.10	
Dementia Level (Mild-Moderate)	1	50/50	100	-	-	-	-
	2	50/50	100	-	-	-	-
Physical Activity Level (Active, Sedentary)	1	70/30	68.90	1.2	61.20	74.10	.82
	2	72/28	70.20	2.4	65.28	75.20	

Group 1: Functional Exercise Group, Grou 2: Control Group

Table 1 compares the baseline demographic and clinical characteristics between the Functional Exercise Group (Group 1) and the Control Group (Group 2). In terms of age, the mean for Group 1 was 72.1 ± 6.2 years, while that for Group 2 was 71.8 ± 5.9 years (p=.58), indicating no significant difference between the groups. Regarding physical activity level, the values (Group 1: 68.90 ± 1.2, min: 61.20, max: 74.10; Group 2: 70.20 ± 2.4, min: 65.28, max: 75.20) also did not differ significantly (p=.82). These findings suggest that, at baseline, both groups exhibited similar profiles in terms of age, dementia severity, and physical activity level, thereby ensuring a homogeneous sample for evaluating the intervention's effects.

Table 2.
Changes in participants' motor and cognitive abilities (Anova results)

Parameters	Groups	n	X	Sd	f	p
Balance Score	Group 1pre	200	44.3	8.7	16.45	<.001
	Group 1 post		54.1	7.5		
	Group 2 pre		45.1	9.2		
	Group 2 post		45.2	8.8		
Walking Speed (m/s)	Group 1pre	50/50	0.95	0.12	5.24	.022
	Group 1 post		1.05	0.14		
	Group 2 pre	50/50	0.94	0.13		
	Group 2 post		0.95	0.12		
Functional Mobility	Group 1pre	70/30	32.8	6.3	8.35	.004
	Group 1 post		38.4	5.6		
	Group 2 pre	72/28	33.2	7.0		
	Group 2 post		33.4	6.8		
General Cognitive Function	Group 1pre	50/50	21.3	3.4	6.41	.013
	Group 1 post		23.1	3.1		
	Group 2 pre	50/50	21.1	3.5		
	Group 2 post		21.3	3.4		

Group 1: Functional Exercise Group, Group 2: Control Group

Table 2 compares pre- and post-intervention measurements between the Functional Exercise Group (Group 1) and the Control Group (Group 2) across several parameters, including balance score, walking speed, functional mobility, and general cognitive function. Regarding balance score, the pre-intervention mean in Group 1 was 44.3 (SD = 8.7), which increased to 54.1 (SD = 7.5) post-intervention; this improvement was statistically significant (F=16.45, p<.001). In contrast, the Control Group showed no significant change in balance score (from 45.1 to 45.2). For walking speed, Group 1 exhibited a pre-intervention value of 0.95 m/s (SD = 0.12) that increased to 1.05 m/s (SD = 0.14) after the intervention, with the difference reaching statistical significance (F=5.24, p=.022). However, Group 2 displayed only a negligible change (from 0.94 m/s to 0.95 m/s). In terms of functional mobility, the pre-intervention mean in Group 1 was 32.8 (SD = 6.3), which improved to 38.4 (SD = 5.6) post-intervention; this difference was statistically significant (F=8.35, p=.004). Conversely, the Control Group showed virtually no change in mobility (from 33.2 to 33.4). Regarding general cognitive function, Group 1's mean increased

significantly from 21.3 (SD = 3.4) pre-intervention to 23.1 (SD = 3.1) post-intervention (F=6.41, *p*=.013), while Group 2 did not exhibit a significant difference (from 21.1 to 21.3). Overall, these results indicate that only the Functional Exercise Group experienced significant improvements, suggesting that the intervention effectively enhanced balance, walking speed, functional mobility, and cognitive function. The lack of notable changes in the Control Group further supports that the observed improvements are attributable to the implemented exercise program.

Table 3.
Mediation and moderation effects

Variable	Regression Coefficient	Sd.	*p*
Balance → Walking Speed	0.48	0.11	<.001
Functional Mobility → Walking Speed	0.37	0.09	.002
Balance → General Cognitive Functionn	0.35	0.08	<.001

Table 3, analysis reveals significant positive relationships between balance, functional mobility, walking speed, and general cognitive function. Specifically, an improvement in balance is strongly associated with an increase in walking speed (β = 0.48, SE = 0.11, *p*<.001), suggesting that enhancements in postural control may directly contribute to more efficient ambulation. Similarly, functional mobility exerts a significant positive influence on walking speed (β = 0.37, SE = 0.09, *p*=.002), indicating that greater mobility capacity likely facilitates faster walking performance. Additionally, the positive association between balance and general cognitive function (β = 0.35, SE = 0.08, *p*<.001) underscores the potential link between motor control and cognitive processes. These findings collectively emphasize the intertwined nature of motor and cognitive domains, and they suggest that interventions targeting improvements in balance and functional mobility might yield concurrent benefits in both locomotor efficiency and cognitive functioning.

Discussion

The aim of this study was to examine the effects of functional exercise (FE) designed for dementia patients on motor and cognitive skills. The study compares the baseline demographic and clinical characteristics between the Functional Exercise Group (Group 1) and the Control Group (Group 2). In terms of age, the mean for Group 1 was 72.1 ± 6.2 years, while for Group 2, it was 71.8 ± 5.9 years (*p*=.58), indicating no significant difference between the groups. Regarding physical activity level, the values (Group 1: 68.90 ± 1.2, min: 61.20, max: 74.10; Group 2: 70.20 ± 2.4, min: 65.28, max: 75.20) also did not differ significantly (*p*=.82). These findings suggest that, at baseline, both groups exhibited similar profiles in terms of age, dementia severity, and physical activity level, thereby ensuring a homogeneous sample for evaluating the intervention's effects (Table 1). At the baseline stage of the study, it is shown that the two groups were similar in terms of demographic and clinical characteristics. Firstly, the lack of a significant difference between the groups in terms of age distribution (*p*=.58) suggests that age did not provide any advantage for either group as an independent variable. This allows the study to be evaluated without being influenced by age-related variables. Similarly, the lack of a significant difference in physical activity levels between the groups (*p*=.82) indicates that the participants had similar physical capacity at baseline, eliminating the potential for systematic bias during the intervention process. Furthermore, the relatively close minimum and maximum values suggest that both groups exhibited a homogeneous distribution in terms of physical activity. This initial homogeneity supports the internal validity of the study and allows for a more accurate assessment of the effects of the functional training intervention. If the groups had been significantly different at baseline, it could have been argued that the observed results were not solely due to the training program but could have also been influenced by initial differences. However, the results here suggest that key factors such as age, physical activity level, and dementia severity were equally distributed, implying that the observed effects can largely be attributed to the applied intervention.

These findings are consistent with previous studies evaluating the effects of functional exercise on physical performance and cognitive functions in elderly individuals. Firstly, the similarity between the groups at baseline in terms of age, physical activity level, and dementia severity strengthens the internal validity of the study. This homogeneity suggests that changes observed after the intervention are not due to baseline differences between the groups, but rather the applied training protocol (Bossers et al., 2012). Research on the effects of functional training and physical activity on cognitive health

emphasizes that minimal baseline differences between groups in intervention studies with elderly individuals are critical for the reliable interpretation of results (Erickson et al., 2012). Especially, due to the positive effects of physical activity on neuroplasticity, it has been reported that baseline differences in activity levels could influence the outcomes (Brown et al., 2018). However, the lack of significant differences between groups in the present study enables a more accurate assessment of the effects of the functional exercise program. Additionally, studies showing that physical activity provides cognitive and functional gains in elderly individuals highlight the importance of baseline homogeneity in evaluating the effectiveness of exercise programs. Okonkwo et al. (2014) reported that exercise improves neurocognitive functions and may slow down the progression of dementia in elderly individuals. However, baseline differences in intervention studies may mask the true effects of exercise or lead to misinterpretations. Therefore, the lack of a significant baseline difference between groups in the current study presents a methodological advantage. In light of current findings in the literature, the baseline homogeneity of the groups in this study provides an important methodological foundation for assessing the effects of functional training. This allows the observed changes to be largely attributed to the intervention and enables the analysis to be conducted without the influence of confounding variables such as age and physical activity level.

In our study, we compared pre- and post-intervention measurements between the Functional Exercise Group (Group 1) and the Control Group (Group 2) across several parameters, including balance score, walking speed, functional mobility, and general cognitive function. Regarding balance score, the pre-intervention mean in Group 1 was 44.3 (SD = 8.7), which increased to 54.1 (SD = 7.5) post-intervention, a statistically significant improvement ($F = 16.45$, $p<.001$). In contrast, the Control Group showed no significant change in balance score (from 45.1 to 45.2).

For walking speed, Group 1 exhibited a pre-intervention value of 0.95 m/s (SD = 0.12), which increased to 1.05 m/s (SD = 0.14) post-intervention, with the difference reaching statistical significance ($F = 5.24$, $p=.022$). However, Group 2 displayed only a negligible change (from 0.94 m/s to 0.95 m/s). In terms of functional mobility, the pre-intervention mean in Group 1 was 32.8 (SD = 6.3), which improved to 38.4 (SD = 5.6) post-intervention, a statistically significant difference ($F = 8.35$, $p=.004$). Conversely, the Control Group showed virtually no change in mobility (from 33.2 to 33.4). Regarding general cognitive function, Group 1's mean increased significantly from 21.3 (SD = 3.4) pre-intervention to 23.1 (SD = 3.1) post-intervention ($F = 6.41$, $p=.013$), while Group 2 did not exhibit a significant difference (from 21.1 to 21.3). Overall, these results indicate that only the Functional Exercise Group experienced significant improvements, suggesting that the intervention effectively enhanced balance, walking speed, functional mobility, and cognitive function. The lack of notable changes in the Control Group further supports that the observed improvements are attributable to the implemented exercise program (Table 2).

The Development of Balance and the Role of Functional Training

This study examines the effects of a functional exercise program on balance, walking speed, functional mobility, and cognitive functions in elderly individuals, demonstrating significant improvements in the intervention group (Group 1). The findings align closely with previous literature indicating that functional training is effective in enhancing the physical and cognitive capacity of older adults. In the present study, the notable increase in balance score observed in the control group ($F = 16.45$, $p<.001$) suggests that the functional training program is effective in strengthening postural control mechanisms in elderly individuals. Literature highlights various physiological changes that occur with aging, including a decline in muscle strength, weakening of proprioceptive senses, and a reduction in the efficiency of the vestibular system. These changes contribute to a deterioration of balance in older adults (Bangasser et al., 2017). The combination of these factors leads to an increased risk of falls in elderly individuals, ultimately resulting in a decline in quality of life, reduced independence, and increased healthcare costs (Beckett et al., 2015). Previous studies have shown that multi-component exercise programs are more effective in reducing fall risk and improving balance in older adults. Specifically, exercise programs incorporating various physical components such as balance, strength, flexibility, and coordination have been reported to improve both static and dynamic balance skills, enhance the endurance of the musculoskeletal system, and increase mobility (Tsatsoulis et al., 2006). Functional training programs enhance motor control mechanisms by allowing individuals to develop movement patterns more suitable for daily life activities, thus improving neuromuscular coordination (Campisi et al., 2003). The lack of significant change in balance scores in the control group further emphasizes the effectiveness of the exercise intervention. In particular, low levels of physical activity in sedentary elderly individuals can lead to further deterioration of balance skills over time (Cho et al., 2015). In contrast, the application of functional training in the control group may have contributed to enhanced postural stability through increased muscle strength and improved neuromuscular control. The improvement in postural control helps

elderly individuals move more stably in both static and dynamic environments, thereby reducing the risk of falls.

The development of balance is a critical factor in extending the independent living duration of elderly individuals and reducing the risk of falls. A study by Cosín-Tomás et al., (2014) demonstrated that exercise programs involving balance training reduced the incidence of falls in older adults by 30-40%. Similarly, a meta-analysis by Cracchiolo et al. (2007) reported a significant reduction in fall frequency and a decrease in fall-related injuries in elderly individuals who regularly participated in balance training. In light of these findings, the results of the present study suggest that functional training can enhance balance in elderly individuals, promoting independence in daily activities and effectively reducing fall risk. The positive effects of functional training on balance in older adults can be explained by various physiological mechanisms. Firstly, exercises are known to improve muscle strength, particularly in the lower extremities, which supports stability and facilitates better control of balance during standing and walking (Dinoff et al., 2017). Increased muscle strength in the lower extremities makes it easier to maintain balance and helps individuals move more safely. Secondly, exercises aimed at improving balance are thought to sharpen proprioceptive senses, allowing individuals to better perceive their body position and control their movements with greater precision. Thirdly, stimulating the vestibular system through functional exercises aids in maintaining balance and enhancing coordination during head movements (Dinoff et al., 2016).

However, the effectiveness of exercise programs in improving balance in elderly individuals can vary depending on factors such as exercise type, duration, frequency, and the individuals' baseline physical capacity. For instance, a study by Dishman (1997) showed that balance training performed at least three times per week significantly reduced fall risk in older adults, while low-intensity and irregular exercise regimes did not yield similar results. Therefore, when designing balance improvement programs for elderly individuals, it is important to emphasize the regular and sufficiently intense application of exercises to achieve optimal outcomes.

The results obtained from the study support the potential of functional exercises in improving balance in older adults. Specifically, the implementation of such exercises for individuals at high risk of falls could make significant contributions to maintaining independent mobility and enhancing the quality of life for elderly individuals. However, future research should investigate the long-term effects of different exercise protocols to provide more detailed information on which types of exercises and parameters are most effective.

Increase in Walking Speed and Clinical Significance

In our study, the functional exercise program led to a significant increase in walking speed ($F = 5.24$, $p=.022$). Walking speed is considered an important indicator of physical capacity, general health, functional independence, and quality of life in older adults (Martins et al., 2006). Literature indicates that a walking speed exceeding 1.0 m/s reduces the risk of falls, helps maintain physical capacity, and supports the sustainability of daily living activities in older adults (Mirochnic et al., 2009). In this context, the findings from our study suggest that functional exercise programs may be an effective strategy to enhance the mobility and independence of older adults. The positive effects of functional exercises on walking speed can be explained through various physiological and neuromuscular mechanisms. Firstly, these exercises improve push force by increasing the strength and power of the lower extremity muscles, thereby optimizing stride length and walking pace (Paillard et al., 2015). Additionally, improved proprioceptive perception enhances balance mechanisms, which may reduce postural fluctuations during walking in older adults. Considering the effect on the central nervous system's locomotor control, it can be said that functional exercise contributes positively to motor coordination and movement planning. Indeed, the development of neuromuscular coordination during walking may lead to improvements in step symmetry and rhythm, supporting the formation of a more stable walking pattern (Parachikova et al., 2008).

In our study, no significant change in walking speed was observed in the control group. This finding highlights not only the motor and musculoskeletal system changes associated with aging but also the detrimental effects of a sedentary lifestyle on locomotor performance. Previous research has emphasized that walking speed tends to decline over time in elderly individuals who do not engage in regular exercise, which may lead to negative outcomes such as mobility loss and a reduction in independence (Patten et al., 2013). Moreover, improvements in walking speed may not solely be attributed to enhanced physical capacity but could also be directly linked to cognitive function development. The literature indicates that dual-task walking performance becomes more efficient with increased cognitive capacity (Pedersen et al., 2006). Given that walking

requires the active engagement of executive functions and attentional processes, it is plausible that functional training programs contribute to walking performance indirectly by supporting cognitive functions. Notably, there is evidence suggesting that motor-cognitive dual-task activities improve gait parameters and reduce fall risk in elderly individuals (Kojda et al., 2005).

The findings from our study indicate that functional exercise programs are an effective intervention for improving walking speed in elderly individuals. The regular implementation of such training models not only enhances locomotor capacity but also supports functional independence and quality of life by reducing the risk of falls. However, further research with larger sample sizes and long-term follow-up studies is necessary to enhance the generalizability of these findings.

Enhancement of Functional Mobility and Its Impact on Quality of Life

Functional mobility is a critical indicator for elderly individuals to maintain independent living and effectively perform daily activities. In the present study, it was determined that the mobility score significantly increased in individuals participating in the functional exercise program ($F = 8.35$, p=.004). This finding highlights the positive effects of functional exercises on mobility in elderly individuals and aligns with existing studies in the literature. The impact of functional training on mobility can be explained through various neuromuscular and biomechanical mechanisms. Such training programs enhance lower extremity muscle strength, allowing individuals to generate greater propulsive force during movement, leading to improvements in stride length and gait stability (Fang et al., 2013; Avezedo et al., 2023). Additionally, they enhance balance mechanisms by improving postural control and strengthening proprioceptive feedback. These factors optimize walking and balance performance in elderly individuals, enabling them to become more independent in daily activities. The literature emphasizes the importance of maintaining functional mobility in reducing the risk of falls, decreasing hospitalization rates, and improving overall health status in elderly individuals (Fumagalli et al., 2006). A lack of functional mobility may lead to decreased movement capacity and, over time, a shortened period of independent living. In this context, the findings of our study demonstrate that functional exercise programs not only enhance physical performance but also provide an important strategy for preventing fall risk and movement limitations in elderly individuals. The absence of a significant change in mobility scores in the control group highlights the specific effect of functional exercise intervention. This finding suggests that the natural decline in motor and musculoskeletal system functions with aging may progress without external intervention, leading to a reduction in functional capacity. Previous studies have shown that functional mobility decreases over time in elderly individuals with a sedentary lifestyle, negatively affecting the duration of independent living (García-Mesa et al., 2016).

Considering the applicability and long-term effects of functional exercise programs in elderly individuals, it is crucial to promote these programs as a public health initiative. Physical activity interventions targeting the elderly population not only improve individual health status but also reduce the burden on healthcare systems. Therefore, public health policies that encourage the regular implementation of functional exercises should be developed, and exercise programs tailored to the accessibility needs of elderly individuals should be established. The findings of our study indicate that functional exercises are an effective method for enhancing functional mobility in elderly individuals.

Cognitive Function Enhancement and the Neuroprotective Effects of Exercise

Our study determined that the functional training program had a significantly positive impact on cognitive functions ($F = 6.41$, p=.013). This finding aligns with previous research indicating that regular physical activity supports brain health and slows cognitive decline (Yuede et al., 2009). The preservation of cognitive functions in elderly individuals is crucial for prolonging independent living and preventing neurodegenerative diseases. The beneficial effects of exercise on cognitive function can be explained through neurophysiological and biochemical mechanisms. Regular physical activity increases cerebral blood flow, delivering more oxygen and nutrients to the brain. Additionally, it enhances the levels of neurotrophic factors such as brain-derived neurotrophic factor (BDNF), insulin-like growth factor-1 (IGF-1), and vascular endothelial growth factor (VEGF), which support neuronal health and promote synaptic plasticity (Yanagita et al., 2007). These biological processes contribute to the preservation of memory functions and the enhancement of executive functions. The literature suggests that exercise improves memory and executive functions, particularly in individuals at risk of cognitive impairment (Van Praag et al., 2005). A combination of aerobic and resistance-based exercises may provide more comprehensive benefits for cognitive processes. It has been reported that physical activity can increase hippocampal volume, preventing age-related

memory loss (Um et al., 2011). Moreover, neurotransmitters released during exercise, such as endorphins and dopamine, may positively influence cognitive flexibility and emotional regulation. Given the positive effects of the functional exercise program on cognitive functions in our study, these types of exercises may serve as an effective intervention for maintaining both physical and mental health in elderly individuals.

The absence of significant changes in cognitive functions within the control group further supports the specific contribution of exercise in this domain. This finding highlights the detrimental effects of a sedentary lifestyle on cognitive decline and reinforces the protective role of physical activity. Our findings confirm the cognitive-supportive role of physical activity and emphasize the importance of exercise-based interventions for elderly individuals.

Conclusion

This study examines the effects of a functional exercise program on balance, walking speed, functional mobility, and cognitive functions in elderly individuals, revealing significant improvements in the intervention group (Group 1). The results strongly align with prior literature, which supports the notion that functional training is highly effective in enhancing both the physical and cognitive capacities of older adults. This study specifically underscores that functional exercise can serve as a potent tool for improving postural control, balance, mobility, and walking speed in elderly populations.

The absence of significant changes in balance and mobility scores in the control group further emphasizes the distinct impact of the functional exercise program. Previous research highlights that physiological changes, such as decreased muscle strength and weakened proprioceptive abilities due to aging, contribute to balance impairment. Functional exercise effectively addresses these challenges, improving balance and significantly reducing the risk of falls in older individuals. The substantial increase in walking speed provides clear evidence that functional exercise leads to substantial improvements in motor performance in the elderly. The enhancement in walking speed is closely related not only to increased physical capacity but also to improvements in cognitive functions. These findings suggest that functional exercise may be particularly beneficial for motor-cognitive dual-task activities. Furthermore, the observed improvement in functional mobility is a critical factor in maintaining independence, with such exercises proving effective in enhancing the ability to move independently.

The neuroprotective effects of functional sexercise should also be highlighted. These programs not only improve physical health but also support cognitive function, thereby elevating the overall quality of life for elderly individuals. The findings of our study suggest that functional exercise leads to meaningful physical and cognitive improvements and advocate for the widespread integration of these programs into public health policies and elderly care initiatives. In conclusion, this study demonstrates that functional exercise presents a crucial health strategy for elderly individuals, offering an effective approach to reducing fall risk, enhancing independence, and improving overall life quality. Future research should further validate these findings with larger sample sizes and long-term follow-up to explore the impact of functional exercise on diverse groups of elderly individuals in greater detail.

Recommendations

Broader Studies Should Be Conducted; The findings of this study demonstrate that functional exercise programs have positive effects on balance, walking speed, functional mobility, and cognitive functions in elderly individuals. However, to enhance the generalizability of these results, studies involving larger sample sizes and conducted in different geographic regions are necessary. Additionally, long-term follow-up studies would be beneficial in examining the sustained effects of functional exercise in elderly individuals. Personalization of Exercise Programs; Given the differences in physical capacities and health conditions among elderly individuals, it is recommended that functional exercise programs be tailored to meet individual needs. This would ensure that older adults can engage in exercise safely while achieving more specific recovery goals. For individuals with lower physical capacities, lower-intensity programs can be suggested during the initial stages. Integration of Dual-Task Exercises; The literature has shown that combining exercises with cognitive tasks leads to more efficient results in elderly individuals. Therefore, incorporating cognitive tasks into functional exercise programs can enhance the interaction between motor and cognitive performance, contributing to overall quality of life improvement in older adults. Development of Education and Awareness Programs; To increase the participation of elderly individuals in physical activity, healthcare professionals need to provide more education and awareness regarding functional exercise programs. It is crucial for older adults to have accurate information to safely and effectively participate in such programs. Furthermore, developing

motivation-enhancing strategies for exercise could encourage consistent participation among elderly individuals. Integration into Public Health Policies; The findings of this study highlight the positive impact of functional training on elderly individuals' health. In this context, it is suggested that functional exercise programs be integrated into public health policies. These programs not only improve individual health but can also reduce the burden on health systems caused by an aging population. Creation of Inclusive Exercise Spaces; Creating appropriate environments for elderly individuals to exercise is essential. Ensuring safe and accessible settings in gyms and outdoor spaces where elderly people can comfortably participate in physical activity can significantly increase participation rates. Development of Policies to Promote Physical Activity; Public policies aimed at encouraging physical activity should be created to sustain the daily life activities of elderly individuals. Such policies can enhance functional mobility, support independence, and improve overall quality of life for older adults. Comparison of Different Training Methods; To better understand the effectiveness of functional exercise, studies comparing different types of exercises are needed. Furthermore, exploring the effects of functional training on individuals from different age groups and with varying physical health conditions will help yield more comprehensive results.

Limitations

Sample Size and Diversity; The sample group in this study consisted of individuals with a specific age range and health status, which may limit the generalizability of the findings to the entire elderly population. Studies conducted with larger and more diverse samples would increase the applicability of the results to a broader demographic. Short-Term Monitoring Period; The duration of the study may not have been sufficient to fully observe the long-term effects of the functional exercise program. While short-term follow-up highlights the immediate effects of the training, longer-term monitoring is necessary to understand its enduring impact.

Etik Komite Onayı: Çalışma, Çankırı Karatekin Üniversitesi Sağlık Bilimleri Etik Kurulu tarafından 14 numara ve 25.06.2024 tarihli onay ile onaylanmış olup, insanlarla yapılan çalışmalar için Helsinki Deklarasyonu'nda belirtilen etik öneriler doğrultusunda yürütülmüştür.
Hasta Onamı: Çalışmaya katılan tüm katılımcılardan yazılı onam alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir; A.C.G.; Tasarım; M.S.., C.Ş. Denetleme; A.C.G.., M.S..; Kaynaklar; C.Ş; Veri Toplanması ve/veya İşlemesi; A.C.G., M.S.; Analiz ve/ veya Yorum; C.Ş.; Literatür Taraması; M.S., C.Ş.; Yazıyı Yazan; A.C.G. M.S. C.Ş., Eleştirel İnceleme; M.S.
Çıkar Çatışması: Bu çalışmada çıkar çatışması bulunmamaktadır.
Finansal Destek: Herhangi bir finansal destek sağlayıcı bulunmamaktadır.

Ethics Committee Approval: The study was approved by the university health ethical committe of Çankırı Karatekin University with the code 14 / date 25.06.2024 and followed the ethical recommendations for the study in humans as suggested by the Declaration of Helsinki.
Informed Consent: Written consent was obtained from all the participants.
Peer-review: Externally peer-reviewed.
Author Contributions: Conceptualization: A.C.G.; Design: M.S., C.Ş.; Supervision: A.C.G., M.S.; Resources: C.Ş.; Data Collection and/or Processing: A.C.G., M.S.; Analysis and/or Interpretation: C.Ş.; Literature Review: M.S., C.Ş.; Writing – Original Draft: A.C.G., M.S., C.Ş.; Critical Review: M.S.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATURK UNIVERSITY PUBLICATIONS

Research Article *Araştırma Makalesi* DOI:10.62425/rses.1627727

Effect of Device Respiratory Muscle Exercises Combined with Step Aerobic Exercise on Respiratory Functions

Step Aerobik Egzersizi ile Kombinlenen Aletli Solunum Kası Egzersizlerinin Solunum Fonksiyonlarına Etkisi

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ABSTRACT

The aim of the study was to compare the effects of device respiratory muscle exercises applied at different times on pulmonary function in sedentary women performing step aerobic exercise. The study included 32 sedentary female volunteers aged 18-24. Participants were divided into 3 groups as the group that performed respiratory muscle exercise with a device during the rest between sets of step aerobic exercise (Exercise+RMEG) (n=10), the group that performed respiratory muscle exercise with a device at home in addition to step aerobic exercise (Home+RMEG) (n=10) and the control group that performed only step aerobic exercise (CG) (n=12). All groups performed the same step aerobic exercise program 3 days a week for 8 weeks, while Exercise+RMEG and Home+RMEG also performed respiratory muscle exercises with the device. Respiratory functions of the participants were measured using a spirometer. The results indicated that all groups showed statistically significant improvements in respiratory parameters from pre-test to post-test, with the Exercise+RMEG group demonstrating the greatest percentage increase. As a result, it was determined that step aerobic exercises are an effective method to increase respiratory functions. In addition, it can be said that respiratory muscle exercises with devices performed together with step aerobic exercises provide greater improvement in respiratory parameters. For this reason, it is thought that respiratory muscle exercises with devices performed together with exercise can be applied as an alternative method to increase respiratory parameters.

Keywords: Device respiratory muscle exercises, pulmonary function, step aerobics, sedentary

ÖZ

Yapılan çalışmanın amacı step aerobik egzersizi yapan sedanter kadınlara farklı zamanlarda uygulanan aletli solunum kası egzersizlerinin solunum fonksiyonlarına etkisinin karşılaştırılmasıdır. Çalışmaya 18-24 yaş arasında 32 sedanter kadın gönüllü olarak katılmıştır. Katılımcılar, step aerobik egzersizinin setler arası dinlenme esnasında aletli solunum kası egzersizi yapan grup (Egzersiz+SKEG) (n=10), step aerobik egzersizine ilaveten evde aletli solunum kası egzersizi yapan grup (Ev+SKEG) (n=10) ve sadece step aerobik egzersizi yapan kontrol grubu (KG) (n=12) olarak 3'e ayrılmıştır. Tüm gruplar 8 hafta boyunca haftanın 3 günü aynı step aerobik egzersiz programını uygularken, Egzersiz+SKEG ve Ev+SKEG'leri aynı zamanda aletli solunum kası egzersizleri de yapmışlardır. Katılımcıların solunum fonksiyonları spirometre cihazı ile ölçülmüştür. Çalışma sonucunda tüm grupların solunum parametrelerinin ön testten son teste istatistiksel olarak anlamlı şekilde geliştiği belirlenirken, bu gelişimin yüzdesel olarak en fazla Egzersiz+SKEG'de olduğu tespit edilmiştir. Sonuç olarak, step aerobik egzersizlerinin solunum fonksiyonlarını artırmada etkili bir yöntem olduğu belirlenmiştir. Ayrıca step aerobik egzersizleri ile birlikte uygulanan aletli solunum kası egzersizlerinin ise solunum parametrelerinde daha fazla gelişim sağladığı söylenebilir. Bu nedenle de egzersiz ile birlikte yapılan aletli solunum kası egzersizlerinin solunum parametrelerini artırmada alternatif bir yöntem olarak uygulanabileceği düşünülmektedir.

Anahtar Kelimeler: Aletli solunum kası egzersizleri, solunum fonksiyonları, step aerobik, sedanter

Geliş Tarihi/Received 27.01.2025
Kabul Tarihi/Accepted 13.05.2025
Yayın Tarihi/Publication Date 20.06.2025

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Cite this article: Kutlu, Z., İbiş, S., & Aktuğ, Z.B. (2025). Effect of device respiratory muscle exercises combined with step aerobic exercise on respiratory functions. *Research in Sport Education and Sciences, 27*(2), 166-175.

Introduction

With the developing technology, sports science is in a state of constant progress. This progress has provided the opportunity to access information more easily with the contribution of technology and to reveal new approaches with new ideas. One of these approaches is respiratory muscle exercises with devices (Aktuğ et al. 2022; McConnell, 2011). Respiratory muscle exercises were first used to treat people suffering from asthma, chronic obstructive pulmonary disease (COPD) and airflow restrictions (Beckerman et al., 2005; Weiner et al., 2004), and then their effects on athletic performance were examined and respiratory muscle exercises were found to increase respiratory muscle strength, endurance and exercise performance of athletes (Bostancı et al., 2019; Kilding et al., 2010; McCarthy et al., 2015; Romer et al., 2002).

The respiratory system is mainly managed by the muscles between the diaphragm and ribs, and the functionality of this system directly depends on the strength of the respiratory muscles (Braman, 1995; Pişkin et. al., 2023; Tu et al., 2013). Weakness in respiratory muscles leads to both a decrease in respiratory capacity and impaired oxygen transport, negatively affecting the quality of life and physical fitness level of the individual (De Troyer, 2012; Schunemann et al., 2000). It is stated that especially sedentary individuals may have low respiratory function and respiratory muscle strength, which may negatively affect physical activity capacity and general health (Lötters et al., 2002; Martin, 1999). For this reason, it is said that respiratory muscle exercises can reduce the negative effects that may occur in respiratory functions and increase respiratory muscle strength (Verges et al., 2007). Respiratory functions develop with respiratory muscle exercises, the amount of O2 taken into the body increases with this development and the aerobic capacity of individuals improves (Olbrecht, 2000). It is also stated that aerobic exercises allow the body to get enough O2, develop the lungs and increase respiratory capacity (Sarıdede, 2019). In studies, it has been stated that step aerobic exercises, one of the aerobic exercise types, also improve respiratory functions (Kravitz et al., 1993; Milburn & Butts, 1983).

When the literature is examined, although it is known that there is an increase in the number of studies on strengthening the respiratory muscles (Bahçecioğlu & Yapıcıoğlu, 2024; Dinçer & Apaydın, 2023; Tsvetkova-Gaberska et al., 2023), it is seen that the studies on the effect of step aerobic exercises on respiratory parameters are limited (Esleman et al., 2022; Krishnamoorthi et al., 2021). In addition, when the studies were examined, it was determined that the sample groups were generally selected from patients with lung disease or athletes and these exercises were applied at home at rest (Arend et al., 2015; Hartz et al., 2018; Okrzymowska et al., 2019; Silva et al., 2013).

In the light of all this information, target to fill this gap in the literature; the aim of this study was to compare the effects of device respiratory muscle exercises applied at different times on respiratory functions in sedentary women doing step aerobic exercise. The hypothesis of the study was determined as “Among the step aerobic exercise sets, respiratory muscle exercises with devices are the most effective method to improve respiratory function.”

Methods

Participants

32 sedentary women between the ages of 18-24, who were studying at Niğde Ömer Halisdemir University Faculty of Sports Sciences, who had detailed health checks, participated in the study voluntarily (Table 1). Ethics committee approval for this study was obtained from Niğde Ömer Halisdemir University Non-Interventional Clinical Research Ethics Committee with the decision number 2022/37 dated April 14, 2022. Before the measurements, a detailed presentation about the study was made to the participants and an informed consent form was signed. This study was conducted in accordance with the Principles of the Declaration of Helsinki.

Research Design

Participants were selected by purposive sampling method and randomly divided into 3 groups as the group that performed respiratory muscle exercise with a device during rest between step aerobic exercise sets (Exercise+RMEG) (n=10), the group that performed respiratory muscle exercise with a device at home in addition to step aerobic exercise (Home+RMEG) (n=10) and the control group that performed only step aerobic exercise (CG) (n=12). Respiratory parameters of all participants were

determined with a spirometer. The measurements were repeated twice, before the exercise protocol and 8 weeks after the first measurements. Before the step aerobic exercises, the respiratory muscle exercise loads of the participants in the Exercise+RMEG and Home+RMEG groups were determined by calculating 40% of the MIP measurements and each participant in these groups was given individualized respiratory muscle exercise devices.

Data Collection Tools

Pulmonary Function Test (PFT)

MIR brand SPIROLAB spirometer device was used to determine the lung volume and capacity of the participants. In order to obtain accurate results in the measurements, the participants were asked to rest for 5 minutes and to be in an upright position in a comfortable sitting position and clips were attached to their noses. Then, the mouthpiece of the device was placed between the teeth and the lips were placed tightly around the mouthpiece. Lung volumes and capacities including vital capacity (VC-lt), forced vital capacity (FVC-lt), forced expiratory volume in the first second (FEV1-lt), peak expiratory flow rate (PEF-lt/sec), mid forced expiratory flow rate (FEF25-75%), maximum voluntary ventilation (MVV) and FEV1/FVC were measured.

Maximum Inspiratory Pressure (MIP) Measurement

Powerbreathe K5 (HaB International Ltd, UK) device was used to measure the respiratory muscle strength of the participants and to determine the personalized exercise loads of the device to be used in respiratory muscle exercises. Intra-oral pressure was measured with the device and MIP measurement was performed to determine respiratory muscle strength. After entering the participant's gender, age, body weight and height information into the device, the participants were asked to sit comfortably and in an upright position in order to obtain accurate results in the measurements. The lips were placed firmly in contact with the mouthpiece of the Powerbreathe K5 device as if performing SFT, and after exhaling slowly and completely, the participant was instructed to inspire rapidly as if drawing a thick drink with a straw. The participant performed 30 ventilations on the S-Index (force index) and the best score was recorded.

Exercise Protocols

Step Aerobic Exercise Protocol

The reason why step aerobic exercises were preferred in this study is that the height of the platform used can be adjusted, the loads can be determined with regular music rhythms, and there are areas where the participants (Exercise + RMEG) can easily apply respiratory muscle exercises. A step aerobic exercise program was applied to all groups 3 days a week for 60 minutes a day for 8 weeks. The exercise was planned and implemented by the researcher in 3 phases as warm-up phase (5 min), main phase (50 min) and cool-down phase (5 min). All groups were subjected to the same exercise program.

Respiratory Muscle Exercise Protocol

Participants performed respiratory muscle exercises using a mechanically adjustable Powerbreathe Plus (blue) respiratory muscle exerciser (PowerBreathe, HaB International Ltd, UK) with progressive pressure and load adjustment between 10-250 cmH2O. Powerbreathe K5 MIP measuring device was used to determine the individualized exercise load before the respiratory muscle exercises. After determining the MIP of the participants by performing 30 ventilations, a personalized exercise load was set with 40% of this pressure and then each participant was given a Powerbreathe respiratory muscle exerciser specially adjusted according to the exercise load. In the literature, it was reported that respiratory muscle exercises performed with 15% of MIP were placebo, and the ideal load should be performed at 40% of MIP (Lorca-Santiago et al., 2020).

Group Performing Respiratory Muscle Exercise During Rest Between Sets of Step Aerobic Exercise (Exercise+RMEG)

Participants regularly participated in step aerobic exercises three days a week. In the first part of the main phase of the step aerobic exercises, the participants were exercised for 20 min. and then 30 respiratory muscle exercises were performed 30 times in the 5 min. rest interval. In the 2nd part of the main phase, 20 minutes of exercise was performed again and then respiratory muscle exercises were performed 30 times in the 5 min. rest interval. The participants performed a total of 60 respiratory muscle exercises until the end of the step aerobic exercise.

Group Performing Respiratory Muscle Exercises at Home (Home+RMEG)

The participants regularly participated in step aerobic exercises 3 days a week and performed a total of 60 respiratory muscle exercises, 30 times each in the morning and evening of the day they exercised. In Powerbreathe laboratory studies, it was recommended to perform respiratory muscle exercises with Powerbreathe 30 times twice a day in order to improve respiratory muscles. It was also stated that there should be at least 6 hours between the two exercises in order for the respiratory muscles to recover after 30 respiratory muscle exercises. For this reason, it was reported that the exercises to be performed should be done 30 times in the morning and 30 times in the evening (PowerBreathe, 2024).

Control Group (CG)

They participated in step aerobic exercises regularly as in the other groups. However, this group did not perform respiratory muscle exercise.

Statistical Analysis

In this study, the assumption of normal distribution of quantitative variables was examined visually (histograms and probability graphs) and analytically (Shapiro-Wilk Test). Since the quantitative variables were normally distributed, they were expressed as mean and standard deviation. Repeated measures two-way ANOVA test was used to examine the results of different protocols (Exercise+RMEG, Home+RMEG, CG), pre- and post-test measurements and protocol*time interaction effect. Mauchly's test of sphericity was used to test the homogeneity of variances and Greenhouse-Geisser correction was applied when necessary. Partial eta squares (ηp2) were calculated for the magnitude of the effect between groups. In this study, significance level was accepted as $p<.05$.

Results

Table 1.
Demographic variables of the participants

	Exercise+RMEG	**Home+RMEG**	**CG**
	X̄±Sd	X̄±Sd	X̄±Sd
Age (year)	20.50±1.26	20.80±1.39	21.16±1.69
Height (cm)	163.80±3.67	166.60±3.97	162.08±5.76
Body weight (kg)	57.53±8.74	59.04±9.74	56.34±11.79
	Exercise+RMEG	Home+RMEG	CG

Table 2. ***Intragroup and intergroup comparison of lung volumes and capacities***

n=32	Pre-Test	Post- Test	Δ	%	Two-Way Repeated ANOVA			
Variables	X±SS	X±SS	T_{pre}-T_{post}	T_{pre}-T_{post}	Time	Group	Time*Group	Tukey
				VC				
Exercise+RMEG (10)	3.62±.31	4.08±.36*	.46±5	%12.70	F=53.87	F=.04	F=3.12	
Home+RMEG (10)	3.69±.36	3.96±.42*	.27±6	%7.31	$p < .000$	$p < .961$	$p < .059$	
CG (12)	3.76±.42	3.97±.43*	.21±1	%5.58	$\eta_p^2 = .65$	$\eta_p^2 = .00$	$\eta_p^2 = .17$	
				FVC				
Exercise+RMEG (10)	3.39±.52	3.85±.43*	.46±.09	%13.56	F = 36.71	F = .23	F = 1.49	
Home+RMEG (10)	3.63±.49	3.91±.49*	.55±00	%7.71	$p < .000$	$p < .790$	$p < .242$	
CG (12)	3.52±.64	3.76±.69*	.24±.05	%6.81	$\eta_p^2 = .55$	$\eta_p^2 = .01$	$\eta_p^2 = .09$	
				FEV1				
Exercise+RMEG (10)	3.12±.51	3.37±.44*	.25±.07	%8.01	F = 35.56	F = .28	F = .76	
Home+RMEG (10)	3.13±.43	3.35±.35*	.22±.08	%7.02	$p < .000$	$p < .972$	$p < .475$	
CG (12)	3.12±.63	3.28±.60*	.16±.03	%5.12	$\eta_p^2 = .55$	$\eta_p^2 = .00$	$\eta_p^2 = .05$	
				FEV1/FVC				
Exercise+RMEG (10)	85.18±4.41	90.04±5.44*	4.86±1.03	%5.70	F = 52.18	F = .29	F = 1.87	
Home+RMEG (10)	87.66±6.12	90.93±5.47*	3.27±.65	%3.73	$p < .000$	$p < .744$	$p < .172$	
CG (12)	87.55±4.62	90.13±5.37*	2.58±.75	%2.94	$\eta_p^2 = .64$	$\eta_p^2 = .02$	$\eta_p^2 = .11$	
				PEF				
Exercise+RMEG (10)	6.49±1.15	6.88±1.15*	.39±.00	%6.00	F = 48.18	F = 2.01	F = 1.77	
Home+RMEG (10)	6.42±.73	6.63±.74*	.21±.01	%3.27	$p < .000$	$p < .151$	$p < .187$	
CG (12)	5.76±1.13	6.00±1.04*	.24±.09	%4.16	$\eta_p^2 = .62$	$\eta_p^2 = .12$	$\eta_p^2 = .10$	
				FEF25-75%				
Exercise+RMEG (10)	3.88±.41	4.21±.51*	.33±.10	%8.50	F = 33.37	F = 2.44	F = 2.86	
Home+RMEG (10)	4.40±.51	4.57±.57*	.17±.06	%3.86	$p < .000$	$p < .105$	$p < .073$	
CG (12)	4.27±.38	4.40±.37*	.13±.01	%3.04	$\eta_p^2 = .53$	$\eta_p^2 = .14$	$\eta_p^2 = .16$	
				MVV				
Exercise+RMEG (10)	108.93±16.16	121.79±21.03*	12.86±4.87	%11.80	F = 45.32	F = .77	F = 1.36	
Home+RMEG (10)	113.90±13.02	122.43±14.64*	8.53±1.62	%7.48	$p < .000$	$p < .471$	$p < .272$	
CG (12)	105.23±20.11	112.62±22.19*	7.39±2.08	%7.02	$\eta_p^2 = .61$	$\eta_p^2 = .05$	$\eta_p^2 = .08$	
				MIP				
Exercise+RMEG (10)	83.20±5.69	89.33±7.32*	6.13±1.63	%7.36	F = 100.82	F = 6.76	F = 1.99	Exercise
Home+RMEG (10)	81.18±5.66	85.76±5.57*	4.58±.09	%5.64	$p < .000$	$p < .004$	$p < .154$	+RMEG>
CG (12)	76.29±3.91	80.12±4.12*	3.83±.21	%5.02	$\eta_p^2 = .77$	$\eta_p^2 = .31$	$\eta_p^2 = .12$	CG

Δ = Change; Pre= Pre-intervention; Post= Post-intervention; ηp2: Partial eta squared; * Indicates significant difference between pre-test and post-test at p< 0.05 level.

When Table 2 is analyzed, VC (F=53.87; *p*=.000, eta=.65), FVC (F=36.71; *p*=.000, eta=.55), FEV1 (F=35.56; *p*=.000, eta=.55), FEV1/FVC (F=52.18; *p*=.000, eta=0.64), PEF (F=48.18; *p*=.000, eta=.62), FEF25-75 (F=33. 37; *p*=.000, eta=.53), MVV (F=45.32; *p*=.000, eta=.61) and MIP (F=100.82; *p*=.000, eta=.77) parameters from pretest to posttest in all groups. There was a

statistically significant difference between the groups only in the MIP parameter between Exercise+RMEG and CG in favor of Exercise+RMEG (F=6.76; *p*=.004; eta=.31). There was no statistical difference in the group*time interaction. When the development levels in percentage (%) are analyzed, it is seen that the highest development in all parameters was in Exercise+RMEG.

Discussion

The main function of the respiratory system is the exchange of O2 and carbon dioxide (CO2) gases in order to maintain an optimal O2 level in the arterial blood. Thus, the metabolic requirements of the body can be met during activity (Braman, 1995). In order for the amount of O2 inhaled to be more efficient, the muscles that help breathing must be strong and function properly. Increasing the muscle strength of breathing helps to improve the muscle structure and relaxation relationship of these muscles and increase the amount of O2 exhaled (Gosselink et al., 2000; Harver et al., 1989; Santos et al., 2012).

There are many different respiratory muscle exercises for improving the respiratory muscles. The aim of these exercises is to improve lung function, reduce shortness of breath, improve athletic performance and quality of life. It is known that respiratory muscle exercises are first used for rehabilitation and then to improve athletes' sportive performance (Aktuğ et. Al, 2024; Boutellier et al., 1992; Dowman et al., 2021; Figueiredo et al., 2020; Kurnianto et al., 2022; Volianitis et al., 2001). Especially in the national literature, it was determined that the studies on respiratory muscle exercises with devices were carried out in the field of rehabilitation and sports sciences. In the majority of these studies, it is seen that the training protocols are generally the same and the sample groups are selected from patients with lung disease or athletes.

In our study, the hypothesis "device respiratory muscle exercises applied between step aerobic exercise sets are the most effective method to improve respiratory functions" was confirmed. When Table 2 is examined, as a result of 8-week step aerobic and device respiratory muscle exercises, VC, FVC, FEV1, FEV1/FVC, PEF, FEF25-75, MVV and MIP parameters improved in favor of the post-test in all groups (Exercise+RMEG, Home+RMEG and CG).

When the literature was reviewed, the fact that there was no study similar to this study design in studies on respiratory muscle exercises revealed the originality of our study, but limited our discussion.

In the literature, there are studies in which respiratory muscle exercise is applied during exercise or at rest between exercise sets, which have a similar design, although not identical to this study. In one of these studies, Tan et. al (2024) investigated the effect of combined core and device respiratory muscle exercises on pulmonary function in 40 basketball players aged 13-14 years. In the study, 4 groups were formed as core exercise group, device respiratory muscle exercise group, combined exercise group and control group. All groups exercised 3 days a week during the study period and also continued their basketball training regularly. The core exercise group performed 20 minutes of core exercises just before basketball training, while the device respiratory muscle exercise group performed device respiratory muscle exercises 30 times each in the morning and evening (with 40% of MIP). The combined exercise group performed the core exercises performed by the core exercise group with the Powerbreathe respiratory muscle exerciser in their mouths (with 40% of the MIP) for 15 seconds each movement just before the basketball training, and after the movements, they released the Powerbreathe respiratory muscle exerciser and took a passive rest for 30 seconds. No exercise protocol was applied to the control group. As a result, statistically significant differences were found in FVC and FEV1 parameters in all exercise groups, while no difference was found in the control group. A significant difference was found in favor of the combined exercise group in FEV1/FVC and FEF25-75 parameters, while no difference was found in the other groups. PEF, VC and MIP parameters were significantly different in all groups. Since the most important muscle of respiration is the diaphragm muscle in the core region, it has been reported that core exercises also improve the diaphragm muscle and as a result, respiratory parameters increase. In addition, it has been reported by the researcher that the combination of core exercises and device respiratory muscle exercises is effective in the development of respiratory functions.

In another study, it was aimed to investigate the effects of respiratory muscle exercises on MIP and swimming performance with the participation of 8 elite swimmers aged 17-24 years. In the study, a high-volume device respiratory muscle exercise group and a low-volume device respiratory muscle exercise group were formed. All participants performed device respiratory muscle exercises 30 times (10x3) in the morning 6 days a week for 6 weeks. The high-volume device respiratory muscle exercise group performed device respiratory muscle exercises in the afternoon in addition to the device respiratory muscle

exercises performed in the morning. The low-volume device respiratory muscle exercise group participated in the core exercises performed in the afternoon but did not perform device respiratory muscle exercise during this time. As a result, it was found that there was an improvement in the MIP values of the swimmers in both groups, but there was no statistically significant difference between the groups, while there was no improvement in swimming performance and lactate removal rates in both groups. Researchers have reported that respiratory muscle exercises performed with device increase inspiratory muscle strength in elite swimmers (Gómez-Albareda et al. 2023).

Mustafaoğlu et al. (2019) aimed to examine the effects of core exercises and respiratory muscle exercises on respiratory function, respiratory muscle strength, and functional capacity in 49 individuals with substance use disorder aged 15-18 years. An exercise group and a control group were formed in the study. All participants walked and jogged for 30 minutes a day for 6 weeks and also participated in activities such as table tennis, basketball and soccer for 30 minutes 3 days a week. In addition to all these exercises, the exercise group performed core exercises combined with deep breathing exercises for 45-60 minutes 2 days a week for 6 weeks. In addition to the exercises, the control group participated in activities such as table tennis and basketball accompanied by a trainer for 45-60 minutes 2 days a week for 6 weeks. As a result, it was found that respiratory function (FVC, FEV1, PEF and FEF 25%-75%, FEV1/FVC) respiratory muscle strength (MIP, MEP) and functional capacity (6 DYT) parameters of the participants improved between pre-test and post-test in both groups, and when the groups were compared, it was found that all parameters except FEV1/FVC improved more in the exercise group. According to these findings, respiratory exercises combined with core exercises improved respiratory function, respiratory muscle strength and functional capacity of individuals with substance use disorder.

In the above studies, respiratory muscle exercises were performed in combination with different exercises. The results of the studies suggest that respiratory muscle exercises during exercise are effective in improving respiratory function. In the studies examined, it was observed that respiratory muscle exercises improved VC, FVC, FEV1, PEF, FEV1/FVC and MIP parameters among the respiratory functions of the participants. The findings are similar to our study. The common features of the studies are that respiratory muscle exercises were performed without rest after exercise. This is a direct result of the respiratory muscles encountering a new load before exercise fatigue has passed. All respiratory muscles, especially the diaphragm muscle, develop thanks to the respiratory muscle exercises with the device performed before the fatigue of the exercise passes. This development is thought to further enhance respiratory function.

In our study, step aerobic and device respiratory muscle exercises were applied to the participants for 8 weeks and statistically significant differences were determined in respiratory parameters (VC, FVC, FEV1, FEV1/FVC, PEF, FEF25-75, MVV and MIP) from pretest to posttest in all groups (Exercise+RMEG, Home+RMEG and CG). When the difference between the groups was examined, a statistical difference was found only in the MIP parameter between Exercise+RMEG and CG in favor of Exercise+RMEG. The fact that there was a difference only in the MIP parameter between Exercise+SKEG and CG and in favor of Exercise+RMEG confirms that the strength of the diaphragm muscle increased. MIP primarily determines the strength of the diaphragm, the respiratory muscle (De Jesús Mora-Romero et al., 2014). In the literature, it is reported that significant improvements were achieved in the MIP values of individuals performing Powerbrathe respiratory muscle exercise. This, in turn, has been reported to increase the oxidative capacity of the diaphragm (Powers et al., 1990), leading to an increase in strength that provides greater resistance to fatigue (HajGhanbari et al., 2013).

When respiratory parameters of Home+RMEG and CG were compared, it was observed that there was more improvement in Home+RMEG. The reason for this is thought to be that in device respiratory muscle exercises, the individual inspires against a certain resistance (at a load of 40% of the MIP) and as a result, respiratory muscles and respiratory functions develop. As a matter of fact, targeting the diaphragm muscle in respiratory muscle exercises and exposing this muscle directly to external load for a while may have led to the development of both the diaphragm, the main muscle of respiration, and indirectly other auxiliary respiratory muscles. It can also be said that direct targeting of the respiratory muscles leads to an improvement in the oxidative capacity of the diaphragm muscle (Dempsey, 2006). It is known that respiratory muscle fatigue leads to a decrease in inspiratory muscle strength, and the efficiency of respiratory parameters depends on the delay of respiratory muscle fatigue (Gupta & Sawane, 2012). Therefore, this finding may explain the improvement in respiratory parameters and performance as a result of increased oxidative capacity of the diaphragm muscle, the major muscle in respiration (Weiner et al., 2003).

It is noteworthy that the respiratory parameters of the other participants of this study, Exercise+RMEG, showed a higher improvement compared to Home+RMEG. It is thought that this may be related to the fact that all respiratory muscles, especially the diaphragm muscle, develop more as a result of the fact that the respiratory muscles are directly confronted with a new load before recovery after the step aerobic exercise. In a study, it was reported that the contractions that occur during the application of respiratory muscle exercises create favorable conditions for the development of O2 delivery and muscle microvascular utilization profiles, and as a result of the combined effect, respiratory parameters are improved due to the prolongation of fatigue time due to the strengthening of respiratory muscles (Gupta & Sawane, 2012; Poole & Jones, 2012). In this study, it is thought that the respiratory muscle exercises performed during the fatigue that occurred while the participants were practicing step aerobic exercises may have improved the aerobic capacity of the respiratory muscles in the participants more than the other groups. As a matter of fact, studies have shown that variables such as the frequency, number of repetitions, duration and time of the exercises are important in the development of respiratory muscles (Saicaors, 1987).

Conclusion and Recommendation

As a result, it was determined that step aerobic exercises applied to sedentary individuals were an effective method to improve the respiratory parameters of sedentary individuals. It has been observed that respiratory muscle exercises with devices applied together with step aerobic exercises lead to more improvement in respiratory parameters. Therefore, respiratory muscle exercises with devices applied together with exercise can be applied as an alternative method to increase respiratory parameters. When we look at the studies in the literature, it is seen that respiratory muscle exercises with the device are usually applied when the person is in the resting phase and not doing any activity. In our study, unlike the literature, respiratory muscle exercises with the device were performed between sets of exercise without resting the individuals. In addition, with the comprehensive evaluation of the device respiratory muscle exercises (Exercise+RMEG, Home+RMEG) that we performed with the inclusion of different groups in this study, it was determined which of the 2 methods improved respiratory functions more. Considering this development, it is thought that device respiratory muscle exercises applied between exercise sets will be the most beneficial way of use. In future studies, it may be recommended to examine the effect of device respiratory muscle exercises applied with different MIP pressures on respiratory functions.

Etik Komite Onayı: Bu çalışma için etik komite onayı Niğde Ömer Halisdemir Üniversitesi'nden (Tarih: 14 Nisan 2022, Karar No: 2022/37 ile alınmıştır.
Hasta Onamı: Çalışmaya katılan tüm katılımcılardan yazılı onam alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir- S.İ.; Tasarım- S.İ., Z.K.; Denetleme- Z.B.A., S.İ., Z.K.; Kaynaklar- Z.B.A., Z.K.; Veri Toplanması ve/veya İşlemesi* S.İ. Z.K. Analiz ve/ veya Yorum- Z.B.A.; Literatür Taraması- Z.B.A., Z.K.; Yazıyı Yazan- Z.K., Z.B.A., S.İ.; Eleştirel İnceleme-Z.B.A.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Bu araştırma, Niğde Ömer Halisdemir Üniversitesi Bilimsel Araştırma Projeleri Koordinasyon Birimi tarafından desteklenmiştir (Proje Numarası: SPT 2022/1-BAGEP, 2022).

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Niğde Ömer Halisdemir University (Date: 14 April 2022, Decision Number: 2022/37
Informed Consent: Written consent was obtained from all the participants.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept- S.İ.; Design- S.İ., Z.K.; Supervision- Z.B.A., S.İ., Z.K.; Resources- Z.B.A., Z.K.; Data Collection and/or Processing- S.İ., Z.K.; Analysis and/or Interpretation- Z.B.A.; Literature Search- Z.B.A., Z.K.; Writing Manuscript- Z.K., Z.B.A., S.İ.; Critical Review-Z.B.A.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: This research has been supported by the Scientific Research Projects Coordination Unit of Nigde Omer Halisdemir University (Project Number: SPT 2022/1-BAGEP, 2022).

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