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Spor Bilimleri Araştırmaları Dergisi'nin temel amacı, Spor Bilimleri alanına ilişkin güncel gelişmeleri bütüncül ve kapsayıcı bir biçimde inceleyerek bu doğrultuda ortaya çıkan özgün makale ve derlemeleri hedef kitle ile paylaşmaktır.

Kapsam

Spor Bilimleri Araştırmaları Dergisi, 2016 yılında yayın hayatına başlamış olup yılda 3 kez yayımlanan Uluslararası Hakemli bir dergidir. Dergi Türkçe ve İngilizce yazılara yer vermektedir. Spor Bilimleri Araştırmaları Dergisi, Spor Bilimleri alanına ilişkin olarak; Beden Eğitimi ve Spor Öğretimi, Spor Yönetimi, Rekreasyon, Hareket ve Antrenman Bilimleri, Sporda Psiko-sosyal Alanlar ve Spor-Sağlık Bilimleri alanlarında kavramsal veya araştırmaya dayanan, sahasına katkı sağlayacağı düşünülen özgün araştırmaları ve derleme makaleleri yayımlamaktadır.

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Journal of Sport Sciences Research

Aim

The main purpose of the Journal of Sport Sciences Research is to analyze the current developments in the field of Sport Sciences in a holistic and inclusive way and to share the original articles and reviews that emerged in this direction with the target audience.

Scope

Journal of Sports Sciences Research is an international refereed journal that began its publication life in 2016 and is published 3 times a year. The journal welcomes articles in Turkish and English languages. Regarding the field of Sport Sciences, the Journal publishes conceptual or research-based original research and review articles in the fields of Physical Education and Sports Teaching, Sports Management, Recreation, Movement and Training Sciences, Psycho-social Fields in Sports and Sports-Health Sciences.

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CONTENTS
VOLUME: 9, ISSUE: 2, JUNE 2024

Orijinal Makale / Original Article

Sayfa /Page

Spor Bilimleri Araştırmaları Dergisi
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Adaptation of the Achievement Emotions Questionnaire for Physical Education (AEQ- PE) to the Turkish Language*

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Abstract

Emotions affect students' cognitive development and performance, their personality and character, and their psychological and physical health. As a type of emotion, achievement emotions are among the most common and functionally important emotions in modern education and modern society. Lack of studies relevant to achievement emotions in the field of physical education in our country made this study necessary to be conducted. Therefore, the study aimed to adapt the Achievement Emotions Questionnaire for Physical Education (AEQ-PE) developed by Fierro-Suero et al. (2020) into Turkish. Data were collected from 369 secondary school students. Confirmatory Factor Analysis (CFA), item-total correlation, Cronbach's Alpha, Spearman Brown, test-retest (n= 90) and measurement invariance analyses were conducted to measure the validity and reliability of the scale. As a result of CFA, goodness-of-fit and factor loading values were found to be at acceptable and good levels. Cronbach's Alpha values of the sub-factors of the scale ranged between .620 and .815. The Spearman Brown coefficient was .767 and the test-retest result was .91. The measurement invariance analysis showed that there was no difference between the male and female students. In addition, the scale dimensions under positive and negative emotions were confirmed by second-order factor analysis. As a result of the analyses, the scale was found to be a valid and reliable measurement tool for the studies which will be conducted on Turkish population.
Keywords: Achievement emotions, Physical education and sport, Control-value theory

Beden Eğitimi için Başarı Duyguları Ölçeği'nin (BE-BDÖ) Türkçeye Uyarlanması

Öz

Duygular, öğrencilerin bilişsel gelişimlerini ve performanslarını, kişiliklerini ve karakterlerini, psikolojik ve fiziksel sağlıklarını etkilemektedir. Bir duygu türü olan başarı duyguları ise, modern çağ eğitiminde ve modern toplumda en sık görülen, işlevsel olarak da en önemli duygu türleri arasındadır. Başarı duyguları ile ilgili çalışmaların beden eğitimi alanında ülkemizde eksikliğinin hissedilmesi bu çalışmanın yapılmasını gerekli kılmıştır. Bu nedenle çalışmada, Fierro-Suero ve diğerleri (2020) tarafından geliştirilen Beden Eğitimi için Başarı Duyguları Ölçeği'ni (BE-BDÖ) Türkçeye uyarlamak amaçlanmıştır. 369 ortaokul öğrencisinden veriler toplanmıştır. Ölçeğin geçerlilik ve güvenirliğini ölçmek için Doğrulayıcı Faktör Analizi (DFA), madde toplam korelasyonu, Cronbach's Alpha, Spearman Brown, test-tekrar test (N=90) ve ölçüm değişmezliği analizleri yapılmıştır. DFA sonucunda uyum iyiliği ve faktör yük değerlerinin kabul edilir ve iyi seviyede olduğu görülmüştür. Ölçeğin alt faktörlerinin Cronbach's Alpha değerleri .620 ile .815 arasında değişmektedir. Spearman Brown katsayısı .767 ve test-tekrar test sonucu .91 olarak bulunmuştur. Ölçüm değişmezliği analizi sonucunda erkek ve kız öğrenciler arasında farklılık olmadığı görülmüştür. Ayrıca ölçek boyutları pozitif ve negatif duygular altında olmak üzere ikinci düzey faktör analizi ile doğrulanmıştır. Analizler sonucunda, ölçeğin Türk popülasyonu üzerinde yapılacak çalışmalarda kullanılması için geçerli ve güvenilir bir ölçme aracı olduğu görülmüştür.
Anahtar kelimeler: Başarı duyguları, Beden eğitimi ve spor, Kontrol-değer teorisi

* This study is based on a master's thesis.
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INTRODUCTION

Academic learning and achievement are crucial subjects of contemporary societies. Especially, to a large extent, research topics like education, professional careers, and social relations depend heavily on these subjects (Pekrun et al., 2002). The fundamentals of learning and achievement are established in childhood, during pupillage. Especially in achievement-oriented societies, learning and achievement are essential components of a student's daily life (Pekrun, 1992). As an academic setting, in our schools, there are many factors, such as physical structure of facilities, individual differences, and classroom climate, affecting learning and achievement (Çelik & Pulur, 2011; Hedjazi & Omidi, 2008). More specifically, the teacher's ability to prepare the student for learning, the physical environment such as soundscape, lighting and equipment, the learner's state of arousal, motivation, anxiety, and level of maturation are determinant factors for learning and achievement (Engin et al., 2009; Seven & Engin, 2008). Studies in the literature also emphasize that emotions are one of the building blocks of the above-mentioned factors that impact learning and achievement (Goetz et al., 2003; Pekrun, 2017; Pekrun et al., 2002).

For more than a decade, the interest in the role of emotions on academic learning and achievement has been growing (Linnenbrink-Garcia & Pekrun, 2011). There are studies which have identified the effect of emotions cognitive development and performance, personality and character formation, and their psychological and physical health (Destacamento, 2018; Pekrun, 2014: 6; Pekrun et al., 2002). In their research studies, Bolitho (2017) and Pekrun (2000, 2014) established a direct link between emotions and academic learning, classroom success, and the profound impact of emotions on students' overall academic achievements, while Linnenbrink-Gracia and Pekrun (2011) further emphasize the facilitating effect of emotions on students' academic achievement and their engagement with course materials. In addition, studies also support the relationship between emotions and self-learning (Pekrun et al., 2002; Schweder, 2020). On the other hand, Pekrun (1992) said that learning and success situations stimulate many emotions. Students may get excited during lessons, develop hope for success, feel proud when they succeed, be surprised when they discover something new, worry about failed exams, get angry with their teachers and friends, or get bored in classroom (Destacamento, 2018; Pekrun, 2014: 6).

The statements mentioned above imply diversity of emotions that students experience in the academic environment, and the positive contributions of emotions on their learning and achievement levels. All these emotions, which are experienced during learning and achievement situations, are called "Achievement Emotions" (Pekrun, 2000; 2006).

CONCEPTUAL FRAMEWORK

Achievement Emotions

Achievement emotions are among the most common and functionally the most important emotions in modern age education and generally in modern society (Pekrun, 2019: 154). Many emotions that arise during class, while working or doing sports can be associated with achievement emotions (Pekrun, 2019: 143). In this sense, achievement emotions which can manifest themselves everywhere, including educational settings (Destacamento, 2018; Pekrun,

2017; 2019: 142), can be intense, and deeply affect learning, performance, achievement, happiness, life satisfaction and psychological well-being (Pekrun, 2017; Pekrun et al., 2002).

Achievement emotions which can be classified according to their values (positive, negative, neutral), contextual reference environment (individual, social) and time (synchronic, prospective, retrospective) are related to achievement activities and related to the success or failure conditions arising from these activities (Pekrun, 2000; Pekrun, 2006; 2014: 6; Pekrun, 2019: 143). Feeling of enjoyment while learning, hope for success, anxiety for failure, pride of success and shame of failure are some examples of achievement emotions which could be categorised as positive and negative emotions (Pekrun, 2014: 6). According to Destacamento (2018), positive emotions aid learning, whereas negative emotions suppress it. Therefore, identifying the evoked emotions in students during course practices provides valuable information for teachers to manage their classroom effectively and adapt their lessons according to the needs of their students (Destacamento, 2018; McCaughtry & Rovegno, 2003).

Achievement Emotion Studies in Various Academic Fields and Education Levels

As mentioned above, for two decades, in the field of education achievement emotions have been subject to scientific research studies. In this process, studies on achievement emotions have been conducted and continued to be conducted in various educational fields. Studies in these fields have been conducted in a wide range from elementary school (Lichtenfeld et al., 2012) to higher education (Pekrun & Stephens, 2010).

When the studies on achievement emotions are examined, the majority of the studies in the field of mathematics stand out. For example, Peixoto (2015) conducted a scale development study to measure anxiety of pre-adolescents towards math tests and exams. On the other hand, Luo et al., (2014) found that achievement emotions totally mediated the relationship between increased belief in math ability, class participation, and math achievement. Also, Bieleke et al., (2021) developed the AEQ-Short version within the scope of mathematics courses and they conducted the validity and reliability study. Additionally, Lichtenfeld et al., (2012) adapted the achievement emotions scale for use in primary school students and introduced it to the field. Pekrun and Stephens (2010), who wrote a book chapter related to achievement emotions, discussed the importance of achievement emotions on exam and test anxiety in higher education. Vierhaus et al., (2016) conducted a study that they examined the organization of learning environments in classrooms to prevent negative developmental patterns of achievement emotions. In another study, Liu et al., (2021) conducted a study that junior high school students' achievement emotions mediated the serial mediation effect between autonomy motivation, teacher support, and creative self-efficacy.

Physical Education and Achievement Emotions

Physical education (PE), which has significant contribution to the acquisition of individual development such as character and personality (Kuter & Kuter, 2012), self-expression, creativity, leisure time use, and cultural development (Kuter & Kuter, 2012; Taşmektepligil et al., 2006), is valued and encouraged as a tool which contributes to international development goals, ensures peace and social equality, improves interpersonal dialogue, and supports economic and social development (United Nations, 2005).

Although emotions experienced in educational settings are directly linked to students' motivation, interest, learning and achievement, and even PE is an essential component, such as maths, music, geography etc., of educational process, it has mostly been subject to the research studies in terms of its physical and cognitive benefits (Kuter & Kuter, 2012). Even though PE's rich experience enables a course environment and climate that induce various emotions (Kuter & Kuter, 2012), the achievement emotions related to PE as a research subject are underestimated, and there is a lack of research studies focused on student emotions in PE (Simonton & Garn, 2019) in national and international PE literature.

Measurement Tools Developed for Achievement Emotions

In the international literature, achievement emotions are measured in different countries and fields. Pekrun et al., (2011) developed the Achievement Emotions Questionnaire (AEQ) to measure the relationship between emotions and students' learning and achievement. Lichtenfeld et al., (2012) developed Achievement Emotions Questionnaire-Elementary School (AEQ-ES) to measure the achievement emotions of elementary school students. Peixoto et al. (2015) conducted validity and reliability studies of the Achievement Emotions Questionnaire to measure pre-adolescent students' feelings of achievement in mathematics. The Achievement Emotions Questionnaire developed by Pekrun et al., (2011) was adapted into PE by Fierro-Suero et al. (2020) and introduced to the field.

In the national literature, Hacıömeroğlu et al., (2013) adapted the Achievement Emotions Scale-Primary School (Lichtenfeld et al., 2012) to Turkish and Turkish culture to determine the achievement emotions of primary school students. Takunyacı and Karadağ (2019) conducted an adaptation study of the Achievement Emotions Questionnaire-Pre-Adolescent Students (Peixoto et al., 2015) and investigated students' achievement emotions towards mathematics.

Purpose of the Current Study

According to Destacamento (2018), positive emotions aid learning whereas negative emotions hinder it. Therefore, identifying the emotions that lesson practices evoke in students provides teachers with valuable information for managing the classroom and adapting lessons to their students' needs (Destacamento, 2018; McCaughtry & Rovegno, 2003). This situation, that is, having knowledge of students' emotional states, is also significant for PE teachers. However, when the literature was examined, although there are questionnaires that measure the achievement emotions in Turkish and Turkish culture (Hacıömeroğlu et al., 2013; Takunyacı & Karadağ, 2019), there is no questionnaire that measures achievement emotions specific to the field of PE. For this reason, bringing a questionnaire that identifies the emotional state for PE lessons, which differ from other lessons in terms of lesson environment and climate, to the literature will make significant contributions to the field. Therefore, in this study, it was aimed to adapt the "Achievement Emotions Questionnaire for Physical Education (AEQ-PE)" scale adapted to PE by Fierro-Suero et al., (2020) into Turkish.

MATERIAL AND METHODS

Participants and Procedure

The subject group of the study consisted of totally 459 students (female 213; age between 11-14) sampled from 5th, 6th, 7th and 8th grades of eight different secondary school in Kırıkkale. Due to the two-phase design of the study sampling was conducted twice; one for construct validity (n= 369; 169 female), one for test-retest reliability (n= 90, 44 female). In the determination of sample size for the construct validity 15 participants per variable were set as criteria (Pituch and Stevens, 2015).

Measurement Instrument

The Achievement Emotions Questionnaire for Physical Education (AEQ-PE; Fierro-Suero et al., 2020) which was adapted from Achievement Emotions Questionnaire (AEQ; Pekrun et al., 2011), was used in this study. AEQ-PE composed of 24 items were grouped under 6 sub-dimensions called as pride, enjoyment, anger, anxiety, hopelessness, and boredom. The internal consistency values were at an acceptable level (Büyüköztürk, 2020: 183) between .72-.83 (Fierro-Suero et al., 2020). In the evaluation of questionnaire items, a 5-point Likert scale (1 - Totally Disagree and 5 - Totally Agree) was used.

The Translation Process of Achievement Emotions Questionnaire for Physical Education

Two academicians from the field of PE who also were proficient in English, two language professionals in English (an expert lecturing in English and a certified public translator), and an academician who studies in the field of Turkish language contributed to the translation process of AEQ-PE. Initially, the items were translated from English to Turkish singly by all experts (Coster & Mancini, 2015). After that, in terms of semantic and conceptual clarity and according to the relevancy of items with the target population, an item-by-item evaluation on the four translated versions were made and a single version was constructed by the PE field experts (Çapık et al., 2018). Subsequently, to control if there was a semantic deterioration or deviation from the original language of the questionnaire, the single version constructed with consensus of PE experts, was check by the certified public translator. After getting grammatic and semantic confirmation from the Turkish language expert, the final version decision was made after a pilot study, testing comprehensibility of items, which were conducted on 30 secondary school students.

Ethical Approval

Ethics committee permission was obtained from Bolu Abant Izzet Baysal University, University Human Research Ethics Committee in Social Sciences. Additionally, the necessary permissions were obtained from Kırıkkale national education directorate and governorship by applying through the MEB AYSE (Ministry of National Education research, competition and social activity).

Statistical Analysis

The validity and reliability studies of the instrument were conducted in line with the data obtained from the students participating in the study. SPSS 26 and AMOS 22 programs were used in the analysis. First-order and second-order confirmatory factor analysis (CFA), item-total correlation, Cronbach's Alpha coefficient, Spearman Brown coefficient, test-retest, and measurement invariance analyses were conducted to determine the validity and reliability of the scale.

FINDINGS

First-Order Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) was applied to test whether the six-dimensional structure of the AEQ-PE was compatible with the sample in which data were collected. Since the data were normally distributed, maximum likelihood calculation method was used. As a result of the analysis, χ2, p, χ2/df, CFI, SRMR and RMSEA goodness of fit indices were reported due to the sample group being more than 250 (N>250) (Gürbüz, 2021, p. 40). The fit indices and maximum-minimum factor loadings obtained at the end of the CFA analysis are presented in Table 1.

Table 1. AEQ-PE First-order CFA Fit Indices

	χ^2	*p*	χ^2/df	CFI	SRMR	RMSEA	Factor Loadings	
							min	max
CFA Values	429.675	0.000	1.81	.928	.048	.047	0.42	0.79
Suggested Values	*p>.05*	*p<.05*	*x^2/df<3*	>.95	<.05	<.05	>0.30	
Fitting			Good Fit	Acceptable	Good Fit	Good Fit		

χ2/df=Chi-square/degree of freedom, CFI=Comparative Fit Index, SRMR=Standardized Root Mean Square Residual, RMSEA=Root Mean Square Error of Approximation

When Table 1 is examined, the χ2/df value was found to be less than 3 as a result of the analysis. This value indicates that the model and the data show good fit. The CFI value was calculated as .928. This value indicates that the tested model and the base model are in good fit. SRMR value was .048 and this value represents good fit. The RMSEA value was found to be .047 which indicates that the model has a good fit with the sample.

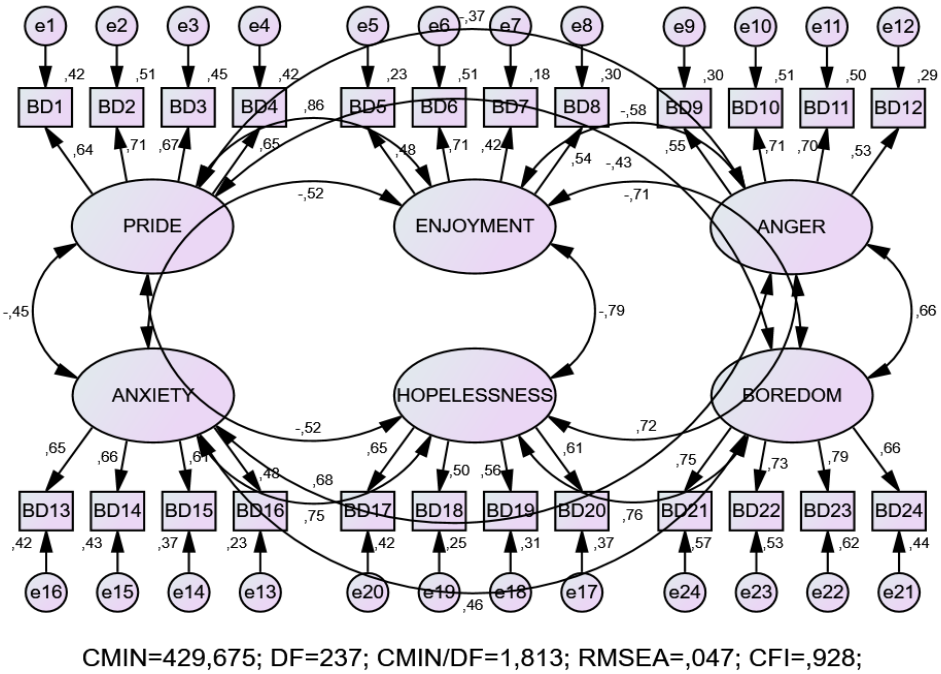

Figure 1 First-order CFA path diagram

The CFA path diagram for the AEQ-PE is given in Figure 1. The diagram consists of 6 factors (pride, enjoyment, anger, anxiety, hopelessness, boredom) and 4 items under each factor. In the diagram drawn to test the model, it is seen that the standardized factor loadings are distributed between 0.42 and 0.79.

Table 2. Error variance, t-values, regression coefficient and factor loading values of AEQ-PE items

	Scale Items	Error Variance	t-values	R^2	Factor Loadings
Pride	1	.047	13.83	.416	.645
	2	.033	15.30	.506	.711
	3	.072	13.63	.454	.674
	4	.070	12.85	.419	.648
Enjoyment	5	.034	9.79	.229	.479
	6	.043	14.24	.506	.711
	7	.037	9.33	.177	.420
	8	.027	11.88	.509	.544
Anger	9	.040	10.76	.304	.552
	10	.046	14.95	509	.713
	11	.039	14.18	.497	.705
	12	.022	10.99	.285	.534
Anxiety	13	.049	12.36	.423	.483
	14	.049	12.76	.433	.609
	15	.082	11.57	.371	.658
	16	.046	9.04	.233	.651
Hopelessness	17	.058	13.88	.419	.606
	18	.065	11.38	.249	.559
	19	.056	13.01	.313	.499
	20	.059	12.84	.367	.647
Boredom	21	.064	17.14	.565	.752
	22	.085	17.07	.531	.729
	23	.029	18.43	.625	.790
	24	.052	16.91	.441	.664

As a result of the CFA, it is seen that all item t-values of the scale are above 2.56. Therefore, the parameter estimation values are significant at the 0.01 level. The error variances in the scale items are also below 0.90 (Table 2).

Item-total Correlation Analysis

Table 3. AEQ-PE item-total correlation

		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Factor 1 Items	**1**	**.751**	.383	.136	.273	.242	.182
	2	**.770**	.461	.300	.239	.290	.357
	3	**.771**	.499	.123	.247	.295	.227
	4	**.766**	.497	.192	.233	.272	.233
Factor 2 Items	**5**	.418	**.653**	.168	.200	.275	.244
	6	.499	**.675**	.349	.282	.478	.487
	7	.350	**.704**	.180	.129	.169	.259
	8	.416	**.713**	.233	.274	.324	.350
Factor 3 Items	**9**	.127	.168	**.783**	.237	.215	.282
	10	.218	.359	**.740**	.421	.409	.428
	11	.266	.344	**.726**	.420	.486	.468
	12	.117	.134	**.727**	.268	.280	.293
Factor 4 Items	**13**	.250	.300	.299	**.744**	.441	.293
	14	.271	.262	.430	**.711**	.374	.310
	15	.274	.225	.299	**.732**	.417	.241
	16	.147	.140	.271	**.695**	.268	.127
Factor 5 Items	**17**	.315	.405	.407	.364	**.668**	.477
	18	.226	.262	.286	.399	**.743**	.289
	19	.204	.246	.332	.351	**.716**	.397
	20	.300	.373	.284	.346	**.695**	.408
Factor 6 Items	**21**	.282	.408	.438	.265	.462	**.778**
	22	.263	.386	.379	.240	.398	**.817**
	23	.278	.391	.374	.306	.458	**.831**
	24	.225	.359	.387	.258	.428	**.800**

Factor 1=Pride, Factor 2=Enjoyment, Factor 3=Anger, Factor 4= Anxiety, Factor 5=Hopelessness, Factor 6=Boredom

Table 3 shows the item total correlations of the scale. In the item-total correlation analysis, the relationship between the items and the related dimensions is satisfactory (r>0.5). It is recommended that items that are not in the relevant dimension should be less than 0.5 (r<0.5) (Gürbüz, 2021: 81).

Internal Consistency Analysis

Table 4. Cronbach's Alpha, Spearman Brown and Test-Retest values of AEQ-PE

Factors	Items	Cronbach's Alpha	Spearman Brown	Test-Retest
1- Pride	4	.759	.767	.905
2- Enjoyment	4	.620		
3- Anger	4	.728		
4- Anxiety	4	.687		
5- Hopelessness	4	.650		
6- Boredom	4	.815		

When Table 4 is examined, it is seen that the Cronbach's Alpha coefficients of the AEQ-PE sub-dimensions vary between .620 and .815. These values can be interpreted as acceptable and good (Büyüköztürk, 2020: 183; Kılıç, 2016).

Spearman Brown Analysis

The split-half method is calculated using the Spearman Brown method based on the relationship between the two halves of the test by separating the items in the scale as odd-even.

This calculation method shows the consistency between test scores (Büyüköztürk, 2020: 182). The Spearman Brown coefficient was found to be .767 as a result of the two-half test reliability performed with 369 collected data. According to Büyüköztürk (2020: 32), this value is considered highly reliable.

Test-retest Analysis

The test-retest method is explained by the correlation between the tests applied to a group twice within a certain period of time (Büyüköztürk, 2020: 182). In the test-retest analysis, the correlation coefficient between the two measurements was found to be .905. According to Büyüköztürk (2020: 32), the test-retest correlation coefficient of the scale is highly reliable.

Measurement Invariance Analysis

Table 5. Measurement Invariance Analysis Results

Modeller	χ^2 (df)	χ^2/df	*CFI*	*SRMR*	*RMSEA*	Model Comparison		
							$\Delta\chi^2$ (Δdf)	ΔCFI
Gender (Male-Female)								
1. Configural	808.4 (474)	1.705	.884	.065	.044	-	-	-
2. Metric	856.4 (498)	1.720	.875	.0709	.044	2 vs. 1	97.9* (48)	.009
3. Scalar	906.3 (522)	1.736	.866	.0706	.045	3 vs. 2	20.9 (15)	.009
4. Strict	1016.5 (561)	1.812	.842	.0760	.047	4 vs. 3	89.2* (24)	.024

Not: *p<.05; *N*= 369 (Male= 200, Female= 169); *CFI*= Comparative fit index; *SRMR*= Standardized Root Mean Square Residual; *RMSEA*= Root mean square error of approximation.

In the measurement invariance analysis conducted for gender, configural invariance was first tested through the baseline model without equating any parameter values. In the literature, the generally accepted value for CFI is above 0.90 (Çokluk et al., 2021; Gürbüz, 2021; Hu & Bentler, 1999). However, it is also said that the CFI value can be considered as 0.80 as a lower limit, considering the model and analysis complexity (Hu & Bentler, 1999). According to the mentioned criteria, the goodness-of-fit values indicated that configural invariance was achieved. After configural invariance was achieved, metric invariance was tested by comparing the multiple-group CFA results obtained by equating the scale items with the configural model. In measurement invariance analyses, it is recommended to use CFI differences instead of $\chi 2$ to compare models, and the ΔCFI value between the compared models should be <.01 (Byrne, 2010: 250). Since the ΔCFI values for the comparisons between the configural model and the metric model, and the metric model and the scalar model are <.01, the results indicated that the scale is equivalent across groups. However, because the ΔCFI for the comparison between scalar invariance and strict model is >.01, it was determined that strict invariance was not achieved. Cause of its stringency than other types of measurement invariance findings, strict model is not reported in most studies and is difficult to achieve (Gürbüz, 2021).

Second-Order Confirmatory Factor Analysis

Following the confirmation of the 6 sub-dimensional structure of the AEQ-PE, a second-order CFA analysis of the positive and negative emotions in the scale was conducted.

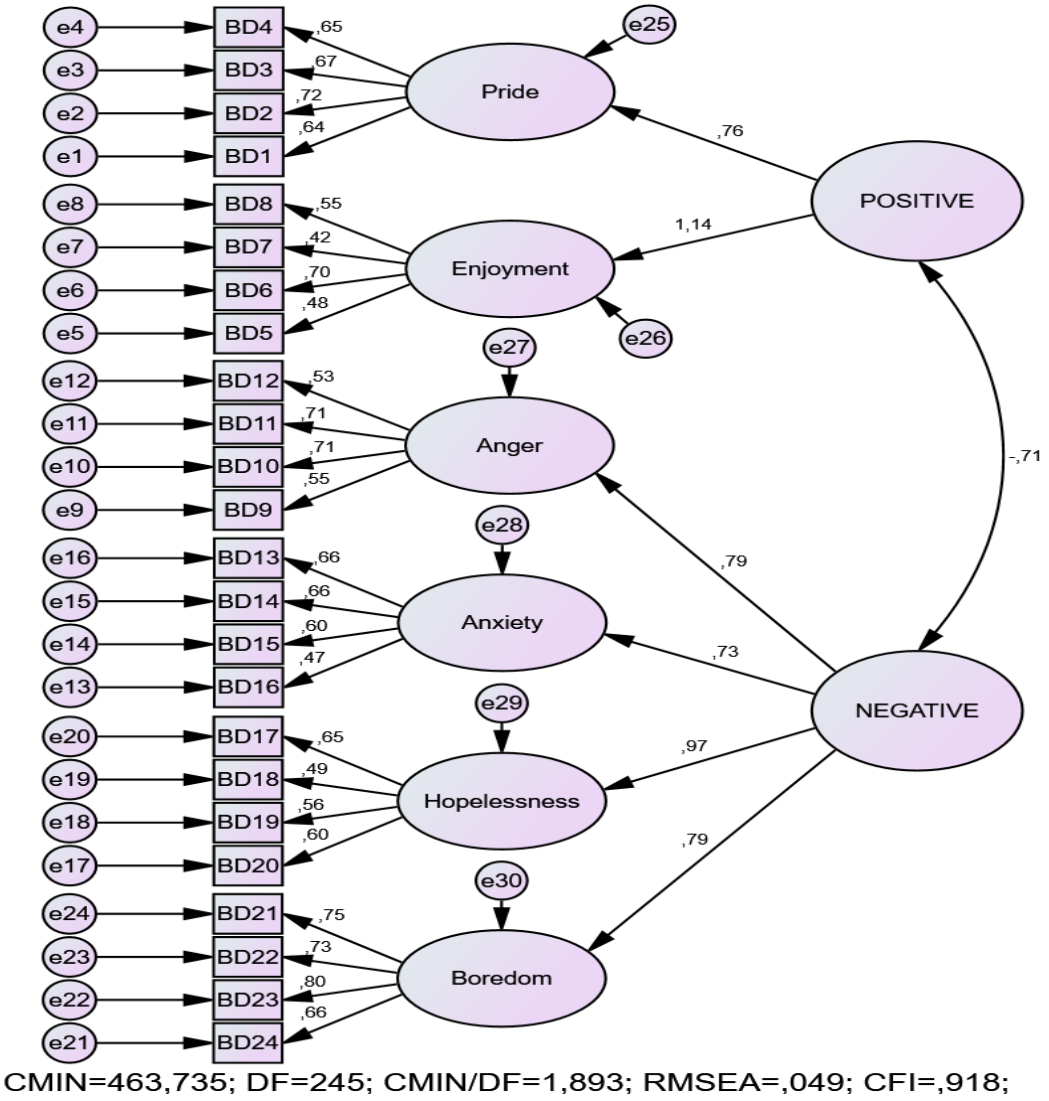

Figure 2 Second-order CFA path diagram

Figure 2 shows the second order CFA path diagram of the AEQ-PE. Pride and enjoyment subscales were confirmed under the positive factor, while anger, anxiety, hopelessness and boredom were confirmed under the negative factor ($\chi 2$=463.735, $p<0.05$, $\chi 2/df$= 1.893, CFI= .918, SRMR= .052 and RMSEA .049). The factor loadings of the scale ranged between .420 and .798.

Table 6. Error variance, t-values, regression coefficient and factor loading values of second-order CFA of AEQ-PE items

		Items	Error Variances	t-values	R^2	Factor Loadings
POSİTİVE	Pride	1	.037	9.83	.406	.638
		2	.027	10.56	.521	.722
		3	.040	10.03	.446	.668
		4	.046	9.83	.421	.649
	Enjoyment	5	.039	7.36	.234	.484
		6	.022	8.34	.495	.704
		7	.049	6.20	.176	.420
		8	.049	7.36	.301	.549
NEGATİVE	Anger	9	.092	7.59	.305	.552
		10	.047	8.98	.502	.708
		11	.059	8.99	.503	.709
		12	.065	7.59	.284	.533
	Anxiety	13	.064	7.34	.442	.474
		14	.069	7.32	.432	.601
		15	.066	7.05	.361	.657
		16	.086	7.34	225	.664
	Hopelessness	17	.029	9.54	.428	.600
		18	.052	7.71	.242	.561
		19	.082	8.54	.315	.492
		20	.035	9.54	.360	.654
	Boredom	21	.031	11.89	.557	.662
		22	.016	11.67	.530	.798
		23	.020	12.46	.637	.728
		24	.015	11.9	.439	.747

The error variance, t-values, R^2 values and factor loadings of the second level CFA are given in Table 6. According to the results, t-values of all items are above 2.56. When the error variances are analyzed, there is no error variance value above .90. According to these results, the second level structure of the AEQ-PE was confirmed.

DISCUSSION and CONCLUSION

This study was conducted to adapt the "Achievement Emotions for Physical Education" scale (Fierro-Suero et al., 2020) into Turkish and Turkish culture. To conduct the validity and reliability analyses of the scale, the scale items were first translated from the source language to the target language as suggested in the field. The first-order confirmatory factor analysis of the scale was performed with the collected 369 data. The results confirm that the goodness-of-fit values of the scale have good fit (see Figure 1). The item-total correlations of the six-dimensional scale was examined. According to these values, the relationship between the items and the relevant dimension is highly correlated to each other, while the relationship between the items and the non-relevant dimensions is found to be less than 0.5, as suggested in the literature (Gürbüz, 2021: 81). As we examined Cronbach's Alpha values of the scale, dimensions ranged from .620 to .815. These values are acceptable and good (Büyüköztürk, 2020: 183; Kılıç, 2016). Looking at the reliability of the scale with the two-half method, the scale items were divided into single-pairs and the Spearman Brown coefficient was found to be .767. This value is highly reliable according to Büyüköztürk (2020: 32). To measure whether

the scale is consistent over time, the scale was applied twice to a sample of 90 participants who were in 5th, 6th, 7th, and 8th grades, 10 days apart. In the test-retest analysis, the correlation coefficient between the two measurements was found to be .91. This value shows that the scale is highly reliable (Büyüköztürk, 2020: 32). One of the strengths of this study is the implementation of measurement invariance analysis. This analysis measures whether the scale is understood at the same level between groups with advanced statistical analyses (Gürbüz, 2021). The measurement invariance analysis revealed that the scale is understood at the same level between female and male students (see Table 5).

Achievement emotions consist of positive and negative emotions (Pekrun & Stephens, 2010). In the studies, positive and negative emotions are examined both individually (Bieleke et al., 2021) and under their positive and negative dimensions (Lichtenfeld et al., 2012). As it seen in Figure 1, the correlation between positive and negative achievement emotions clearly reveals the relationship between these dimensions. Therefore, in the study, the pride and enjoyment subscales were validated under the positive dimension, and the anger, anxiety, hopelessness, and boredom subscales were validated under the negative dimension by conducting a second-order factor analysis (see Figure 2). Thus, the emotions that are the dimensions of the scale can be considered individually, as well as grouped under positive and negative dimensions.

The achievement emotions questionnaire for physical education has been used by different researchers in the field. The scale was first adapted to the field of PE by Fierro-Suero et al., (2020). Fierro-Suero and his colleagues also conducted their study on a sample of 358 participants with a same age group similar with this present study. The confirmatory factor analysis findings in their study showed a high positive correlation between positive emotions, while negative emotions showed a moderate to high positive correlations, as it was stated in our study.

In another study in which the achievement emotions questionnaire for physical education was adapted to Malay language, the study was conducted on a sample of 607 Malaysian children (Ibrahim et al., 2021). The correlation between the dimensions of the scale in the confirmatory factor analysis of the scale was found moderate to high, as in this and the study by Fierro-Suero et al., (2020). The confirmatory factor analysis results in these three studies showed parallelism with each other.

Compared to the two previous adaptation studies, to empower the validity and reliability findings of the questionnaire, in this present research study additional tests, such as the item-total correlation, Spearman Brown, test-retest analyses and measurement invariance analysis were conducted which is the strength of this study when compared to Fierro-Suero et al., (2020) and Ibrahim et al., (2021). Additionally, in this present study, with a second-order confirmatory factor analysis it has been shown that the scale is combined under positive and negative factors.

As a conclusion, the AEQ-PE, with its short and understandable items (Ganassali, 2008), in this present study showed strong validity and reliability findings, making it an evaluative measurement instrument for research studies in Turkish culture and population. As a result of the analyses, the scale was found to be a reliable and valid measurement tool. The scale measures the feelings of achievement for PE.

Further Recommendations

The PE lessons should not be seen as a lesson that students take only in a certain period of their life, but as a lesson that they should apply the skills they have learned throughout their life. In this research, the importance of achievement emotions in the field of education is clearly emphasized. Therefore, feelings of achievement for PE are of particular importance. Students' positive sense of achievement for PE should be kept high and measures should be taken for this purpose. For future research, the effect of the concepts of control and value in the control-value theory on the achievement emotions in PE can be examined. It can be examined how the value and control that students give to the PE lesson affect their feelings of achievement for PE. In addition, examining AEQ-PE and variables such as pleasure, physical competence, performance, happiness, academic achievement and familial factors can add depth to the field.

Conflicts of Interest: There is no financial or personal conflict of interest on the part of the authors in this study.

Authors' Contribution: Research Design - MC and ÜK, Data Collection - MC, Statistical Analysis - MC and ÜK, Manuscript Preparation – MC.

Ethical Approval

Ethics Committee: Bolu Abant Izzet Baysal University Human Research Ethics Committee in Social Sciences
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APPENDIX l.

		Beden Eğitimi için Başarı Duyguları Ölçeği (BE-BDÖ)	**Tamamen Katılmıyorum**	**Katılmıyorum**	**Kararsızım**	**Katılıyorum**	**Tamamen Katılıyorum**
GURUR	**1**	Beden eğitimi dersine ayak uydurabildiğim için gurur duyuyorum.					
	2	Beden eğitimi derslerine katılmaktan gurur duyuyorum.					
	3	Beden eğitimi ile ilgili bildiklerim için gurur duyabileceğimi düşünüyorum.					
	4	Beden eğitimi derslerindeki başarılarımdan duyduğum gurur beni derse katılımım için motive ediyor.					
EĞLENCE / ZEVK	**5**	Beden eğitimi derslerinin heyecan verici olması beni derse katılmaya motive ediyor.					
	6	Beden eğitimi derslerine katılmaktan zevk alıyorum.					
	7	Beden eğitimi derslerinde olmak ve öğretmenin önerilerini yerine getirmek beni heyecanlandırıyor.					
	8	Beden eğitimi derslerinin faydasını gördüğüm için derse katılmaktan/gitmekten mutluyum.					
ÖFKE	**9**	Beden eğitimi dersi esnasında öfkemin arttığını hissediyorum.					
	10	Sinirli olduğum için beden eğitimi derslerinde huzursuz oluyorum.					
	11	Beden eğitimi dersinde öğrenmek zorunda olduğum gereksiz şeyleri düşünmek beni sinirlendiriyor.					
	12	Beden eğitimi dersinden çıktığımda sinirli oluyorum.					
KAYGI	**13**	Beden eğitimi dersinde yapmam gereken şeylerin çok zor olabileceği beni endişelendiriyor.					
	14	Beden eğitimi dersinde kendimi gergin hissediyorum.					
	15	Beden eğitimi dersinde yanlış birey söylemekten/yapmaktan korkarım ve hiçbir şey söylememeyi/yapmamayı tercih ederim.					
	16	Beden eğitimi dersinde anlamadığım bir şey olursa kalbim hızla çarpar.					
UMUTSUZLUK	**17**	Beden eğitimi dersine hazırlanmak anlamsız çünkü zaten bu derste kötüyüm.					
	18	Beden eğitimi dersine girmeden önce bile dersi doğru anlamayacağımı/yapamayacağımı biliyorum.					
	19	Egzersizleri doğru yapmak imkânsız olduğu için beden eğitimi dersine gitmemeyi tercih ediyorum.					
	20	Beden eğitimi dersindeki etkinlikleri etkili bir şekilde yapma konusundaki tüm umudumu kaybettim.					
SIKKINLIK	**21**	Beden eğitimi dersi çok sıkıcı olduğu için dersten çıkmak istiyorum.					
	22	Beden eğitimi dersi esnasında sıkılıyorum.					
	23	Beden eğitimi dersi beni bunaltıyor.					
	24	Beden eğitimi dersini oldukça sıkıcı buluyorum.					

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Perceived Physical Literacy Scale for Secondary School Students: A Study on Validity and Reliability

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Abstract

The purpose of this research is to develop a physical literacy scale for secondary school students. 650 students from 5th, 6th, 7th and 8th grades participated in the research. The draft form was prepared by reviewing the literature and taking expert opinions. Interviews were conducted with 40 students to test the comprehensibility of the items (the wording of 5 items was revised). As a result of the pilot reliability analysis and Bartlett's sphericity test, it was accepted that the correlation between the variables was sufficient, and the scale consisted of questions with a unique and homogeneous structure. Then, Kaiser-Meyer-Olkin, Bartlett and Cronbach Alpha values were checked, and they were determined to be suitable and sufficient for EFA. As a result of EFA, 20 items collected in 4 factors were obtained. The variance explained by these factors is 58.442%. As a result of the CFA conducted in SPSS AMOS 24 programme, 3 items that did not meet the model fit index criteria were removed. It was determined that the standardized item loadings of the 17 items that met the model fit conditions ranged between 0.654-0.895, R^2 values ranged between 0.43-0.80 and standard errors ranged between 0.045-0.102. Regarding reliability, AVE, CR, and internal consistency coefficients were examined, and it was determined that they meet the specified criteria. The final version of the scale consists of four sub-dimensions ("Motivation", "Knowledge and Understanding", "Confidence" and "Physical Competence"). In conclusion, it was determined that the developed scale is a valid and reliable measurement tool for assessing students' perceptions of physical literacy.
Keywords: Physical literacy, Physical activity, Physical education and sports, Secondary school students

Ortaokul Öğrencileri için Algılanan Fiziksel Okuryazarlık Ölçeği: Geçerlilik ve Güvenirlilik Çalışması

Öz

Bu araştırmanın amacı, ortaokul öğrencileri için fiziksel okuryazarlık ölçeği geliştirmektir. Araştırmaya 5,6,7 ve 8. Sınıflardan 650 öğrenci katılmıştır. Taslak form literatür taraması ve uzman görüşleri alınarak hazırlanmıştır. Maddelerin anlaşılırlığını test etmek için 40 öğrenciyle görüşmeler yapılmıştır (5 maddenin ifadeleri yeniden düzenlendi). Pilot güvenirlilik analizi ve Bartlett's küresellik testi sonucunda değişkenler arası korelasyonun yeterli olduğu, ölçeğin özgün ve homojen yapıda sorulardan oluştuğu kabul edilmiştir. Ardından Kaiser-Meyer-Olkin, Barlett ve Cronbach Alfa değerleri kontrol edilerek AFA için uygun ve yeterli oldukları tespit edilmiştir. AFA sonucunda 4 faktörde toplanan 20 madde elde edilmiştir. Bu faktörlerin açıkladığı varyans %58.442'dir. SPSS AMOS 24 programında yapılan DFA sonucunda ise, model uyum indekslerini karşılamayan 3 madde çıkarılmıştır. Model uyum şartlarını taşıyan 17 maddenin standartlaştırılmış madde yükleri 0,654-0,895 arasında; R2 değerleri 0,43-0,80 arasında ve standart hataları 0.045-0.102 arasında değiştiği tespit edilmiştir. Güvenirlilik kapsamında ise AVE, CR ve iç tutarlık katsayıları incelenmiş ve koşulları sağladığı belirlenmiştir. Ölçek son haliyle 4 alt boyuttan ("Motivasyon", "Bilgi ve Anlayış", "Güven" ve "Fiziksel Yeterlilik") oluşmaktadır. Sonuç olarak, geliştirilen ölçeğin, öğrencilerin fiziksel okuryazarlık algılarını ölçen, geçerli ve güvenilir bir ölçme aracı olduğu tespit edilmiştir.
Anahtar kelimeler: Fiziksel okuryazarlık, Fiziksel aktivite, Beden eğitimi ve spor, Ortaokul öğrencileri

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INTRODUCTION

Throughout human history, the instinctive need for movement has been deeply ingrained, with physical activity serving as a fundamental tool for maintaining internal balance. This intrinsic drive has persisted from the evolutionary past of humanity to the present day, playing a crucial role in ensuring survival. However, with the advent of modern technological and social changes, sedentary lifestyles have become increasingly prevalent. Therefore, individuals have drifted away from the physical activity they naturally require. As a result, the rise in sedentary behaviour has had adverse effects on people's physical health and overall well-being, underscoring the heightened significance of physical literacy (Belanger et al., 2018).

Numerous scientific research outcomes and international organizations reveal the necessity for individuals to remain physically active throughout their lifespan. Physical literacy encompasses multifaceted development such as knowledge and understanding, motivation, confidence, and physical competence which are essential for individuals to stay active throughout their lives (Akarsu & Büyükçelebi, 2022; McKean, 2013; Sum et al., 2018). In this context, Whitehead (2013) defines physical literacy as the motivation to value and take responsibility for purposeful physical activities lifelong, involving confidence, physical competence, knowledge, and understanding.

Physical literacy should not be regarded as equivalent to physical activity, rather, it is considered a significant precursor to physical activity. In this sense, individuals may not engage in physical activity without possessing or understanding physical literacy. However, by participating in physical activities, individuals can enhance their levels of physical literacy (Whitehead, 2001). Building upon these notions, the United Nations Educational, Scientific and Cultural Organization (UNESCO) emphasizes the crucial role of quality physical education in school curricula, as it forms the basis for lifelong physical activity and sports participation. Individuals who are physically literate through quality physical education classes adapt to the changing environment by participating in physical activities, increasing confidence in areas requiring physical, mental, sensory, and social skills (UNESCO, 2015). As evident from these considerations, physical literacy is recognized as an integral component of individual personality development, encompassing a broad spectrum of skills.

In the past two decades, the assessment of physical literacy has predominantly focused on demonstrating fundamental movement skills or determining sport-specific abilities (Longmuir, 2017). Such assessments provide a limited interpretation of the level of physical literacy (Giblin et al., 2014). Lundvall (2015) has argued that this restricted assessment of physical literacy is insufficient to grasp the complexity of the concept and aspects the evaluation of other aspects of physical literacy. For instance, assessing other qualities of physical literacy, such as competence in physical movement competence and knowledge and understanding of how to be physically active, the knowledge and understanding of being active, the desire for physical activity, and possessing the motivation and confidence necessary for it, is imperative (Corbin, 2016).

Several measurement tools developed for this purpose are identified in the literature. Sum et al., (2016) created the Perceived Physical Literacy Scale for physical education teachers. This scale is designed to assess teachers' perceived physical literacy in terms of knowledge and

understanding, self-confidence, self-expression, and communication with others. Munusturlar & Yıldızer (2020) adapted the Perceived Physical Literacy Scale for physical education teachers, developed by Sum et al., (2016), for a sample in Türkiye. Sum et al., (2018) developed the Perceived Physical Literacy Scale for adolescents. Yılmaz & Kabak (2021) also developed the Perceived Physical Literacy Scale for adolescents. Özgül et al., (2023) developed the Physical Literacy Attitudes Scale for secondary school students. When all these studies are examined, it is noted that there is a lack of specific research focusing on measuring the perceived physical literacy of secondary school students.

The physical literacy of secondary school students is critical for their potential to become active individuals in the future. Being aware of this importance, a measurement tool is needed to evaluate the physical literacy perception of secondary school students. Accordingly, the aim of this study was to develop a perceived physical literacy scale for secondary school students, considering the importance of fostering physical literacy at this educational level in order to raise active individuals in the future.

MATERIAL AND METHODS

Research Model

This study employs a survey design for the development of a scale. The survey design aims to define a condition that has existed in the past or continues to exist in its own terms without making any changes (Büyüköztürk, 2009). Therefore, a survey design was preferred for this research.

Study Group

The study group comprises 650 secondary school students attending 5th, 6th, 7th, and 8th grades in Malatya in 2023. Students with no physical health issues, specific diseases (such as heart, respiratory, or neurological diseases), and musculoskeletal system disabilities were included in the research.

1. Study group: The first study group, comprising 40 students in total (20 males, 20 females), was determined using a random sampling method to test the clarity of the items. The group tense 10 students from the 5th grade (5 males, 5 females), 10 students from the 6th grade (5 males, 5 females), 10 students from the 7th grade (5 males, 5 females), and 10 students from the 8th grade (5 males, 5 females).

2. Study group: The second study group, consisting of 310 students in total (165 males, 145 females), was selected using a random sampling method for conducting Exploratory Factor Analysis (EFA). The group tense 72 students from the 5th grade (38 males, 34 females), 81 students from the 6th grade (41 males, 40 females), 69 students from the 7th grade (39 males, 30 females), and 88 students from the 8th grade (47 males, 41 females).

3. Study group: The third study group, comprising 266 students in total (140 males, 126 females), was chosen using a random sampling method for conducting Confirmatory Factor Analysis (CFA). The group tense 65 students from the 5th grade (35 males, 30 females), 58

students from the 6th grade (28 males, 30 females), 66 students from the 7th grade (36 males, 30 females), and 77 students from the 8th grade (41 males, 36 females).

4. Study group: The fourth study group, consisting of 34 students in total, was determined using a simple random sampling method for collecting data for the test-retest reliability analysis. The group tense 8 students from the 5th grade (4 males, 4 females), 8 students from the 6th grade (4 males, 4 females), 8 students from the 7th grade (4 males, 4 females), and 10 students from the 8th grade (5 males, 5 females).

Perceived Physical Literacy Scale for Secondary School Students Scale Structure

The scale, designed for secondary school students, includes items that aim to measure their perceptions of key aspects of physical activity, including knowledge and understanding, motivation, confidence and physical competence. The knowledge and understanding sub-dimension is related to the capacity of individuals to grasp basic concepts and principles related to physical activity, health and fitness. The motivation sub-dimension relates to an individual's tendency to participate in physical activity and the drive to continue these activities. Highly motivated individuals may maintain an active lifestyle due to various factors such as health, fitness, personal goals or social interaction. The self-confidence sub-dimension is related to the positive belief in one's own physical abilities. This enables individuals to engage in physical activities without hesitation to take risks and to participate in new activities with confidence. Additionally, confidence in physical literacy includes the individual's belief that they can succeed in activities such as sports and exercise, which encourages them to stay active on a regular basis. Finally, the physical competence sub-dimension relates to an individual's physical capacity to perform at a certain level. This includes physical characteristics such as strength, endurance, flexibility and coordination, as well as specific movement and sport skills. Physical competence enables an individual to move effectively and efficiently in daily life and sporting activities, while also promoting health and well-being. In accordance with this framework, responses were obtained based on a 5-point Likert scale, wherein the options are delineated as follows: "1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, and 5= Strongly Agree". Higher score on the items suggests a greater degree of concurrence with the proposition contained within each item, while lower scores indicate a lesser degree of concurrence.

Ethical Approval

Approval for the implementation of the scale was obtained from the Inönü University Social and Humanities Research and Publication Ethics Commission on 04-05-2023, with decision number 57 in session 3. Additionally, after obtaining approval from the Malatya Provincial Directorate of National Education, informed voluntary consent forms were obtained from the parents/guardians of the participants.

Analysis of Data

The analysis of the data collected within the review of the study was conducted step by step. Firstly, a draft form was created by scanning the literature and obtaining expert opinions. The construct validity rate and construct validity index were examined for the validity of the form's structure. Hotelling's T-Squared and Bartlett's sphericity test were applied for pilot reliability. Then, Exploratory Factor Analysis (EFA) was applied to the collected data. After EFA, the

data were collected again with the remaining items and Confirmatory Factor Analysis (CFA) was applied. After CFA, the data were collected again and Composite Reliability (CR), Average Variance Extracted (AVE) and Cronbach's Alpha Coefficient were calculated. Additionally, data were collected within the scope of test-retest reliability.

FINDINGS

Development of the Measurement Tool

Designing the Scale and Creating the Draft Form

The scale items were prepared through the literature review (Mohammadzadeh et al., 2021; Munusturlar & Yıldızer, 2020; Özgül et al., 2023; Sport for Life, 2023; Sum et al., 2018; Sum et al., 2016; Yılmaz & Kabak, 2021) and expert opinions on physical literacy, child development, and measurement and evaluation. Initially, existing development studies were examined through a literature review, and an item pool was created. Subsequently, face-to-face interviews were conducted with students in the first study group to test the clarity of the items. As a result of these interviews, expressions in five items of the 29-item pool were reorganized.

Content Validity

The Content Validity Ratio (CVR) is used in measurement tool development studies where pilot applications are not feasible. CVR is a method used to transform qualitative data into quantitative data by using expert opinions (Yurdugül, 2005). The CVRs were calculated for the items in the scale form by taking the opinions of 8 experts knowledgeable about physical literacy, child development, measurement and evaluation" is better. In calculating CVR, values were assigned to each item, half of the experts must state that the substance is suitable for a value of 0, more than half must state that the substance is not suitable for a value less than 0, and that the substance is not suitable if it is greater than 0" is better. When calculating CVR, items with negative or equal to 0 values were first excluded from the scale. Subsequently, items with CVRs greater than 0 were analyzed. According to Veneziano and Hooper (1997) the minimum values for content validity criteria are provided in the table below (Table 1).

Table 1. Minimum values for content validity ratios

Number of Experts	Minimum Value	Number of Experts	Minimum Value
5	0.99	13	0.54
6	0.99	14	0.51
7	0.99	15	0.49
8	0.78	20	0.42
9	0.75	25	0.37
10	0.62	30	0.33
11	0.59	36	0.30
12	0.56	40+	0.29

According to Table 1, the minimum values, according to the number of experts consulted, also indicate the significance level of the item. In this study, consulting 8 experts reveals that the minimum value for the content validity criterion is 0.78. The Content Validity Index (CVI) is obtained from the total CVR average of the items to be included in the final scale form and has a significance level of $\propto = 0.05$ (Yurdugül, 2005).

Based on the CVRs obtained from expert opinions, 3 out of 29 items were removed, and seven were changed. Consequently, the CVRs for items 5, 8, 12, 14, 15, 20, and 26 were calculated as 0.90, and for other items, the CVRs were calculated as 1.0. After removing these items (5, 8, 12, 14, 15, 20, and 26) mentioned for CVI calculation, the calculation was repeated, and a value of 1.0 was obtained. The obtained CVI value from the final form, with opinions from 8 experts, can be considered high and statistically significant, as CVI > 0.78.

Pilot Reliability

Hotelling's T-Squared analysis and Bartlett's sphericity test were examined to determine the degree determine how effectively the structure intended to be measured could be measured with the developed measurement tool. In the Hotelling's T-Squared analysis, the Hotelling's T-Squared value was found to be 501.358, the F value was 18.497, and the p-value was less than 0.05. The result of Bartlett's sphericity test being less than 0.05 and statistically significant indicates sufficient correlation among variables. Therefore, it can be accepted that the scale consists of homogeneous structure questions and is original.

Validity: EFA and CFA

Before proceeding with EFA and CFA procedures, a normality test was conducted on the data. Since the skewness and kurtosis values were between -1.5 and 1.5, it was assumed that the data followed a normal distribution (Tabachnick et al., 2013). Based on this result, EFA was conducted.

The Kaiser-Meyer-Olkin (KMO) test value, which evaluates the suitability of the data for EFA was found to be 0.876, and the Barlett Test value was 3201.334 ($p<.001$). Additionally, the internal consistency coefficient (Cronbach's Alpha) was determined as 0.854. According to the results obtained, it was understood that the data were suitable and sufficient for EFA (Bayram, 2004). As a result of item analysis, were 4 (I enjoy participating in physical activities that challenge me), 7 (I consider it necessary to participate in physical activity to stay healthy), 11 (I know the benefits of physical activity), 12 (I prefer studying instead of participating in physical activity), 13 (I am aware of the skills in physical activities where I am lacking), and 26 (I maintain my balance very well in physical activities) were excluded as their communalities were below 0.30. Accordingly, 20 items collected in four factors were considered for evaluation. The variance explained by the four factors is 58.442%. As noted in the studies of Çokluk et al., (2012) explaining between 40% and 60% of the variance is considered sufficient for multi-factor scales.

Table 2. Explained total variance

Factor	Eigenvalue	Total variance explained		Sum of Rotated Factor Loadings
		Variance %	Cumulative Variance %	
1.	5.168	25.842	25.842	3.717
2.	3.014	15.068	40.910	2.900
3.	2.329	11.644	52.554	2.636
4.	1.178	5.888	58.442	2.436

According to Table 2, it is observed that items with eigenvalues greater than 1 are grouped within 4 factors. Yaşlıoğlu (2017) suggests that factors with eigenvalues exceeding 1 can be considered statistically significant. When the Kaiser criterion (eigenvalue>1) is examined, it is seen that it can explain 58.442% of the variance. Furthermore, the rotated factor loadings

indicate values of 3.717 for the 1st factor, 2.900 for the 2nd factor, 2.636 for the 3rd factor, and 2.436 for the 4th factor.

Table 3. Rotated component matrix and item total correlations

Items	1	2	3	4	Item Total Correlations
Item 1		0.674			0.503
Item 2		0.777			0.534
Item 3		0.712			0.471
Item 5		0.687			0.280
Item 6		0.694			0.524
Item 8				0.634	0.474
Item 9				0.495	0.443
Item 10				0.623	0.320
Item 14				0.654	0.426
Item 15				0.751	0.341
Item 16	0.793				0.334
Item 17	0.856				0.487
Item 18	0.871				0.550
Item 19	0.851				0.537
Item 20	0.880				0.511
Item 21			0.810		0.342
Item 22			0.737		0.290
Item 23			0.694		0.402
Item 24			0.703		0.244
Item 25			0.559		0.245

When examining Table 3, the first factor consists of items 16, 17, 18, 19, 20; the second factor consists of items 1, 2, 3, 5, 6; the third factor consists of items 21, 22, 23, 24, 25, and the fourth factor consists of items 8, 9, 10, 14, 15. When examination of the total correlations among items, it is observed that they range between 0.503 and 0.245.

The 20 items obtained from EFA were loaded into the AMOS 24 program for CFA analysis. The results of the CFA analysis are presented in Table 4.

Table 4. Confirmatory factor analysis results

Model Fit Indices	First Level	Perfect Fit Criterion	Acceptable Fit Criterion
X^2	190.461	$0 \leq X^2 \leq 2sd$	$2sd \leq X^2 \leq 3sd$
Sd	113		
X^2/Sd	1.685	$0 \leq X^2/sd \leq 2$	$2 \leq X^2/sd \leq 3$
p	0.000	$0.05 \leq p \leq 1.00$	$0.01 \leq p \leq 0.05$
RMSEA	0.047	$0.00 \leq RMSEA \leq 0.05$	$0.05 \leq RMSEA \leq 0.08$
GFI	0.935	$0.95 \leq GFI \leq 1.00$	$0.90 \leq GFI \leq 0.95$
AGFI	0.912	$0.90 \leq AGFI \leq 1.00$	$0.85 \leq AGFI \leq 0.90$
NFI	0.929	$0.95 \leq NFI \leq 1.00$	$0.90 \leq NFI \leq 0.95$
RMR	0.070	$0 \leq RMR \leq 0.05$	$0.05 \leq RMR \leq 0.08$
CFI	0.970	$0.95 \leq CFI \leq 1.00$	$0.90 \leq CFI \leq 0.95$
IFI	0.970	$0.95 \leq IFI \leq 1.00$	$0.90 \leq IFI \leq 0.95$

In the CFA results, the X^2 value is 190.461, with a degree of freedom (df) of 113, and X^2/df ratio of 1.685. The p-value is 0.000, RMSEA value is 0.047, GFI value is 0.935, AGFI value is 0.912, NFI value is 0.929, RMR value is 0.070, CFI value is 0.970, and IFI value is 0.970. According to many experts, these values indicate that the model meets the acceptable fit conditions (Bayram, 2004; Bayram, 2010; Erkorkmaz et al., 2013; Hair et al., 1998; Şimşek, 2007).

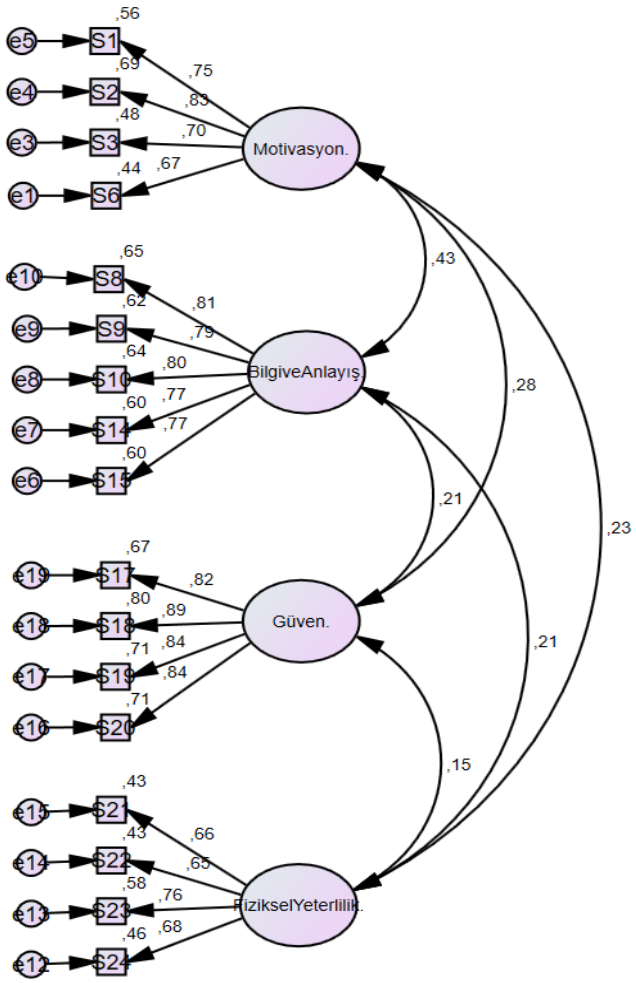

Figure 1. Standardized factor loadings of the scale items obtained from confirmatory factor analysis.
Note: Motivasyon: motivation; Bilgi ve anlayış: knowledge and understanding; Güven: confidence; Fiziksel yeterlilik: physical competence.

In Figure 1, it can be observed that the scale items have standardized loadings ranging from 0.65 to 0.89.

Table 5. Item analysis results

Item Number	Item Number in Draft Scale	Standardized Item Loadings (β1)	R^2 (β2)	Standard Error
1	Item 1	0.745	0.56	0.056
2	Item 2	0.831	0.69	0.050
3	Item 3	0.695	0.48	0.064
4	Item 6	0.665	0.44	0.068
5	Item 8	0.809	0.65	0.061
6	Item 9	0.790	0.62	0.069
7	Item 10	0.802	0.64	0.066
8	Item 14	0.772	0.60	0.070
9	Item 15	0.773	0.60	0.069
10	Item 17	0.821	0.67	0.057
11	Item 18	0.895	0.80	0.045
12	Item 19	0.844	0.71	0.056
13	Item 20	0.844	0.71	0.049
14	Item 21	0.657	0.43	0.102
15	Item 22	0.654	0.43	0.101
16	Item 23	0.759	0.58	0.093
17	Item 24	0.681	0.46	0.099

According to Table 5, the standardized item loadings of the 17 items range between 0.654 and 0.895, R^2 values range between 0.43 and 0.80, and standard errors range between 0.045 and 0.102. When examining the results of EFA and CFA, it can be concluded that the 17-item physical literacy scale is valid according to many experts (Bayram, 2004; Meydan & Şeşen, 2011; Şimşek, 2007).

Scale Reliability

For the reliability of the scale, internal consistency coefficient, AVE, and CR values were examined. Additionally, the scale was applied to the 4th study group consisting of 34 students with a 30-day interval using the test-retest method.

According to the reliability results, for the motivation dimension, the Composite Reliability (CR) value for the motivation dimension 0.82, the AVE value was 0.54, and the Cronbach's Alpha coefficient was 0.821, for the knowledge and understanding dimension, CR value was 0.89, AVE value was 0.62, and Cronbach's Alpha coefficient was 0.892, for the confidence dimension, CR value was 0.91, AVE value was 0.72, and Cronbach's Alpha coefficient was 0.913; and for the physical competence dimension, CR value was 0.78, AVE value was 0.47, and Cronbach's Alpha coefficient was 0.782. Experts suggest that all CR values should be greater than AVE values, and AVE value should be greater than 0.5 (Yaşlıoğlu, 2017), which is satisfied by the obtained results. Moreover, experts indicate that the internal consistency coefficient should be 0.70 or higher (Bayram, 2004; Büyüköztürk, 2009), and the obtained values were observed to be above 0.70. Finally, the reliability coefficient of the data obtained in the test-retest was examined. Accordingly, the reliability coefficient was 0.75 for the motivation dimension, 0.82 for the knowledge and understanding dimension, 0.81 for the confidence dimension, and 0.80 for the physical competence dimension. All these findings indicate the reliability of the developed scale.

DISCUSSION AND CONCLUSION

The aim of this study is to develop a valid and reliable scale to determine the perceived levels of physical literacy of secondary school students. The measurement tool developed this study consists of four sub-dimensions that reveal secondary school students' perceptions of their own physical literacy. These sub-dimensions are motivation, knowledge and understanding, confidence, and physical competence.

The draft form prepared in the study, the draft form prepared based on the literature and expert opinions was presented to the experts for content and scope review. In the analysis performed using the Lawshe technique, three items were excluded from evaluation because it was determined that they measured the same feature as another item. Additionally, seven items were changed in line with expert opinions.

In the context of pilot reliability, the created form was applied to 310 students, and then, then the students' grades were determined by examining Hotelling's T-Squared value (501.358), F value (18.497) and p value ($p<0.05$). The developed measurement tool effectively measures the desired structure. The Bartlett’s sphericity test result was also scrutinized, confirming the

adequacy of inter-variable correlations. Based on these results, it was concluded that the scale consists of homogeneous items and is original.

To assess the suitability of the obtained data for EFA, the Kaiser-Meyer-Olkin (KMO) test value, Bartlett's Test value, and Cronbach's Alpha value were examined, and their suitability and adequacy for EFA were confirmed. In the item analysis, items 4, 7, 11, 12, 13, and 26 were removed from the draft form consisting of 26 items. Therefore, 20 items collected in four factors were considered for evaluation, explaining a variance of 58.442%. Subsequently, the 20 items obtained from the EFA results were applied to the second study group. In the CFA results, items 5, 16, and 25 were excluded. After removing these items, fit indices were checked (X2= 190.461, df= 113, X2/df= 1.685, p= 0.000, RMSEA= 0.047, GFI= 0.935, AGFI= 0.912, NFI= 0.929, RMR= 0.070, CFI= 0.970, and IFI= 0.970), and it was concluded that they met the model fit conditions. Additionally, it was found that the standardized item loadings of the 17 items ranged from 0.654 to 0.895, R2 values ranged from 0.43 to 0.80, and standard errors ranged from 0.045 to 0.102. Through exploratory and confirmatory factor analyses conducted for validity, the 17-item perceived physical literacy scale for secondary school students was found to be valid (Bayram, 2004; Meydan & Şeşen, 2011; Şimşek, 2007). Regarding reliability, the AVE, CR, and internal consistency coefficients of the scale's sub-dimensions were examined, demonstrating that reliability conditions were met.

The final version of the scale consists of four sub-dimensions. The first sub-dimension is called '*Motivation*,' the second sub-dimension is '*Knowledge and Understanding*,' the third sub-dimension is '*Confidence*,' and the fourth sub-dimension is '*Physical Competence*.' The scale, rated on a 5-point Likert scale, ranges from 1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree to 5= Strongly Agree. The lowest score from the scale is 17, while the maximum score is 85.

The research findings indicate that the developed scale is a valid and reliable measurement tool in assessing students' perceived physical literacy. Teachers, coaches, researchers, and stakeholders can utilize the perceived physical literacy scale for secondary school students.

Conflicts of Interest: The authors declare that they have no conflict of interest.

Authors' Contribution: Author/s' contribution to the research should be explained in this section. Research Design-MG, Data Collection-MA, statistical analysis-MA; MG, Preparation of the article, MA; MG; YD.

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APPENDIX. Perceived Physical Literacy Scale for Secondary School Students

		Kesinlikle Katılmıyorum	**Katılmıyorum**	**Kararsızım**	**Katılıyorum**	**Kesinlikle Katılıyorum**
	Motivation					
1.	I enjoy participating in physical activities where I acquire new knowledge.	(1)	(2)	(3)	(4)	(5)
2.	I enjoy participating in physical activities where I acquire new skills.	(1)	(2)	(3)	(4)	(5)
3.	Engaging in physical activities makes me happy.	(1)	(2)	(3)	(4)	(5)
4.	I enjoy participating in physical activities that I can do.	(1)	(2)	(3)	(4)	(5)
	Knowledge and Understanding					
5.	Physical activities are a part of my life.	(1)	(2)	(3)	(4)	(5)
6.	I understand concepts related to physical activity (physical education, sports, etc.).	(1)	(2)	(3)	(4)	(5)
7.	Physical activities help me solve problems I encounter.	(1)	(2)	(3)	(4)	(5)
8.	I research things I am curious about regarding physical activity.	(1)	(2)	(3)	(4)	(5)
9.	I pay great attention to healthy eating.	(1)	(2)	(3)	(4)	(5)
	Confidence					
10.	I always have sufficient motivation to participate in physical activities.	(1)	(2)	(3)	(4)	(5)
11.	Participating in physical activities boosts my self-confidence.	(1)	(2)	(3)	(4)	(5)
12.	Learning new movement skills doesn't take me long.	(1)	(2)	(3)	(4)	(5)
13.	I don't worry about participating in physical activities I haven't tried before.	(1)	(2)	(3)	(4)	(5)
	Physical Competence					
14.	I consider myself skillful in physical activities.	(1)	(2)	(3)	(4)	(5)
15.	I can apply newly learned movement skills in different settings.	(1)	(2)	(3)	(4)	(5)
16.	I can perform challenging (complex) movements.	(1)	(2)	(3)	(4)	(5)
17.	I am quite good at object control movements, such as throwing and catching a ball or hitting a ball with a racket.	(1)	(2)	(3)	(4)	(5)

Ek. Ortaokul Öğrencileri için Algılanan Fiziksel Okuryazarlık Ölçeği

		Kesinlikle Katılmıyorum	**Katılmıyorum**	**Kararsızım**	**Katılıyorum**	**Kesinlikle Katılıyorum**
	Motivasyon					
18.	Yeni bilgiler edindiğim fiziksel aktivitelere katılmaktan hoşlanırım.	(1)	(2)	(3)	(4)	(5)
19.	Yeni beceriler edindiğim fiziksel aktivitelere katılmaktan hoşlanırım.	(1)	(2)	(3)	(4)	(5)
20.	Fiziksel aktivitelere katılmak beni mutlu eder.	(1)	(2)	(3)	(4)	(5)
21.	İyi olduğum fiziksel aktivitelere katılmaktan hoşlanırım.	(1)	(2)	(3)	(4)	(5)
	Bilgi ve Anlayış					
22.	Fiziksel aktiviteler hayatımın bir parçasıdır.	(1)	(2)	(3)	(4)	(5)
23.	Fiziksel aktivite ile ilgili kavramları (beden eğitimi, spor vs) anlarım.	(1)	(2)	(3)	(4)	(5)
24.	Fiziksel aktiviteler karşılaştığım problemleri çözmeme yardımcı olur.	(1)	(2)	(3)	(4)	(5)
25.	Fiziksel aktiviteyle ile ilgili merak ettiklerimi araştırırım.	(1)	(2)	(3)	(4)	(5)
26.	Sağlıklı beslenmeye çok dikkat ederim.	(1)	(2)	(3)	(4)	(5)
	Güven					
27.	Fiziksel aktivitelere katılım için her zaman yeterli motivasyona sahibim.	(1)	(2)	(3)	(4)	(5)
28.	Fiziksel aktivitelere katılmak kendime olan güvenimi artırır.	(1)	(2)	(3)	(4)	(5)
29.	Yeni hareket becerilerini öğrenmem uzun sürmez.	(1)	(2)	(3)	(4)	(5)
30.	Daha önce denemediğim fiziksel aktivitelere katılmaktan endişelenmem	(1)	(2)	(3)	(4)	(5)
	Fiziksel Yeterlilik					
31.	Fiziksel aktivitelerde kendimi yeterince becerikli bulurum.	(1)	(2)	(3)	(4)	(5)
32.	Yeni öğrendiğim hareket becerilerini farklı ortamlarda uygulayabilirim.	(1)	(2)	(3)	(4)	(5)
33.	Zorlayıcı (karmaşık) hareketleri yapabilirim.	(1)	(2)	(3)	(4)	(5)
34.	Top atma-tutma, raket topa vurma gibi nesne kontrolü gerektiren hareket becerilerinde oldukça iyiyimdir.	(1)	(2)	(3)	(4)	(5)

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Adapted Games for the Development of Gross Motor and Manipulative Skills of Primary School Children with Down Syndrome

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Abstract

Among the single-subject research models, the single-start, multiple-probe across-behavior model was used. The population of the research consists of children with down syndrome between the ages of six (6) and ten (10) living in Isparta. The sample of the research was created with two (2) children determined by simple random sampling method from among the families that constitute the population and agreed to participate in the research voluntarily. The research lasted seventeen (17) weeks in total. The children participating in the research were able to walk to the determined target in accordance with the tempo, to run to the determined target in accordance with the tempo, to walk between obstacles, to run through obstacles, to walk on a balance board, to jump from the step board to the ground with two feet, to jump from the ground to the step board with two feet, to reach the target with both hands. It is aimed to develop the skills of throwing the ball, throwing the ball to the target with the right hand, and throwing the ball to the target with the left hand. A behavior observation form was used to collect data. The data obtained at the end of the application was analyzed by showing it on a graph. The data obtained in the research were converted into line graphs. It was concluded that children learn simple movements faster than complex movements. It was concluded that the adapted game-based movement training program was effective in the development of psychomotor skills of children with Down syndrome.
Keywords: Down syndrom, Educational game, Education

İlkokul Çağındaki Down Sendromlu Çocukların Kaba Motor ve Manipülatif Becerilerinin Geliştirilmesinde Uyarlanmış Oyunlar

Öz

Tek denekli araştırma modellerinden tekli başlangıç, davranışlar arası çoklu yoklama modeli kullanılmıştır. Araştırmanın evrenini, Isparta ilinde yaşayan, altı (6) ile on (10) yaş aralığındaki down sendromlu çocuklar oluşturmaktadır. Araştırmanın örneklemi ise, evreni oluşturan ve araştırmaya gönüllü olarak katılmayı kabul eden ailelerin arasından basit tesadüfi örnekleme yöntemiyle belirlenen iki (2) çocuk ile oluşturulmuştur. Araştırma toplamda on yedi (17) hafta sürmüştür. Araştırmaya katılan çocukların, belirlenen hedefe tempoya uygun yürüme, belirlenen hedefe tempoya uygun koşma, engellerin arasından yürüme, engellerin arasından koşma, denge tahtası üzerinde yürüme, çift ayak ile step tahtasının üzerinden yere sıçrama, çift ayak ile yerden step tahtasının üzerine sıçrama, hedefe çift elle top atma, hedefe sağ el ile top atma, hedefe sol el ile top atma becerilerinin geliştirilmesi hedeflenmiştir. Verilerin toplanmasında davranış gözlem formu kullanılmıştır. Uygulama sonunda elde edilen veriler, grafik üzerinde gösterilerek analiz edilmiştir. Araştırmada elde edilen veriler çizgi grafiğe dönüştürülmüştür. Çocukların yaşı basit hareketleri karmaşık hareketlere göre daha çabuk öğrendikleri sonucuna varılmıştır. Uyarlanmış oyun temelli hareket eğitim programının down sendromlu çocukların psikomotor becerilerinin gelişiminde etkili olduğu sonucuna ulaşılmıştır.
Anahtar kelimeler: Down sendrom, Eğitsel oyun, Eğitim

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INTRODUCTION

Play is one of the most important tools through which we can observe children's development from every aspect. In addition to contributing to the development of children, games are also seen as an educational tool through which children spend their energy and interact with their peers. It is commonly recognized that games help children with normal development as well as those with Down syndrome, who are categorized as children with special needs, to advance their knowledge, abilities, and mental and physical capacities (Gözün-Kahraman and Kılınç, 2022).

Down Syndrome (DS) is one of the developmental disorders caused by chromosomal disorder (Sugimoto et al., 2016). Chromosome variations are the only distinguishing factor between individuals with Down syndrome and the ones without DS. These who have one more chromosome than the normal human being, have physical differences due to their extra chromosome. Children with DS show some deficits in psychomotor, cognitive and emotional domains. These deficiencies restrict DS children's daily living activities and their ability to learn and perform appropriate movements (Horvat et al., 2013). When the activities or physical activities of children with Down Syndrome are examined, it is known that they participate in or prefer different sports such as walking, swimming, bowling, dancing and team sports (Bardak et al., 2022; Gutiérrez-Vilahú et al., 2016; Pitteti et al., 2012; Popa and Galeru, 2012).

Children with DS may experience delays in motor development and other areas. It is known that motor development in these children requires twice the time required by an average normal child. Children with DS acquire gross motor skills at different ages than typically developing children, and as the skills become more complex, the difference in the process of acquiring the skills increases (Pereira et al., 2013). As it is known, gross motor skills include skills such as walking, running, jumping, etc. performed by large muscle groups. In addition, it is known that there are skills such as hitting a stationary ball, bouncing the ball, catching, throwing and rolling the ball, which are known as manipulative skills (Breckenridge and Vincet, 1955; Davis, 1984; Davis and Burton, 1991; Gallahue, 1996; Wickstrom, 1977). Children with DS enjoy physical activities and participate in them more easily; it has been revealed that those with poor motor skills and lack of coordination are less interested in physical activity (Barr and Shields, 2011). It is known that he willingly participates in such game activities, the most important of which is games. Normally, when a child starts playing with other children, he compares himself and begins to see his own strengths and weaknesses. He tries to compare himself with others during games. He realizes his adequacy and deficiencies (Aracı, 1999).

In terms of the physical development of DS children through games, as well as the development of their gross motor skills and manipulative skills, games adapted to these features can help DS children develop social adaptation and skills. When the literature is examined, it is thought that more studies on sports activities in children with Down syndrome (Ilkım et al., 2018; Uğur-Mutlu and Haşıl-Korkmaz, 2021) are necessary. There are not many studies on adapted games for children with Down syndrome. In line with all this information, this study aimed to determine whether there are differences in the skill levels of primary school children with Down syndrome who regularly participate in adapted games in the development of their gross motor and manipulative skills.

MATERIAL AND METHODS

Research Model

Among the single-subject research models, the single-start, multiple-probe across-behavior model was used. In the multiple probe model between behaviors with a single initial probe phase, it is a research model in which measurements are made throughout the study in order to follow the same behavior after a measurement is made about the target behavior before the study (Karasar, 2022; Özdamar, 2003; Sarı, 2015; Şata 2020).

Research Group

The population of the research consists of children with Down syndrome between the ages of six (6) and ten (10) living in Isparta. The sample for the research was created with two (2) children determined by simple random sampling method from among the families that constitute the population and agreed to participate in the research voluntarily. Written consent was obtained from the children's families to provide educational game activities to the selected children.

Procedures

The research lasted seventeen (17) weeks in total, including one (1) week of observation and sixteen (16) weeks of application. During the research, the same educational game program was applied to both (2) children. The children participating in the research were able to walk to the determined target in accordance with the tempo, to run to the determined target in accordance with the tempo, to walk through obstacles, to run through obstacles, to walk on a balance board, to jump from the step board to the ground with two feet, to jump from the ground to the step board with two feet, to reach the target with both hands. It is aimed to develop the skills of throwing the ball, throwing the ball to the target with the right hand, and throwing the ball to the target with the left hand. While teaching these skills, a program prepared in educational game format was applied.

Ethical Approval

Ethics committee approval was received for this study from SDU Faculty of Medicine Clinical Research Ethics Committee (E- 87432956-050.99-621066, Date:07.11.2023).

Data Collection Tools

A behavior observation form was used to collect data. It is used if the aim is to increase or decrease the number of a behavior. Behavior must have a clear beginning and end. In this type of recording, the observer counts the number of times the behavior occurred during the specified observation time (Vuran, 2017).

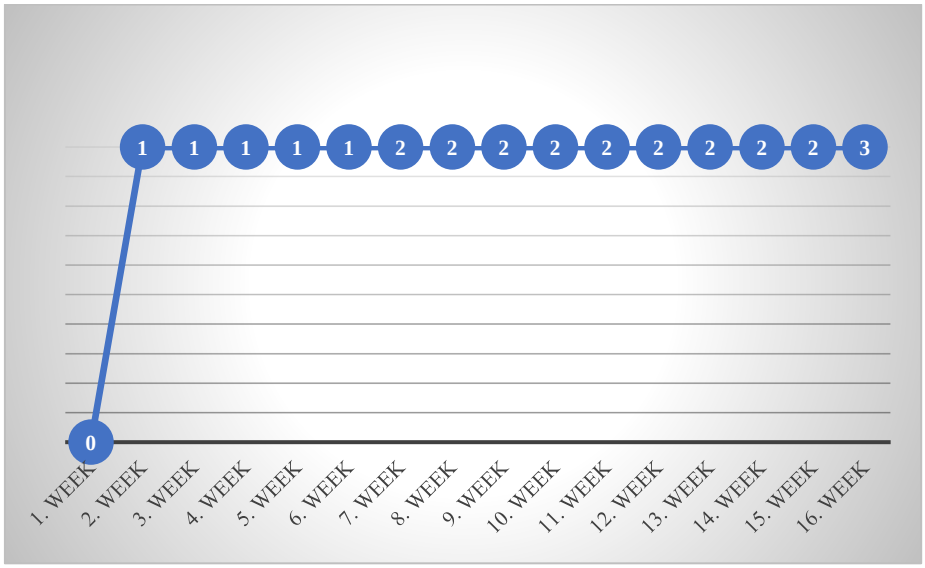
Analysis of Data

The data obtained at the end of the application was analyzed by showing it on a graph. Since the number of participants in the research was two (2), the data obtained during the sixteen (16) week period was converted into point scores in accordance with the scale protocol and turned into a line graph to reveal the change (Özdamar, 2013).

FINDINGS

This section includes the reporting of the data obtained from the education program applied to the children participating in the research in the form of graphic analysis. In order to respect personal rights, the children's names and surnames are not clearly written. Children were coded as Participant 1, Participant 2.

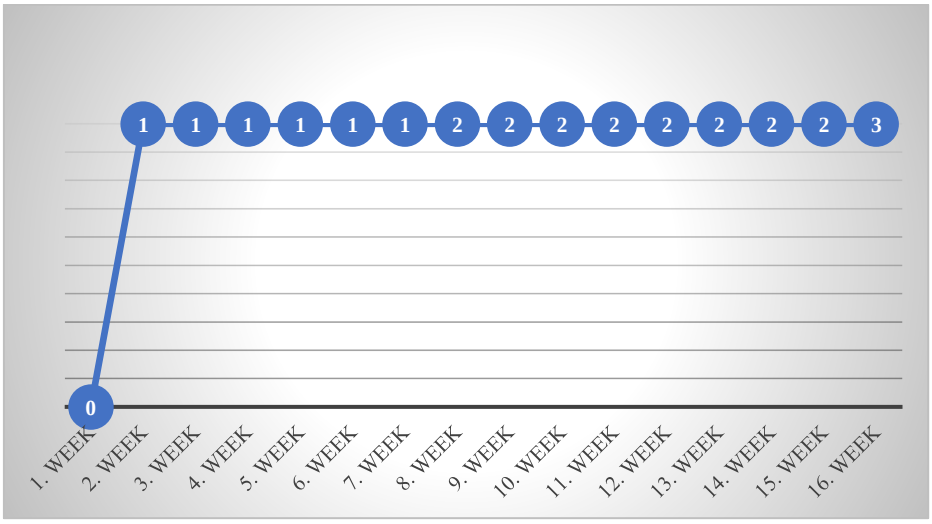
Analysis results of the first participant child



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 1. Walks in accordance with the tempo between the determined target(10m)

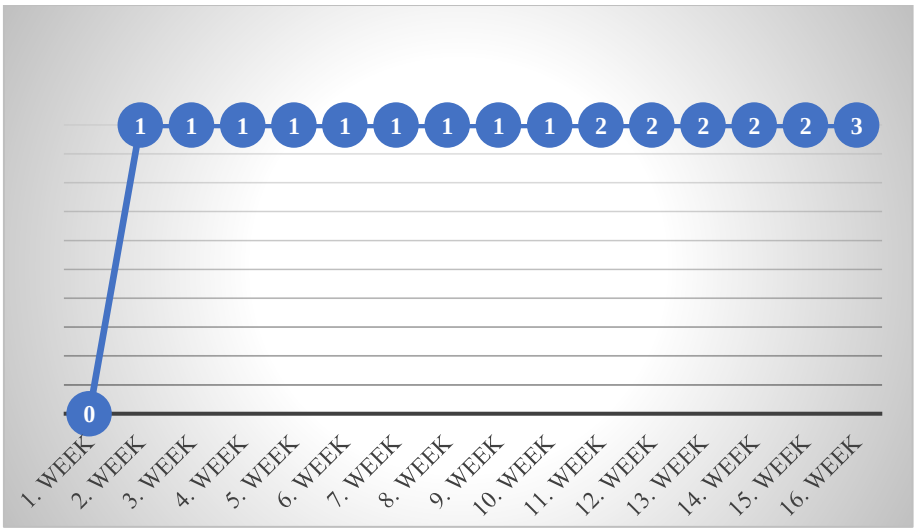
Looking at the results in Figure 1, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and sixth weeks, the child could perform the same movement as desired with physical assistance. Between the seventh and fifteenth weeks, it was observed that he could do the movement with the help of a model. In the sixteenth week, it was observed that the child could perform the movement independently and as desired when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 2. Runs according to the tempo between the determined target(10m)

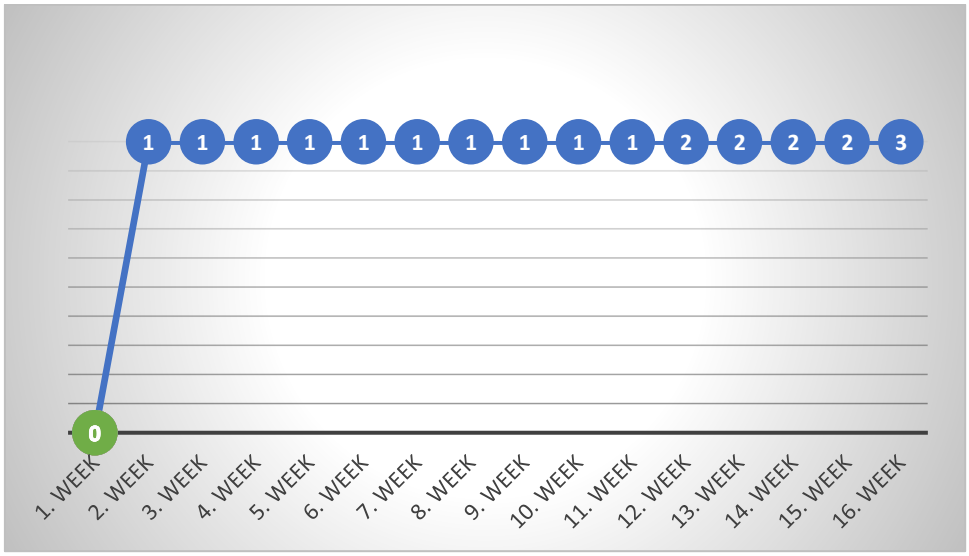
Looking at the results in Figure 2, it was seen that the child could not perform the skill requested from him in the first week in the desired way. In the second and seventh weeks, it was observed that the same movement could be performed as desired with physical assistance. Between the eighth and fifteenth weeks, it was observed that he could do the movement with the help of a model. At the sixteenth week, it was observed that the child could perform the movement independently as desired when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 3. Walks through obstacles (5 obstacles)

Looking at the results in Figure 3, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and tenth weeks, the same movement could be performed as desired with physical assistance. It was observed that the child could perform the movement with the help of a model between the eleventh and fifteenth weeks. At the sixteenth week, it was observed that the child could perform the movement independently as desired when given a command.

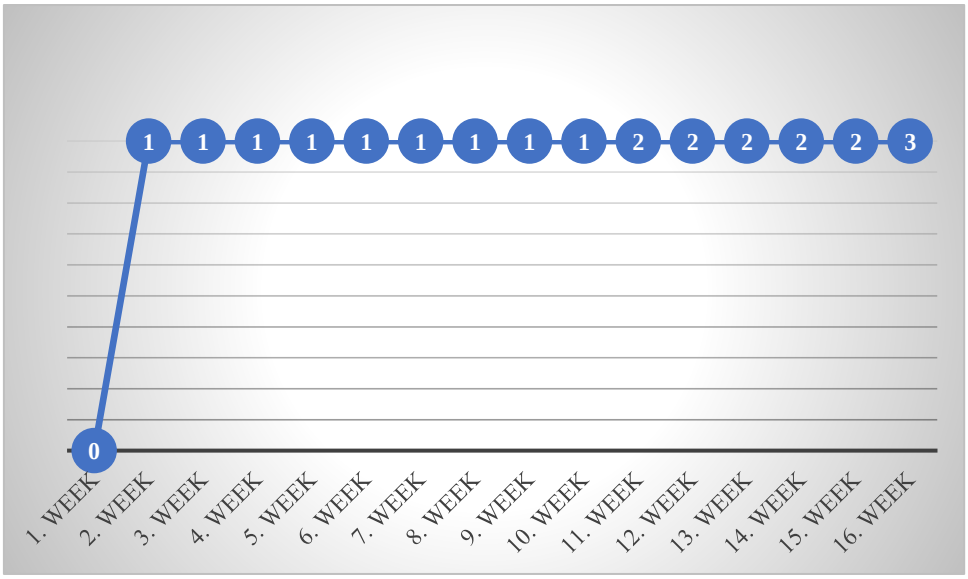


1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 4. Runs through obstacles (5 obstacles)

Looking at the results in Figure 4, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and eleventh weeks, the child could perform the same movement as desired with physical assistance. It was observed

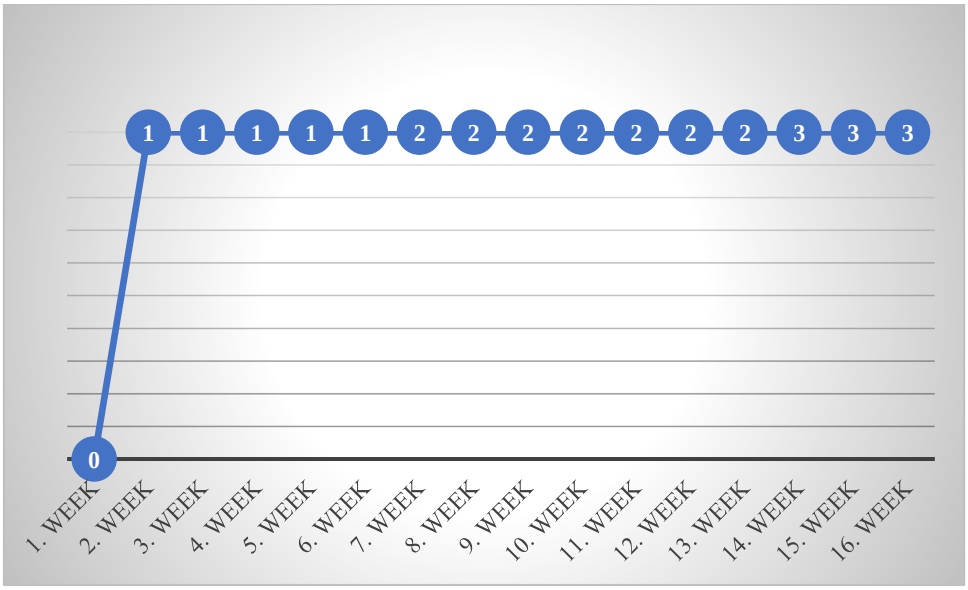
that the child could perform the movement with the help of a model between the eleventh and fifteenth weeks. At the sixteenth week, it was observed that the child could perform the movement independently as desired when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 5. Walks on balance board (10cm width, 3m length)

Looking at the results in Figure 5, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and tenth weeks, the child could perform the same movement as desired with physical assistance. Between the eleventh and fifteenth weeks, it was observed that he could do the movement with the help of a model. At the sixteenth week, it was observed that the child could perform the movement independently as desired when given a command.

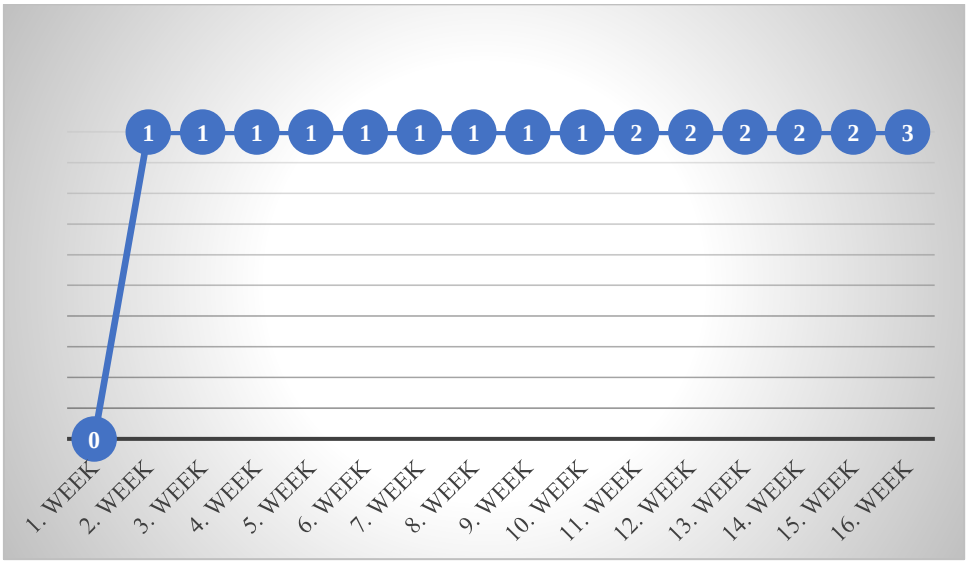


1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 6. Double foot jumps over the step board to the ground (10cm high)

Looking at the results in Figure 6, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and sixth weeks, the

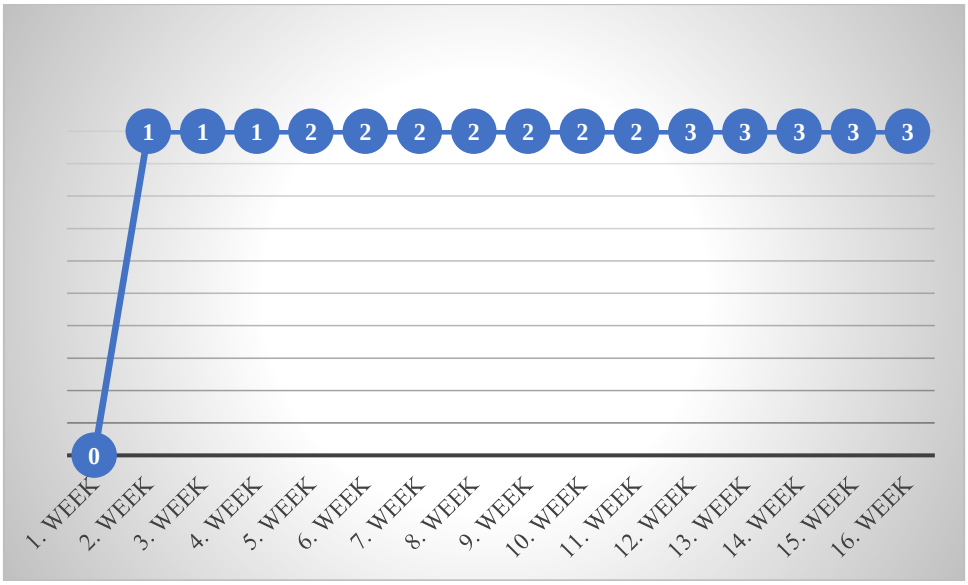
child could perform the same movement as desired with physical assistance. Between the seventh and thirteenth weeks, it was observed that he could do the movement with the help of a model. Between the fourteenth and sixteenth weeks, it was observed that the child could perform the movement independently when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 7. Double feet jump from the ground onto the step board (10cm high)

Looking at the results in Figure 7, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that the child could perform the same movement as desired with physical assistance in the second and tenth weeks. Between the eleventh and fifteenth weeks, it was observed that he could do the movement with the help of a model. At the sixteenth week, it was observed that the child could perform the movement independently as desired when given a command.

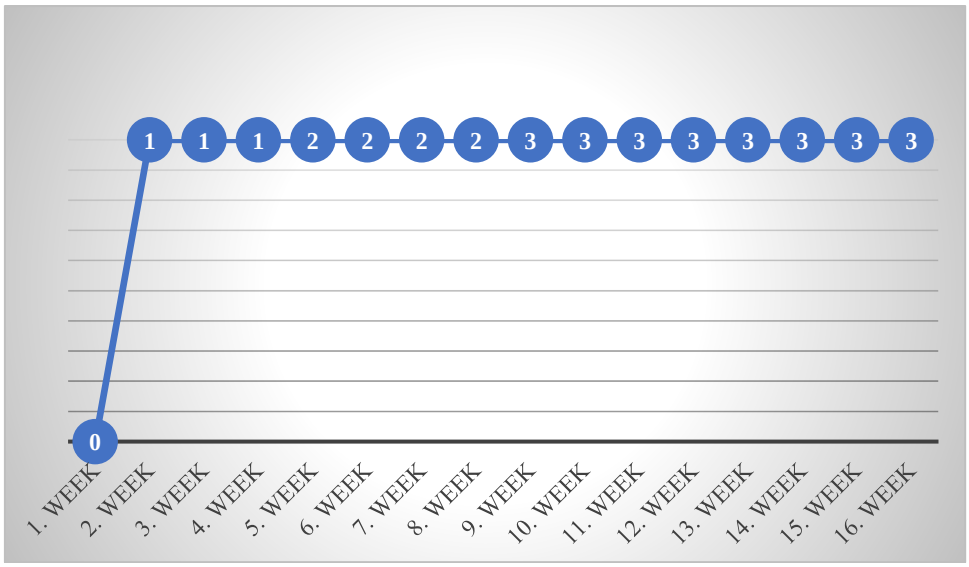


1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 8. Throwing a ball to the target with two hands (3m distance)

Looking at the results in Figure 8, it was seen that the child could not perform the skill requested in the first week in the desired way. In the second and fourth weeks, it was observed that the same movement could be performed as desired with physical assistance. It was observed that

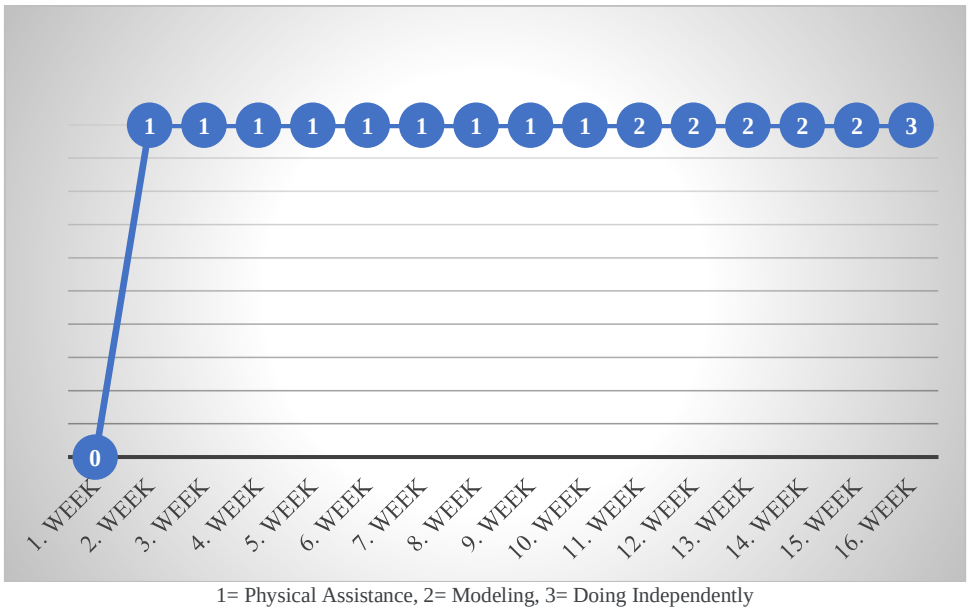
the child could perform the movement with the help of a model between the fifth and eleventh weeks. In the twelfth to sixteenth weeks, it was observed that the child could perform the movement independently when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 9. Throwing the ball to the target with right hand (3m distance)

Looking at the results in Figure 9, it was seen that the child could not perform the skill requested in the first week in the desired way. In the second and fourth weeks, it was observed that the same movement could be performed as desired with physical assistance. It was observed that the child could perform the movement with the help of a model between the fifth and eighth weeks. Between the ninth and sixteenth weeks, it was observed that the child could independently perform the movement as desired when given a command.



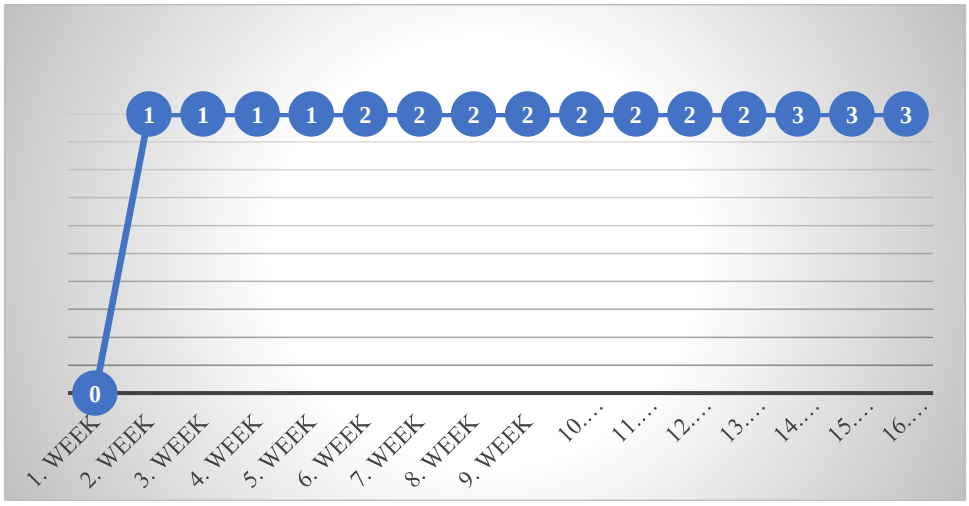
1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 10. Throwing the ball to the target with left hand (3m distance)

Looking at the results in Figure 10, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and tenth weeks, the same movement could be performed as desired with physical assistance. Between the eleventh and fifteenth weeks, it was observed that he could do the movement with the help

of a model. At the sixteenth week, it was observed that the child could perform the movement independently as desired when given a command.

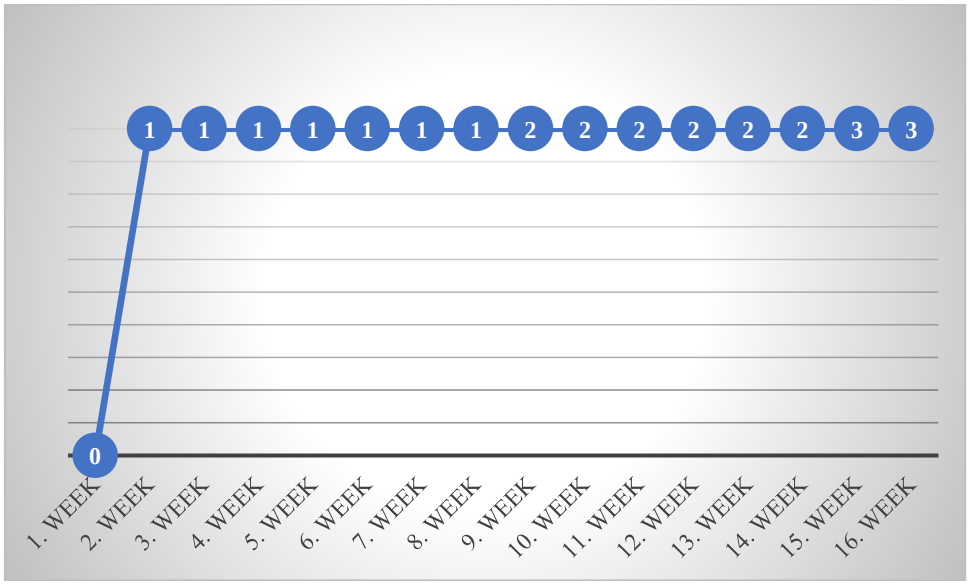
Analysis results of the second participant child



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 11. Walks in accordance with the tempo between the determined target (10m)

Looking at the results in Figure 1, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and fifth weeks, he could perform the same movement as desired with physical assistance. Between the seventh and thirteenth weeks, it was observed that he could do the movement with the help of a model. In the fourteenth to sixteenth weeks, it was observed that the child could perform the movement independently and as desired when given a command.

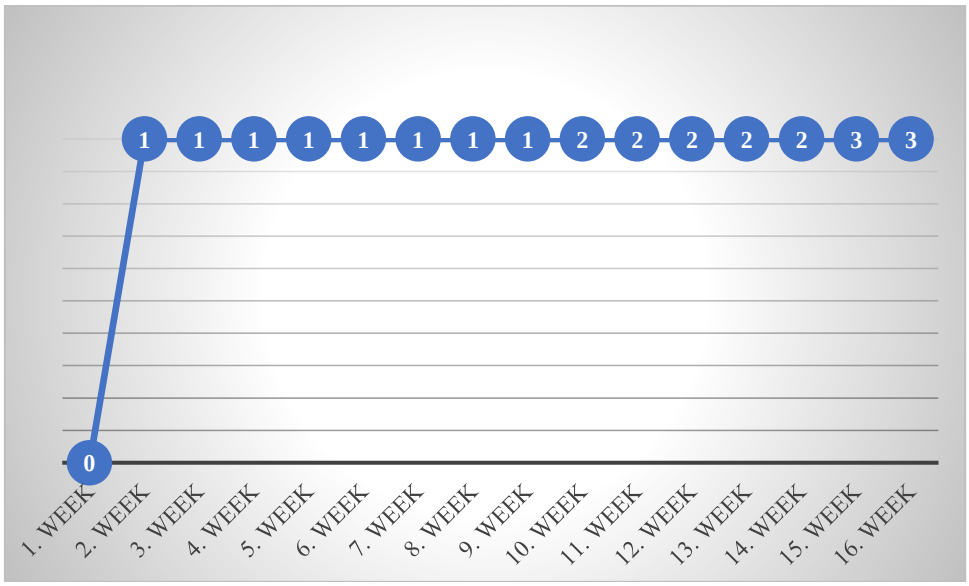


1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 12. Runs according to the tempo between the determined target (10m)

Looking at the results in Figure 2, it was seen that the child could not perform the skill requested from him in the first week in the desired way. It was observed that in the second and eighth weeks, he could perform the same movement as desired with physical assistance. Between the ninth and fourteenth weeks, it was observed that he could do the movement with the help of a

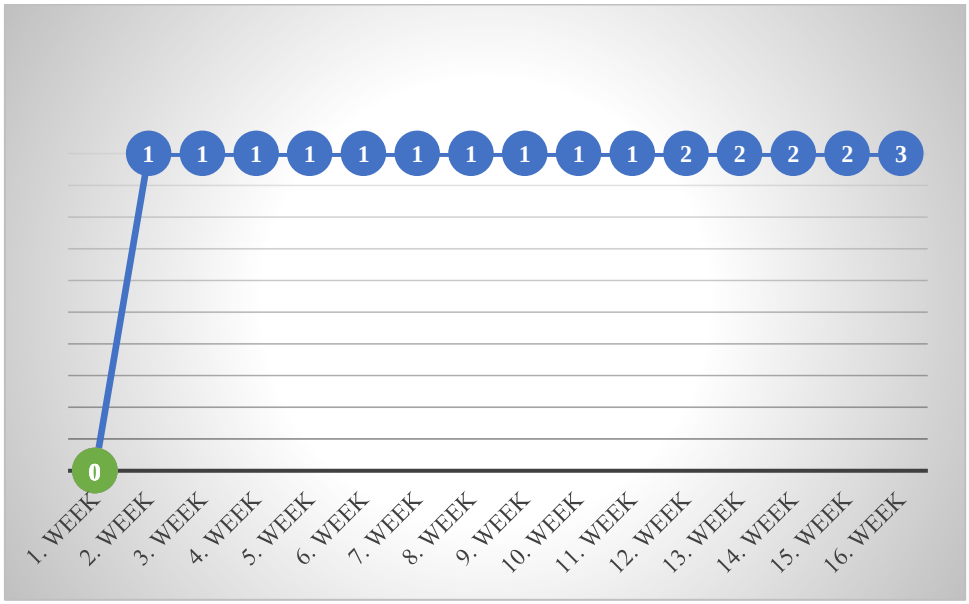
model. In the fifteenth and sixteenth weeks, it was observed that the child could perform the movement independently and as desired when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 13: Walks through obstacles (5 pieces)

Looking at the results in Figure 3, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and ninth weeks he could perform the same movement as desired with physical assistance. Between the tenth and fourteenth weeks, it was observed that he could do the movement with the help of a model. In the fifteenth and sixteenth weeks, it was observed that the child could perform the movement independently and as desired when given a command.

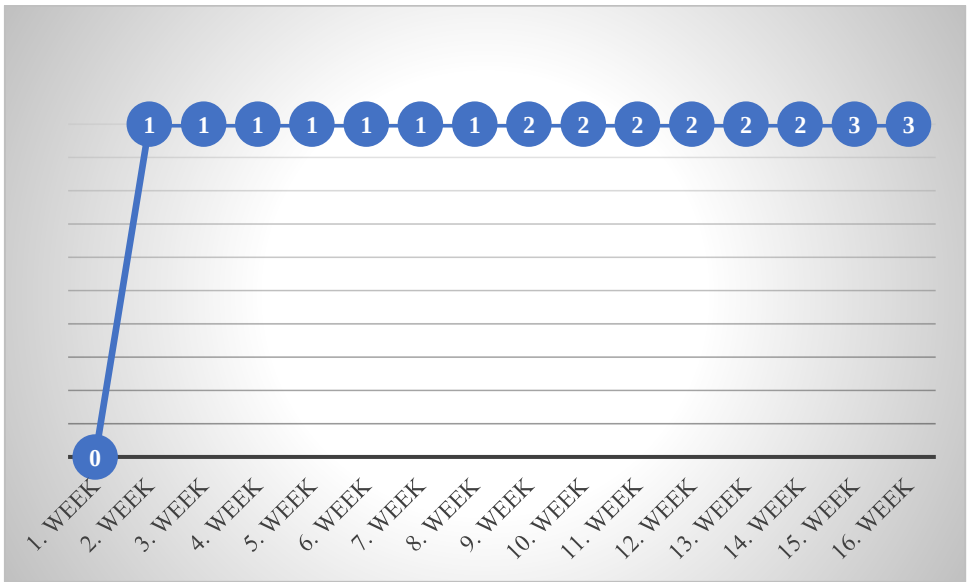


1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 14. Runs through obstacles (5 obstacles)

Looking at the results in Figure 4, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and eleventh weeks he could perform the same movement as desired with physical assistance. Between the twelfth and fifteenth weeks, it was observed that he could do the movement with the help of a model.

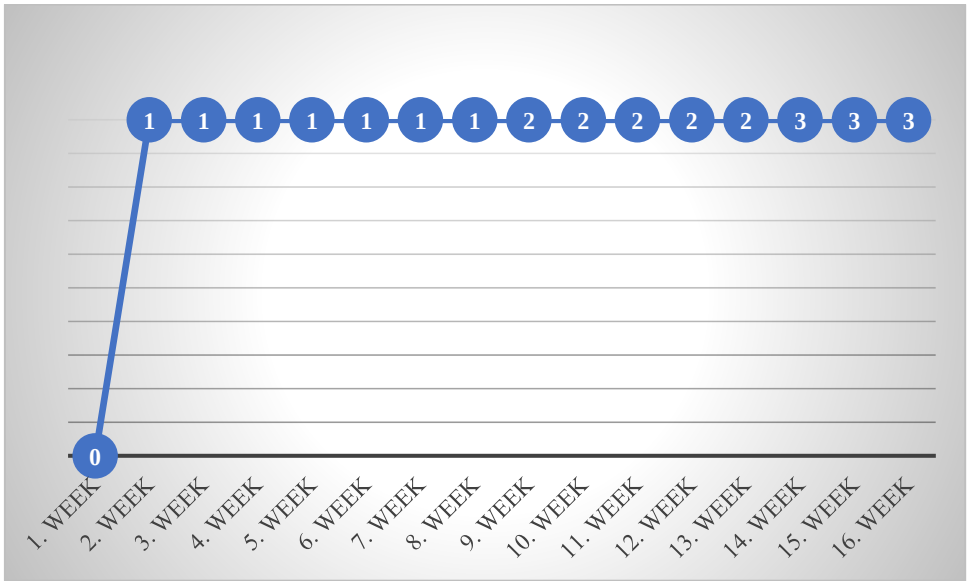
In the sixteenth week, it was observed that the child could perform the movement independently and as desired when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 15. Walks on obstacle board (10cm wide)

Looking at the results in Figure 5, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and eighth weeks, he could perform the same movement as desired with physical assistance. Between the ninth and fourteenth weeks, it was observed that he could do the movement with the help of a model. In the fifteenth and sixteenth weeks, it was observed that the child could perform the movement independently and as desired when given a command.

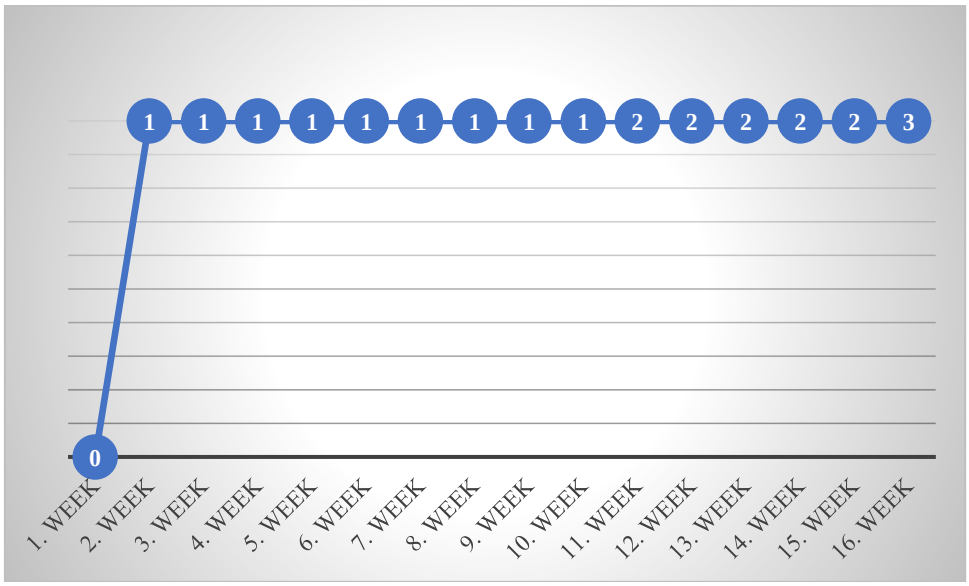


1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 16. Bounce from the double footstep board to the ground (10cm high)

Looking at the results in Figure 6, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and eighth weeks, he could perform the same movement as desired with physical assistance. Between the ninth and thirteenth weeks, it was observed that he could do the movement with the help of a model. In

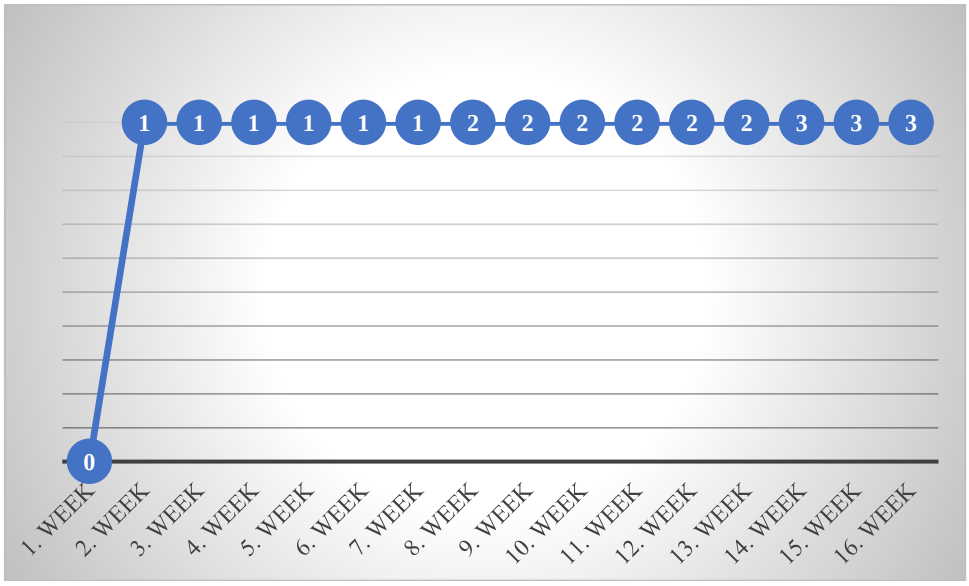
the fourteenth and sixteenth weeks, it was observed that the child could perform the movement independently and as desired when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 17. Bounce from the double footstep board to the ground (10cm high)

Looking at the results in Figure 7, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and tenth weeks he could perform the same movement as desired with physical assistance. Between the eleventh and fifteenth weeks, it was observed that he could do the movement with the help of a model. At the sixteenth week, it was observed that the child could perform the movement independently and as desired when given a command.

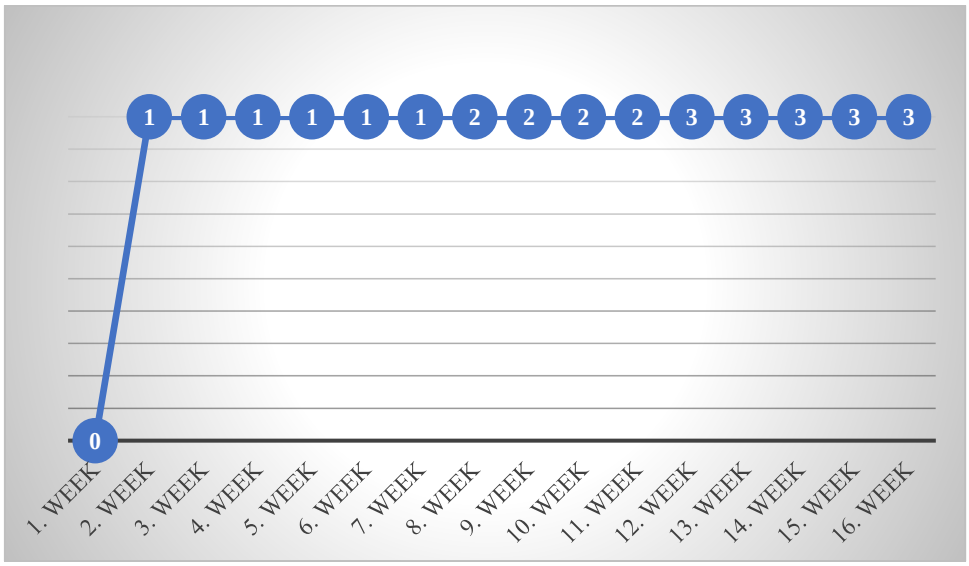


1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 18. Throwing a ball to the target with two hands (3m distance)

Looking at the results in Figure 8, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and seventh weeks, he could perform the same movement as desired with physical assistance. Between the eighth and thirteenth weeks, it was observed that he could do the movement with the help of a model. In

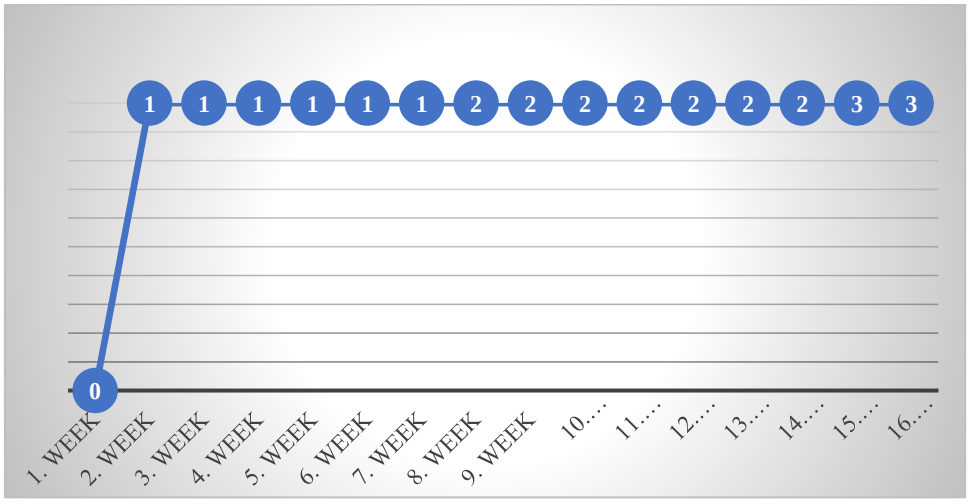
the fourteenth and sixteenth weeks, it was observed that the child could perform the movement independently and as desired when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 19. Throwing the ball to the target with right hand (3m distance)

Looking at the results in Figure 9, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and seventh weeks, he could perform the same movement as desired with physical assistance. Between the eighth and eleventh weeks, it was observed that he could do the movement with the help of a model. In the twelfth and sixteenth weeks, it was observed that the child could perform the movement independently and as desired when given a command.



1= Physical Assistance, 2= Modeling, 3= Doing Independently

Figure 20. Throwing the ball to the target with left hand (3m distance)

Looking at the results in Figure 10, it was seen that the child could not perform the skill requested in the first week in the desired way. It was observed that in the second and seventh weeks, he could perform the same movement as desired with physical assistance. Between the eighth and fourteenth weeks, it was observed that he could do the movement with the help of a model. In the fifteenth and sixteenth weeks, it was observed that the child could make the movement independently and as desired when given a command.

DISCUSSION

When the results obtained from the research were evaluated, it was determined that both children were inadequate in exhibiting the motor skills required from them at first. As the study continued, it was observed that they were able to perform the skills gradually. It has been observed that activities prepared and implemented in accordance with children's developmental levels are effective in the development of children's motor skills. It was determined that as the level of movements became more difficult for both children, there was also a difference in the time it took to perform the movements independently. In other words, while they were able to perform easy movements independently in a shorter time, it was observed that the time to perform more difficult movements independently increased. When the research findings are examined, it has been determined that the independent performance of movement skills that require strength, balance, speed and coordination is longer. Based on all these findings, it can be said that play activities prepared according to the development levels of children influence the development of motor skills of children with Down syndrome.

Considering the results of the studies obtained in the literature review, it is reported that people with Down syndrome are behind their peers with and without special needs, especially in motor skills, and that their participation in sports is extremely important for the development of their motor skills (Boer, 2023; Cai and Baek, 2022). In Nalbant's (2011), doctoral thesis study on people with Down syndrome, he concluded that there was a continuous increase in the locomotor skills of individuals with Down syndrome who participated in a physical activity program during the fourteen-week period. As a result of Şenlik's (2017), study with children with Down syndrome, it was determined that physical education lessons had positive effects on both the motor skills and psychological adaptation levels of children with Down syndrome. In the study conducted by Karabürk (2019), it was concluded that sports training applied with the traditional method could improve balance in 6 weeks in children with Down syndrome in the similar age group.

As a result of the study conducted by Mirze (2020), it was determined that the program of adapted physical education and game activities applied for 16 weeks had a positive effect on the physical fitness and motor skills of individuals with Down syndrome. As a result of Uzuner's (2016) study, children with Down syndrome are slower than their peers in terms of fine motor skills, strength and agility, balance, and motor skill levels including upper, lower extremity and manual coordination, and therefore children with down syndrome should be treated as early as possible. It has been determined that including physical activities that will improve motor skills is important in the development of motor skills. As a result of his study, Demir (2021), found that the motor skills of children with Down syndrome can be improved through physical exercises. As a result of Yana's (2021), study, she found that sensory integration exercises have a positive contribution to the development of motor skills of children with Down syndrome. As a result of his study, Özata (2023,) determined that physical activities are important in developing the balance, coordination and motor skills of children with Down syndrome. In the study conducted by Çoban (2019), it was reported that exercise caused changes in individuals' skills such as balance, focus, and attention. As a result of the research conducted by Kulak et al. (2011), and Covain et al. (2023), they reported that physical activities contribute to the development of balance, flexibility, and speed skills.

CONCLUSION

While children could not independently perform the desired behaviors before starting the training, it was observed that when the children were given the opportunity to repeat the activities prepared and implemented in accordance with their developmental levels with intermittent repetitions, they were able to perform the desired movements independently and showed improvement. It was also determined that the children's age contributed to the ease of movement on the materials consisting of large surface floors and learning. It was concluded that children learn simple movements faster than complex movements. It has been observed that children can use these sides better because their right side is dominant. It was concluded that the adapted game-based movement training program was effective in the development of psychomotor skills such as walking, running, jumping and throwing for children with mild Down syndrome.

RECOMMENDATIONS

Nowadays, when the importance of doing game-based activities is increasing, different studies can be carried out by involving different disciplines on how sports skill performance can be increased to a higher level, as well as being effective in the motor skill development of individuals, especially in childhood.

Conflict of Interest: There are no personal or financial conflicts of interest among the authors regarding the scope of the study.

Authors' Contribution: Study Design; HA, EÇ –Data Collection; HA, EÇ –Statistical analysis; HA –Manuscript Preparation; HA, EÇ.

Ethical Approval
Ethics Committee: Süleyman Demirel University Faculty of Medicine Clinical Research Ethics Committee
Date: 07.11.2023
Decision/Protocol number: E- 87432956-050.99-621066

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Enhancing Anaerobic Performance in Kickboxers: The Strategic Role of Short-Duration Napping

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Research Article
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Abstract

The intricate relationship between sleep and athletic performance has long been a subject of interest in sports science. This study delves into the specific impact of short-duration napping on anaerobic performance parameters in the study of kickboxing, an intense combat sport demanding both physical prowess and strategic acumen. We conducted a controlled investigation with 14 young elite male kickboxers, characterized by an average age of 20.29 ± 0.80 years, a height of 174.48 ± 4.11 cm, body masses of 70.46 ± 7.78 kg, and a body mass index (BMI) of 23.12 ± 2.02 kg/m². The experimental design encompassed three distinct conditions: no napping (N0), a 25-minute nap (N25), and a 45-minute nap (N45). The evaluation focused on several key performance metrics, including countermovement jump (CMJ), mean power, and peak power outputs. Intriguingly, our findings indicated that while CMJ values remained relatively unaffected by the napping conditions, significant variations were observed in both mean and peak power outputs, particularly among participants who napped. These variations suggest that napping, even for short durations, can significantly influence certain anaerobic performance parameters in kickboxers, with a marked improvement in power-related aspects. This research contributes to the expanding body of literature on the role of sleep and rest in athletic performance, specifically highlighting the potential of napping as an effective strategy for enhancing physical capabilities in combat sports. The implications of these findings extend beyond the realm of kickboxing, offering valuable insights and practical applications for athletic training and performance optimization across various sports disciplines where anaerobic capabilities are crucial.
Keywords: Anaerobic performance, Kickboxing, Napping, Peak power output, Sports performance optimization

Kickboksta Anaerobik Performansı Arttırmak: Kısa Süreli Şekerlemenin Stratejik Rolü

Öz

Uyku ile atletik performans arasındaki karmaşık ilişki, uzun zamandır spor bilimlerinin ilgi alanında yer almaktadır. Bu çalışma, fiziksel güç ve stratejik akıl gerektiren yoğun bir dövüş sporu olan kickboks bağlamında kısa süreli şekerlemenin anaerobik performans parametreleri üzerindeki özel etkisini incelemektedir. Ortalama yaşları 20.29 ± 0.80, boy ortalamaları 174.48 ± 4.11 cm, vücut ağırlıkları 70.46 ± 7.78 kg ve vücut kütle indeksi (VKİ) 23.12 ± 2.02 kg/m² olan 14 genç elit erkek kickboksçu ile kontrollü bir araştırma gerçekleştirilmiştir. Deneysel tasarım, üç farklı durumu kapsamaktadır: şekerleme yok (N0), 25 dakikalık şekerleme (N25) ve 45 dakikalık şekerleme (N45). Değerlendirme, countermovement sıçraması (CMJ), ortalama güç ve tepe güç çıkışları dahil olmak üzere birçok anahtar performans metriğine odaklanmıştır. Bulgularımız, ilginç bir şekilde, şekerleme koşullarının CMJ değerlerini nispeten etkilememiş olmasına karşın, özellikle şekerleme yapan katılımcılar arasında hem ortalama hem de zirve güç çıkışlarında önemli değişiklikler gözlemlendiğini göstermektedir. Bu değişiklikler, kısa süreli şekerlemenin, özellikle güçle ilgili yönlerde, kickboksçularda belirli anaerobik performans parametrelerini önemli ölçüde etkileyebileceğini düşündürmektedir. Bu araştırma, uyku ve dinlenmenin atletik performanstaki rolü üzerine genişleyen literatüre katkıda bulunmakta, özellikle kısa süreli şekerlemenin dövüş sporlarında fiziksel yetenekleri arttırmak için etkili bir strateji olarak potansiyelini vurgulamaktadır. Bu bulguların etkileri, kickboks alanını aşarak, anaerobik yeteneklerin kritik olduğu çeşitli spor disiplinlerinde antrenman ve performans optimizasyonu için değerli içgörüler ve pratik uygulamalar sunmaktadır.
Anahtar Kelimeler: Anaerobik performans, Kickboks, Şekerleme, Zirve güç çıkışı, Spor performansı optimizasyonu

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INTRODUCTION

The exploration of effective performance enhancement strategies in combat sports has become a focal point in sports science research (Matsumoto et al., 2009; Russo & Ottoboni, 2019). Among various interventions, strategic napping has garnered attention for its potential to augment athletic capabilities (Teece et al., 2023; Yagin et al., 2022). This study specifically investigates the impact of strategic napping on anaerobic performance parameters in kickboxers.

Anaerobic performance is crucial in martial arts sports, where short bursts of high-intensity activity are paramount (Bayer et al., 2023; Bayrakdaroğlu & Can, 2018; Chaabène et al., 2015; Slimani et al., 2017). Parameters such as power output and explosive strength are key determinants of success in the ring (Laett et al., 2023). Understanding how various factors, including rest and recovery strategies like napping, affect these parameters can provide valuable insights for training and preparation. The concept of strategic napping, particularly in high-intensity sports like kickboxing, goes beyond mere rest. It encompasses a targeted approach to optimize physiological and cognitive functions that are critical for peak performance (Nindl et al., 2015). In disciplines such as kickboxing, where split-second decisions and rapid force generation are essential, even marginal gains in performance can be the difference between victory and defeat (Chaabene et al., 2019). Thus, understanding the nuanced effects of napping on physical and cognitive abilities becomes paramount (Marshall & Turner, 2016).

Previous research has indicated that sleep quality and duration significantly influence athletic performance, recovery, and overall well-being (Jones et al., 2020; Sawczuk et al., 2018). However, the specific role of napping, especially of varied durations, remains underexplored, particularly in the context of combat sports (Dinges, 1989; Lovato & Lack, 2010). This gap in research presents an opportunity to delve deeper into how short-term rest periods during the day can affect physical performance, especially in sports requiring high anaerobic capacity.

This study endeavors to fill a notable gap in sports science research by rigorously assessing the impact of napping of varied durations on key anaerobic performance metrics within the context of kickboxing. Focusing on quantifiable outcomes such as the countermovement jump (CMJ), mean power, and peak power, this research aims to provide robust empirical evidence regarding the efficacy of napping as a tool for enhancing athletic performance. The choice of kickboxers as the subject population is particularly pertinent, considering the sport's inherent requirements for both physical strength and strategic acumen. Consequently, this investigation into the effects of napping is especially relevant and timely. The overarching significance of this research is anchored in its potential to fundamentally transform training and recovery methodologies in combat sports, with a specific focus on kickboxing. By integrating the concept of strategic napping into athletic routines, this study posits a novel and pragmatic approach to performance enhancement. The central hypothesis underpinning this research posits that napping, particularly of short durations, will exert a positive influence on specific anaerobic performance parameters in kickboxers, most notably in the domains of mean and peak power outputs. This hypothesis is predicated on the assumption that adequate rest, even when administered in brief periods, can substantially enhance high-intensity athletic performance. This enhancement is theorized to occur through the optimization of physiological

recovery processes and the enhancement of mental acuity. This study, therefore, not only aims to substantiate the utility of napping in sports contexts but also seeks to lay the groundwork for future explorations into the broader implications and benefits of rest and recuperation strategies in high-performance athletic settings.

MATERIAL AND METHODS

Research Model

This study employs a crossover randomized controlled trial to investigate the effects of strategic napping on anaerobic performance among kickboxers. Participants were subjected to three distinct conditions: No nap, a 25-minute nap, and a 45-minute nap, with each session separated by a 48-hour washout period to minimize carry-over effects. This design not only facilitates the evaluation of nap durations in a controlled, randomized setting but also allows participants to act as their own controls, thereby enhancing the reliability of the data.

Participants

In maintaining the scientific rigor and ensuring the validity of the data collected, a meticulous approach was adopted in selecting the study's participants. The requisite sample size for the investigation was determined using the G-power software 3.1.9.7 (University of Dusseldorf, Dusseldorf, Germany) (Faul et al., 2007). The power analysis was conducted with F tests (ANOVA: repeated measures, within factors) tailored to the design of our study. The parameters set for this analysis included an alpha error probability of 0.05, a minimum effect size of 0.45, and a power (1-β error probability) of 0.80, yielding an actual power of 81.2%. Based on this analysis, a minimum of 10 participants was deemed necessary. To mitigate the risk of participant attrition, 18 young elite athletes were initially recruited. However, four athletes were subsequently excluded from data analysis due to their inability to complete all required sessions. Consequently, the study was conducted with 14 young elite athletes. These participants' ages ranged from 20.29 ± 0.80 years, their heights were 174.48 ± 4.11 cm, body masses were 70.46 ± 7.78 kg, and body mass indices were 23.12 ± 2.02 kg/m². Their maximum heart rate values averaged at 195.56 ± 1.39 beats per minute, and resting heart rate values at 61.99 ± 3.16 beats per minute.

The selection of participants was based on criteria established by Matsudo et al., in 1987, (Matsudo et al., 1987) requiring athletes to have ranked within the top nine positions in their age categories at national championships. Further inclusion criteria encompassed: a) a top 9 ranking in national competitions organized by the Turkish Kickbox Federation, b) registration in the database of the Turkish Kickbox Federation, and c) engagement in training sessions for a minimum of three days per week (Schoenfeld et al., 2019). Exclusion criteria were stringently applied to uphold the study's internal validity and ensure robust outcomes. Participants were excluded if they: a) used exogenous substances affecting health functions, b) exhibited hyperactivity, c) demonstrated unacceptable behaviors, d) failed to adhere to research protocols, or e) encountered difficulties in complying with the study's guidance. The diligent enforcement of these criteria ensured a participant pool of kickboxers without significant health issues that could confound the research outcomes. Notably, the participants were not habitual nappers.

Ethical Approval

This study was conducted in strict adherence to the ethical guidelines outlined in the Helsinki Declaration. Comprehensive information regarding the study's objectives, rationale, and hypotheses was communicated to all participants, following which informed consent was duly obtained. Additionally, requisite ethical approvals were secured from the Inonu University, Non-Interventional Health Sciences Research Ethics Committee (decision number 2022-4280), ensuring that the research was conducted in line with established ethical standards and guidelines.

Experimental Design

The research employed a meticulously structured experimental design to evaluate the impact of strategic napping on the anaerobic performance of kickboxers. Initial preparatory stages involved three familiarization sessions, designed to acquaint participants with the designated nap location and the specific procedures for assessing anaerobic performance post-napping. These sessions were crucial for minimizing variability in responses attributable to unfamiliarity with the testing environment or protocol.

Subsequent to the familiarization phase, participants were scheduled for three distinct testing sessions. These sessions were separated by a minimum interlude of 48 hours to mitigate any potential carry-over effects. The testing conditions were as follows: No nap opportunity (N0), a 25-minute nap opportunity (N25), and a 45-minute nap opportunity (N45). On arrival at the laboratory for each session, participants were accorded a ten-minute acclimatization period to adapt to the sleeping environment.

The nap intervention protocol was initiated at precisely 1:40 p.m., where participants were allowed to choose their preferred lying position. Starting at 2:00 p.m., they engaged in the respective napping protocols (N0, N25, N45) within darkened, quiet sleeping chambers, designed to optimize conditions for rest. It is pertinent to note that during the nap period, participants in all conditions were instructed to refrain from engaging in activities that could impair nap quality, such as the use of mobile phones or playing video games. This directive was based on existing literature underscoring the detrimental impact of visual stimuli on sleep quality (Stowe et al., 2023; Yagin et al., 2022).

Post-napping, participants underwent a standardized warm-up regimen lasting five minutes. This warm-up included two minutes of easy running followed by three minutes of specific exercises, encompassing foot sweeps, finger, wrist, and ankle rotations, trunk side stretches, trunk rotator stretches, hip circles, and knee bends. This routine was designed to prepare the athletes physically and mentally for the subsequent performance assessments.

At 5:00 p.m., following the warm-up, participants performed the countermovement jump (CMJ) test. The conclusion of each session involved expressing gratitude to the participants for their involvement. Furthermore, upon the culmination of the entire experimental series, a comprehensive debriefing was conducted, during which participants were thanked for their contribution and provided with insights into the study's preliminary findings and objectives. This procedure ensured ethical compliance with research norms and fostered a sense of contribution and acknowledgement among the participants.

Data Collection

Anthropometric Measurements

In the process of data collection, rigorous anthropometric measurements were conducted using state-of-the-art equipment. Participants' body dimensions were assessed utilizing a SECA® device (Gmbh, Hamburg, Germany), renowned for its precision in anthropometric measurement. The measurements were taken under standardized conditions to ensure consistency and accuracy. Participants were positioned upright, barefoot, and with their body - including ankles, calves, hips, scapula, and head - aligned against a flat wall surface. This posture was critical for obtaining accurate body dimension data. The method adhered to the Frankfurt plane principle for determining the head position, a standard approach in anthropometry to ensure a reproducible and natural head posture during measurement. The height of each participant was recorded during the inhalation phase, as this is recognized to be a moment when the body's stature is maximally extended, thus providing the most accurate height measurement. For the assessment of body mass, participants were required to wear standardized lightweight clothing (Toledo 2096 PP, São Bernardo do Campo, Brazil), which minimized the potential variance introduced by heavier or bulkier attire. The Body Mass Index (BMI) was subsequently calculated, adhering to the standard formula. This calculation involved dividing the participant's weight (expressed in kilograms) by the square of their height (expressed in meters) (Sales et al., 2018). This method of BMI calculation is universally accepted in clinical and research settings due to its simplicity and effectiveness in providing a quick assessment of body fat distribution and potential health risks associated with weight categories.

Countermovement Jump (CMJ) Assessment

The Countermovement Jumps (CMJs) were a critical component of the study's data collection process, focusing on evaluating the explosive lower-body power of the volunteer kickboxers. This assessment was conducted using a high-precision force platform (Newtest 2000, Oulu, Finland), which is instrumental in capturing accurate biomechanical data. Each participant was instructed to perform a series of three CMJs, with a standardized one-minute rest interval between each jump to ensure recovery and maintain the consistency of performance across trials. The protocol for the CMJ required participants to begin and conclude in a standardized upright stance, with feet positioned at hip-width apart and hands placed firmly on the hips. This specific posture was mandated to ensure uniformity across participants and to mitigate any extraneous influences that could affect the jump's outcome. Notably, hand movement was restricted during the entire measurement process to eliminate any potential impact on the jump height. Upon receiving the command, participants were required to initiate the jump by swiftly lowering their center of mass through knee flexion to a self-selected depth, followed immediately by a vertical leap exerted with maximal effort from the lowest position reached (Pedersen et al., 2019; Tayech et al., 2020). This action is essential for eliciting the stretch-shortening cycle, a key element in assessing explosive strength. For the analysis, the highest of the three jump heights recorded for each participant was used. This selection criterion is based on the premise that the maximum jump height best represents the participant's explosive power capabilities. In addition, anaerobic power metrics, including peak and average power outputs, were calculated for each participant utilizing the Johnson & Bahamonde Formula (Johnson & Bahamonde, 1996). This formula integrates variables such as jump distance, body weight, and

height, thereby allowing for a comprehensive and nuanced analysis of the participants' explosive power capacities in the context of their individual physical characteristics.

Statistical Analysis

Comprehensive statistical analyses were conducted utilizing the GraphPad Prism software version 8.0.1 (GraphPad Software Inc, San Diego, California, USA), a sophisticated tool recognized for its robustness in statistical computations and data visualization. The alpha threshold for statistical significance was established at $p < 0.05$, aligning with conventional standards in empirical research. The preliminary step in the statistical analysis involved verifying the normality of the data distribution. This verification was crucial to determine the appropriateness of subsequent statistical tests. The Shapiro–Wilk test, supplemented by assessments of skewness and kurtosis values, was employed for this purpose. The data adhered to the criteria of a normal distribution, thereby justifying the use of parametric statistical methods. Consequently, the variables were summarized as mean ± standard deviation (SD), a standard approach for presenting central tendency and variability in normally distributed data. To ensure the appropriateness of the analytical techniques, the homogeneity of variances across groups was assessed using the Levene Test. This test is fundamental in validating the assumptions underlying parametric tests such as Analysis of Variance (ANOVA). Following this, a Repeated Measures ANOVA was utilized to analyze the differences in CMJ, mean power, and maximum power across the different napping conditions (N0, N25, N45). The Repeated Measures ANOVA is particularly suited for designs where the same subjects are exposed to different conditions over time. In cases where significant differences were identified by the ANOVA, the Bonferroni post-hoc test was employed to ascertain specific pairwise differences. To quantify the magnitude of the observed effects, effect sizes were calculated using Cohen's d formula. Additionally, for the ANOVA results, effect sizes were expressed as partial eta squared ($\eta p2$) values, providing a nuanced understanding of the effect magnitude. The interpretation of these values followed standard conventions, with $\eta p2 \leq 0.01$ indicating a small effect size, $0.01 \leq \eta p2 \leq 0.06$ indicating a medium effect size, and $\eta p2 \geq 0.14$ indicating a large effect size (Hopkins et al., 2009).

FINDINGS

The demographic information of the participants. According to the table, the participants' age was determined to be 20.29 ± 0.80 years, height 174.48 ± 4.11 cm, weight 70.46 ± 7.78 kg, and BMI value 23.12 ± 2.02 kg/m², Maximum Heart Rate value 195.56 ± 1.39 (beats/min), Resting Heart Rate value 61.99 ± 3.16 (beats/min) (Table 1.).

Table 1. Descriptive characteristics of soccer players (M ± SD)

Variables	Mean ± SD	95% CI Lower	95% CI Upper
Age (year)	20.29 ± 0.80	19.88	20.71
Height (cm)	174.48 ± 4.11	172.32	176.63
Body Mass (kg)	70.46 ± 7.78	66.39	74.53
BMI (kg/m²)	23.12 ± 2.02	22.06	24.18
BFR (%)	17.39 ± 4.89	14.84	19.95
HRmax (beats/min)	195.56 ± 1.39	194.84	196.29
HRrest (beats/min)	61.99 ± 3.16	60.33	63.64

BMI: Body mass index, HRmax: Maximum heart rate, BFR: Body fat ratio, HRrest: Rest heart rate

Table 2 compares the countermovement jump of the participants in N0, N25, and N45. According to the table, the participants' countermovement jump (CMJ) values were not significantly differed (p=.372, ηp2=.049). The post-hoc Bonferroni test revealed no significant differences between the N0 and N25 CMJ values (respectively; p>0.999, [-4.595 to 3.024 95% CI], N0 and N45 CMJ values (respectively; p= 0.501, [-5.952 to 1.666 95% CI], N25 and N45 CMJ values (respectively; p >0.999, [-5.166 to 2.452 95% CI].

Table 2. Comparison of the vertical jump of the participants

Parameters	Time	M±S.D.	Between groups	F	p	η_p^2	95% CI
CMJ (cm)	N0	39.64±3.91	N0-N25: >0.999 N0-N45:0.501 N25-N45:>0.999	1.014	.372	.049	(37.38,41.90)
	N25	40.43±4.11					(38.06,42.80)
	N45	41.79±4.06					(39.44,44.13)

N0: No-nap control, N25: a 25-minute nap, N45: a 45-minute nap, * p<.05

Table 3 compares the mean power of the participants in N0, N25, and N45. According to the table, the participants' mean power (MP) values were significantly differed (p <0.000, ηp2= 0.624). The post-hoc Bonferroni test revealed significant differences between the N0 and N25 MP values (respectively; p= 0.008, [-5689 to -816.8 95% CI], N0 and N45 MP values (respectively; p= 0.001, [-13907 to -3836 95% CI], N25 and N45 MP values (respectively; p= 0.001, [-8905 to -2332 95% CI].

Table 3. Comparison of the mean power of the participants

Parameters	Time	M±S.D.	F	p	η_p^2	95% CI
Mean power (watt)	N0	184532±28754	21.65	. 000*	.624	(167929 to 201134)
	N25	187784±29212				(170918 to 204651)
	N45	193403±28610				(176884 to 209922)

MP: Mean power, N0: No-nap control, N25: a 25-minute nap, N45: a 45-minute nap, * p<.05

Table 4 compares the peak power of the participants in N0, N25, and N45. According to the table, the participants' peak power (PP) values were significantly differed (p =0.730, ηp2= 0.015). The post-hoc Bonferroni test revealed significant differences between the N0 and N25 PP values (respectively; p >0.999, [-59712 to 47376 95% CI], N0 and N45 MP values (respectively; p >0.999, [-70365 to 36722 95% CI], N25 and N45 MP values (respectively; p >0.999, [-64197 to 42890 95% CI].

Table 4. Comparison of the peak power of the participants

Parameters	Time	M±S.D.	F	p	η_p^2	95% CI
Peak power (watt)	N0	340432±56353	0.316	.730	0.015	(307894.372969)
	N25	346600±57325				(313501.379698)
	N45	357253±56199				(324805.389702)

PP: Peak power, N0: No-nap control, N25: a 25-minute nap, N45: a 45-minute nap, * p<.05

DISCUSSION AND CONCLUSION

The findings of this study provide valuable insights into the impact of strategic napping on anaerobic performance parameters in elite kickboxers. The data revealed that while the countermovement jump (CMJ) did not show significant variations across different napping conditions, there were notable changes in mean and peak power outputs, particularly in the napping groups. These results suggest that short-duration napping may have a significant influence on specific aspects of physical performance, especially those related to power. There are no studies in the literature suggesting no significant change in CMJ performance across nap conditions; This suggests that explosive power measured by the CMJ may not be as sensitive to short-term rest interventions such as napping, although no evidence has been seen in previous studies.

However, the observed variations in mean and peak power outputs are particularly intriguing. These findings corroborate the hypothesis that even brief periods of rest can enhance certain aspects of anaerobic performance. This could be attributed to the restorative effects of napping on central nervous system (CNS) fatigue, which plays a crucial role in power generation and muscular endurance (Ajjimaporn et al., 2020; Boukhris et al., 2023; Souabni et al., 2021).

A substantial body of scholarly literature exists which encompasses research on the provision of napping opportunities (Hsouna et al., 2019; Souabni et al., 2023). However, no study has been found to examine its impact on CMJ, mean and peak power performance in kickboxers. The study by Hsouna et al., (2023) and our current research share a common focus on the effects of napping on athletic performance, yet they exhibit distinct differences in methodology

and outcomes. Both studies investigate the impact of varying nap durations on aspects of physical performance, with Hsouna et al. examining a broader range of parameters including attention, emotions, and stress, in addition to physical metrics. Our research, on the other hand, is more narrowly concentrated on the physical prowess of kickboxers, specifically analyzing countermovement jump (CMJ) and power outputs. Hsouna et al. found significant improvements in 5-jump performance with longer naps (35 and 45 minutes), whereas our study did not observe significant changes in CMJ across different napping conditions (Hsouna et al., 2019). However, we noted considerable variations in mean and peak power outputs, particularly in napping groups, highlighting the benefits of short-duration naps in enhancing specific anaerobic performance parameters in kickboxers. These differences underscore the nuanced and varied impacts of napping on different aspects of athletic performance, suggesting that the effectiveness of napping may vary depending on the specific performance metric being assessed and the sport in question. The study by Souabni et al., (2023) and our current research both examine the effects of napping on athletic performance, yet they present notable differences in their focus and outcomes. Souabni et al. explored the impact of a 40-minute nap on various physiological responses and specific abilities, observing improved performance in defensive, offensive, and upper body power in the napping condition compared to the control (Souabni et al., 2023). This aligns with our research, which also highlights the positive effects of napping on athletic performance, specifically in kickboxers. However, while Souabni et al. reported overall better performance in specific combat skills and power with a longer nap duration, our study concentrated on mean and peak power outputs as a result of shorter naps, without observing significant changes in the countermovement jump (CMJ), a measure of explosive leg strength. Both studies reinforce the concept that strategic napping can enhance certain aspects of performance in athletes, yet the specific benefits appear to be influenced by the duration of the nap and the particular performance metrics evaluated. Our research adds to this understanding by suggesting that even short-duration naps can significantly impact anaerobic performance parameters, especially in power-related aspects, in a sport like kickboxing. The study by Boukhris et al., (2020) and our research share a central theme of examining the impact of napping on athletic performance, yet they differ in their specific focus, methodologies, and findings. Boukhris et al. explored a broader spectrum of outcomes including attention, mood states, sleepiness, perceived exertion, recovery, and muscle soreness in addition to physical performance measures like maximal voluntary isometric contraction (MVIC) and shuttle run in amateur team sport players. They observed that both 40-minute and 90-minute naps enhanced various performance metrics and mood states compared to no napping, with more pronounced improvements following the longer nap duration (Boukhris et al., 2020). Conversely, our study specifically targeted the physical prowess of kickboxers, focusing on measures such as the countermovement jump (CMJ) and power outputs. While we did not observe significant changes in CMJ performance across napping conditions, our research highlighted significant improvements in mean and peak power outputs, particularly in the napping groups. This suggests that even short-duration napping can effectively enhance specific anaerobic performance parameters in high-intensity sports. Both studies underscore the positive influence of napping on athletic performance, but they diverge in their approach to nap duration and the range of performance metrics evaluated. Boukhris et al., (2020) suggest that longer naps might be more beneficial for a broader range of physical and cognitive outcomes, while our study indicates that shorter naps can also yield significant benefits, particularly in power-related aspects of performance in combat sports. These differences

highlight the nuanced and varied impacts of napping on different aspects of athletic performance and suggest that the optimal napping strategy may vary depending on the specific demands of the sport and the performance metrics of interest.

The strategic implementation of napping as a performance enhancement tool could therefore be especially beneficial in combat sports like kickboxing, where bouts of high-intensity activity are interspersed with periods of lower intensity. Incorporating napping into the training and competition schedules of athletes could optimize their performance, particularly in sports requiring quick, explosive movements and high levels of power output. One limitation of this study is the homogeneity of the participant pool, which consisted solely of young, elite male kickboxers. Future research could expand on these findings by including a more diverse range of athletes, including female athletes and those at different levels of expertise and training. Additionally, investigating the impact of napping on other performance parameters, such as reaction time and cognitive function, would provide a more comprehensive understanding of its benefits.

The present study embarked on an exploration of the effects of strategic napping on key anaerobic performance parameters in elite kickboxers. It provides empirical evidence that short-duration napping can significantly influence certain aspects of physical performance, particularly in terms of mean and peak power outputs. These findings enhance our understanding of the complex interplay between rest and physical performance in high-intensity sports. While the countermovement jump (CMJ) did not demonstrate significant variations across napping conditions, the notable improvements in power output parameters point towards the specific benefits of napping on aspects of performance reliant on the central nervous system and muscular endurance. This study contributes to a nuanced appreciation of the role of rest and recovery, particularly in the form of napping, in enhancing athletic performance. It underscores the potential of integrating strategic napping into the training and recovery protocols of athletes, especially in sports where power and explosiveness are crucial.

The strategic use of napping appears to be a promising and practical approach to enhance certain aspects of anaerobic performance in athletes, particularly in sports demanding high levels of power and explosiveness. The simplicity and non-invasiveness of this intervention make it an attractive option for athletes and coaches seeking to gain a competitive edge.

Recommendations

A comprehensive recommendation is to integrate structured, short-duration napping into athletic training programs, particularly in disciplines requiring high anaerobic capacity. This integration should consider varying durations (25 to 45 minutes) to accommodate individual physiological responses and training schedules. Further academic exploration in diverse sports settings is recommended to substantiate the generalizability of napping as a performance-enhancing strategy, potentially extending its application beyond combat sports to other anaerobic-intensive disciplines. This approach advocates for a more nuanced understanding of sleep's role in optimizing athletic performance.

Conflict of Interest: The authors hereby affirm that no conflict of interest, either financial or personal, has influenced the research and findings presented in this study. This declaration encompasses all potential conflicts that might impinge upon the integrity and objectivity of the research.

Authors' Contribution: Study Design- Adanur & Eken; Data Collection- Adanur; Statistical Analysis- Eken; Manuscript Preparation- Adanur & Eken.

Ethical Approval
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The Effect of Physical Education Content on Children's Activity during Recess based on Skill Level

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Abstract

The purpose of this study was to investigate voluntary participation of lower-, average, and higher skilled children during parkour recess and MVPA in physical education, parkour recess and regular recess. In total 147 (55 girls, 92 boys) elementary children from seven schools participated. During (i.e., generalization) and after (i.e., maintenance) a 10-lesson parkour unit was taught, five parkour recess sessions were organized. Systematic observation was used to assess children's physical activity levels. Average skilled children participated more (74%) in parkour recess compared to higher skilled children (55%; p=.002). No differences were found for MVPA between lower-, average -and higher skilled children in any of the settings. Regardless of skill level, children voluntarily participated in parkour recess with MVPA levels 15-20% higher compared to regular recess. These findings are especially important for lower-skilled children, who are more at risk for lower participation in physical activities and adhering to physical activity guidelines.
Keywords: Participation, School health, MVPA

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INTRODUCTION

Regular physical activity is associated with several health benefits in both children and adolescents (Biddle et al., 2004). The Institute of Medicine (IOM) and the World Health Organization (WHO, 2020) recommend at least 60 minutes of moderate to vigorous physical activity (MVPA) a day for five to 17-year olds (WHO, 2022). However, a recent review on surveillances of physical activity indicated that in general children (3-18 years) have low levels of physical activity and that physical activity levels decrease with age (Aubert et al., 2021). In addition, substantial declines in MVPA are observed from early childhood (Farooq et al., 2018, 2020). In Flanders (Belgium), only 7% of children aged 6-9 meet the 60 minutes daily MVPA guideline (Wijtzes et al., 2016). Children with high skill levels are 2.46 times more likely to meet physical activity guidelines than children with low skill levels (De Meester et al., 2018). Since physical activity behaviors in childhood track into adulthood, these children are more at risk for health problems (De Meester et al., 2018). Results from these studies support the call to increase children's MVPA by means of school-based interventions, since schools are the place where children spent most of their waking hours (Clarke et al., 2013; Pate et al., 2006). For some children, schools are the only setting where they can engage in physical activity and receive physical education taught by an expert (Coolkens et al., 2018a). Physical education can be a crucial context in which children's motor competence is built, which is important since higher skilled children are 2.46 times more likely to meet the daily MVPA guidelines (De Meester et al., 2018).

Study Purpose

The purpose of this study was to investigate differential effects of children's skill level on voluntary participation and MVPA in parkour recess concurrently with the teaching of a 10-lesson parkour unit in physical education (i.e., generalization phase) and after the parkour unit in physical education had ended (i.e., maintenance phase). In addition, skill level differences regarding MVPA between children were investigated in physical education and regular recess.

CONCEPTUAL FRAMEWORK

School-Based Physical Activity

To support children in achieving the 60 minutes per day guideline, multicomponent school-based approaches like the Comprehensive School Physical Activity Program (CSPAP) are suggested (Brusseau and Burns, 2018). The CSPAP identifies five components for children to engage in physical activity and to develop the knowledge, skills, and confidence to be physically active for a lifetime (Carson and Webster, 2019). Although one of the goals of a CSPAP is to promote coordination among the five different components, research examining how this should be conducted is limited (Erwin et al., 2013). Therefore, this study investigates the coordination of two components of the CSPAP model, namely physical education and recess (i.e., during school physical activity component).

For physical education, the IOM and the Association for Physical Education (Harris, 2015) recommend that children should engage at least 50% of lesson time in MVPA (Elliot et al., 2015). Systematic reviews in elementary physical education have shown that children do not meet this benchmark, with MVPA levels of 34% (Fairclough et al., 2006) and 45% (Hollis et al., 2016). Similar results were found in Flanders, with MVPA levels ranging from 42-47% in elementary schools (Cheng et al., 2021). Recess, which is an important element within the physical activity during school component, is increasingly viewed as an opportunity to improve children's daily percentages of MVPA (CDC, 2017). Recess is defined as noncurricular, but assigned time during a school day that children spend on the playground. Previous research suggests that recess can contribute up to 40% of the daily recommended minutes of MVPA (Ridgers et al., 2006; 2018). In Flanders, it is mandatory for schools to schedule 50 minutes daily for lunch recess (Het Vlaams Ministerie van Onderwijs en Vorming, 2022). During this time, children have lunch after which they spent time on the playground. Lunch recess has the potential to contribute substantially to children's daily MVPA, especially when a suggested benchmark of 50% MVPA during recess is reached (Stratton and Mullan, 2005).

Connecting Physical Education with Recess

Since one of the goals of CSPAP is to provide coordination between the different components to maximize the applications and practice of skills learned in physical education, researchers have investigated the effect of connecting physical education and recess (Cheng et al., 2021; Coolkens et al., 2018b; Iserbyt et al., 2022; Knowles et al., 2018). Knowles et al., (2018) connected a 10-lesson unit tag rugby and a 10-lesson unit handball to weekly voluntary organized recess sessions in which five to 12 boys participated, while none of the girls participated. In the first of a series of studies in which the content of physical activity programs (i.e., parkour) during recess were connected with the content of physical education, Coolkens et al., (2018a) showed that when the physical education teacher led these sessions by implementing class wide activities and the provision of prompts, 79% of children voluntarily participated and generated on average 76% MVPA. When these sessions were only supervised by the teacher, participation averages 70% and MVPA was 70%. In a second study, Coolkens et al. (2018b) reported that voluntary participation during parkour recess sessions was 73% for second grade elementary children. Only in the first of three parkour recess sessions, there was a significant difference with fewer low-skilled children participating compared to their higher skilled peers. Children generated 76% MVPA overall during organized recess, with no significant difference concerning skill level. In a similar study with third-grade elementary children, voluntary participation was 73% and children generated 68% MVPA during parkour recess and 44% MVPA during physical education (Cheng et al., 2021). The latter finding is in line with the latest review indicating average MVPA during physical education to be 45% (Hollis et al., 2016). During regular recess (or lunch recess) those children generated 46% MVPA. All these studies focused on generalization, which means children engage in activities learned during a training setting (i.e., physical education) in another setting (i.e., generalization setting or parkour recess; Cheng et al., 2021; Coolkens et al., 2018b; Iserbyt et al., 2022; Knowles et al., 2018). In a study focused on fitness activities for middle school, students could participate in fitness sessions during lunch recess before, during (generalization) and after (maintenance) the fitness content was implemented during physical education (Iserbyt et al.,

2022). During the first session more higher-skilled students participated compared to lower-skilled students, while during the other eight sessions no significant differences were found based on skill level. Voluntary participation was lower compared to the studies in elementary schools, with proportions of participation ranging from 5%-60% during generalization. During the last fitness session, which was organized when the fitness unit in physical education was completed (i.e., maintenance), no lower-skilled students participated and only 15% of higher-skilled children (Iserbyt et al., 2022). Overall, students generated up to 48% of MVPA during these sessions, with no significant differences for skill level.

Maintenance

Although maintenance of participation in physical activity is necessary to develop and maintain a physically active lifestyle, very few studies report maintenance data. One large scale study examined the long-term effects of a physical education intervention, which was a health-related curriculum for fourth-graders called Sports, Play and Active Recreation for Kids (SPARK; McKenzie et al., 1997). One and a half years later, a decline to 88% of the intervention levels for MVPA was shown. The CATCH-on study, which was a follow-up study on the SPARK project, five years post intervention, reported the same MVPA levels as during intervention phase, however vigorous physical activity declined sharply by almost one fourth of the initial levels (McKenzie et al., 2003).

METHOD

Research Design and Participants

In total 147 (55 girls, 92 boys, mean age 8 years) elementary children from seven schools in Flanders (Belgium) were selected for participation in this experimental study based on convenience sampling. Schools were included when they could make their gymnasium available for parkour recess during lunch recess and when physical education teachers met the eligibility criteria (see further). Skill level was determined by the children's physical education teacher based on previous assessments of physical activity content (Hastie et al., 2017). Teachers labeled children as lower-, average-, or higher-skilled based in his/her previous experiences with the children. Physical education teachers (2 females, 5 males, mean age 39 y) met the following eligibility criteria: (a) following a four-hour professional development workshop to learn how to teach parkour, (b) willing to teach a 10-lesson parkour unit in physical education, (c) willing to organize ten parkour recess sessions.

Data Collection Tools

Participation during parkour recess was recorded after each session. Physical activity during physical education and parkour recess was collected through systematic observation using the System for Observing Fitness Instruction Time (SOFIT), while for regular recess the System for Observing Children's Activity and Relationship during Play (SOCARP) was used (McKenzie et al., 1992; Ridgers et al., 2010). In both systems, momentary time sampling with a 6-second observe and 6-second record interval was used (McKenzie et al., 1992; Ridgers et

al., 2012). During each observation, two children were followed by coding them alternatingly every ten intervals. During the 6-second observe interval observers focus on the target child, at the "record" prompt the decision is made concerning the activity level. Physical activity is divided into five categories, namely level 1 (lying), level 2 (sitting), level 3 (standing), level 4 (walking), and level 5 (very active), combining these two latter levels result in the MVPA values.

Procedure

Independent variables: In this study, physical education served as the training setting, parkour recess was the generalization setting, and regular recess was the comparison setting. During generalization phase, physical education, parkour recess and regular recess were the three settings where observations were made. During maintenance phase, only parkour recess and regular recess were observed, since physical education content was disconnected (i.e., other content) from parkour recess.

Physical education: In physical education, parkour as a content was taught through a 10-lesson unit during generalization phase, after which teachers could teach any content but parkour during maintenance phase (see supplementary file, Vanluyten et al., 2023a). Planned lesson time was 50 minutes for all schools, except for one school which had sessions of 70 minutes. Parkour can be defined as an individual motor domain where children overcome various obstacles by running, jumping, swinging and climbing (Vanluyten et al., 2023b). Children were taught several parkour moves, which could be combined in order to show a routine during the final lesson. Teachers received a standardized four-hour workshop in their own school for teaching parkour and were assessed on their mastery of the content upon completion.

Regular recess: Regular recess refers to the 'business as usual' situation in which school staff and teachers supervised the children while they spent time on the playground. Regular recess time (time spent on the playground) ranged between 30-70 minutes (average 44 minutes). Small equipment (i.e., balls, jump ropes, hoops) was often available and children could engage in any preferred behavior such as playing active games, talking with friends, or reading a book.

Parkour recess: A total of 10 parkour recess sessions were organized, five during the generalization phase and five during the maintenance phase. This means one parkour recess session was organized every two weeks, with a duration of 20 minutes per session. During parkour recess no new content was taught. Physical education teachers in all schools gave four short, standardized prompts to promote physical activity during parkour recess. These prompts were the same each parkour recess but their order was randomized. The four instructions were the following: (a) "Show the parkour moves from the previous physical education lesson, I will encourage you and see if you can do it correctly", (b) "Try to do as many parkour moves as possible, count out loud whenever you finished a parkour move. When you reach ten, you will get a token (i.e., bracelet)", (c) Do parkour moves in dyads, the first performer does parkour moves, the others follow the same moves", (d) "You can move freely around the gym and use all the equipment that is set up, I will supervise and encourage you". Participation in parkour recess was voluntary and implemented during regular recess. Children had the choice to

participate in parkour recess or to stay on the playground like they did any other day during regular recess.

Ethical Approval

Informed consent was obtained from teachers and parents after the Social and Societal Ethics Committee of the first author's university approved the study on the 22nd of May 2020.

Collection of Data

Participation in each parkour recess session was recorded based on the video recordings. Participation rates were calculated by dividing the number of children that were present during parkour recess by the total amount of children (for both boys and girls). For physical education and parkour recess MVPA data from the first nine lessons were collected through video coding in which all children (n=147) were coded, which represents more than 1300 hours of observation. Data from the final lesson was excluded as it served as a summative assessment. For each school all ten parkour recess sessions were observed and the MVPA of all participating children was coded. For regular recess, video was not feasible due to the large playground, so live coding was needed. Therefore, during each observation four to eight boys and girls of different skill levels were randomly selected. At least 11 observations were conducted in each school (range: 11-22 observations). Data was collected from September 2020 to June 2021.

Observer training and reliability: An extensive training of nine steps was used in order to train observers to collect reliable data on children's MVPA using systematic observation. In step one the observers had to study a lecture on systematic observation, while in step two the SOIFT or SOCARP manual had to be studied (McKenzie et al., 1992; Ridgers et al., 2012). Step three, four and five consist of tests concerning codes, coding conventions and written situations, 100% success is needed to further proceed the training protocol. In step six and seven a video in real-time is coded, agreement should be 85% or higher. In step eight the same reliability should be achieved when coding twice with a trained observer, after which coding independently is possible from step nine. Interobserver reliabilities for physical activity during physical education were 84% with 19% overlap, during parkour recess 85% with 12% overlap and during regular recess 93% with 47% overlap. All observer reliability measurements met the 80% benchmark for behavioral research (Cooper et al., 2020).

Analysis of Data

All data were analyzed using the Statistical Package for Social Science software (SPSS, version 27) and R 4.1.1 (R Core Team 2021). A chi-square test was used to analyze children's participation in each parkour recess session as a function of skill level. For overall participation rates (mean participation), a one-way analysis of variance (ANOVA) and post-hoc Tukey HSD test was used to assess differences based on skill level, while for each phase a Welch ANOVA was used. For each skill level group, a Wilcoxon signed rank test was used to assess differences based on phase. Differences based on skill level for physical education, parkour recess and regular recess was tested with respectively a Welch ANOVA, a one-way ANOVA and a Kruskal-Wallis test. Wilcoxon signed ranks and a paired T-test was used to assess MVPA

differences between settings and phases. In addition, effect sizes were reported. To control for the clustered nature of our data since children are nested within schools, an intraclass correlation coefficient (ICC) was calculated and a chi Square for clustered data test (Gregg et al., 2020) and multilevel regression was used.

FINDINGS

Since children were clustered in schools, ICC's were calculated showing the need for cluster control for overall participation (0.39; p<.001), MVPA during regular recess (0.09; p<.001), MVPA during parkour recess (0.49; p<.001) and MVPA during physical education (0.79; p<.001).

Participation in parkour recess: Figure 1 shows the average proportions of voluntary participation in parkour recess for higher-, average -and lower skilled children. Significant differences were found in recess session three, χ^2 (1, 147) = 9.28, p=.01, six, χ^2 (1, 147) = 10.41, p=.005, and ten, χ^2 (1, N=147) =11.99, p=.002. In recess session three, more average skilled children (88%) participated compared to higher skilled children (69%), χ^2 (1, 147) = 6.71, p=.01, and lower skilled children (64%), χ^2 (1, 147) = 7.99, p=.005. For recess session six, the same differences were found between average skilled children (73%) compared to higher (46%), χ^2 (1, 147) = 8.70, p=.003, and lower skilled children (45%), χ^2 (1, 147) = 6.26, p=.012. For recess session ten a significant difference was found between average (73%) and higher skilled children (43%), χ^2 (1, 147) = 11.95, p<.001. Differences based on skill level for overall participation were found, F(2, 147) = 6.08, p=.003, indicating a significant difference between higher (55%) and average (74%) skilled children, p=.002.

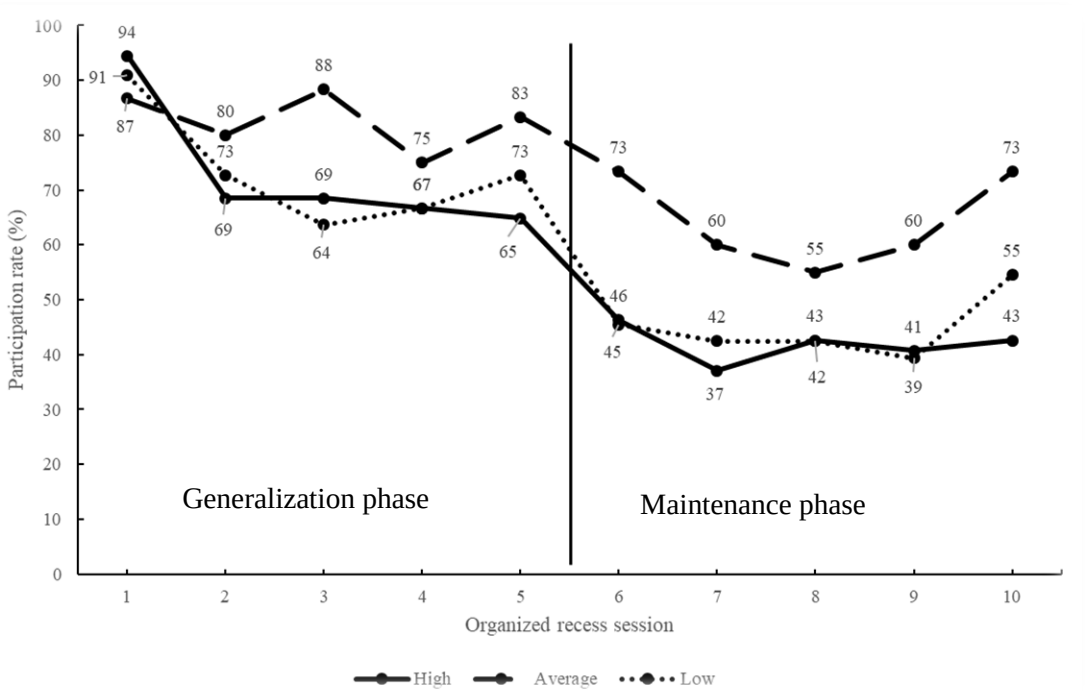

Figure 1. Participation rate of high, average and low skilled children during parkour recess sessions

No differences in participation were found based on skill level during generalization phase. However, during maintenance phase average skilled children achieved significantly higher rates (64%) compared to higher skilled children (39%), F(2,146) = 6.95, p=.001. Participation for each skill level group was higher during generalization phase compared to maintenance phase, Z = 4.61, p<.001, ES = 0.65 for higher skilled children, Z = 4.43, p<.001, ES = 0.58 for average skilled children, Z = 3.71, p<.001, ES = 0.62, and for lower skilled children.

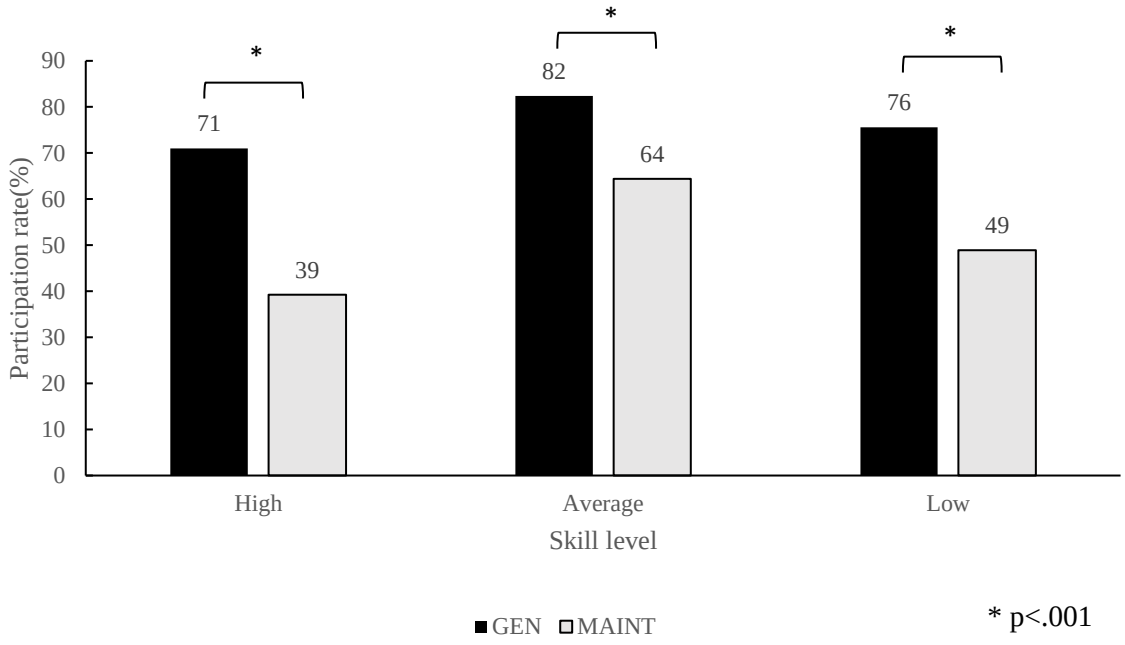

Figure 2. Participation rate of high, average and low skilled children in parkour recess during generalization and maintenance phase

Moderate to vigorous physical activity: There were no differences found based on skill level in physical education, parkour recess and regular recess. When comparing physical education and parkour recess, significant differences were found for higher skilled, Z = 5.79, p<.001, ES = 0.80, average skilled, Z = 6.52, p<.001, ES = 0.85 and lower skilled children, t(36) = 11.21, p<.001, ES = 1.87, all having higher MVPA levels during parkour recess. Similarly, higher MVPA levels were observed during parkour recess compared to regular recess for higher skilled, t(51) = 5.96, p<.001, ES = 0.84, average skilled, t(59) = 6.42, p<.001, ES = 0.84, and lower skilled children, t(36) = 5.04, p<.001, ES = 0.84. Comparing physical education with regular recess, only average skilled children reached significantly higher MVPA levels during regular recess, t(59) = 2.62, p=.018, ES = 0.34.

Overall, MVPA levels in parkour recess during maintenance phase (66%) were higher than during generalization phase (60%), Z = 4.30, p<.001, ES = 0.41, while there were no differences for MVPA in regular recess between generalization and maintenance (47% versus 46%). During generalization phase there were no significant differences based on skill level in parkour recess and in regular recess, similar there were no differences found during maintenance phase in both settings.

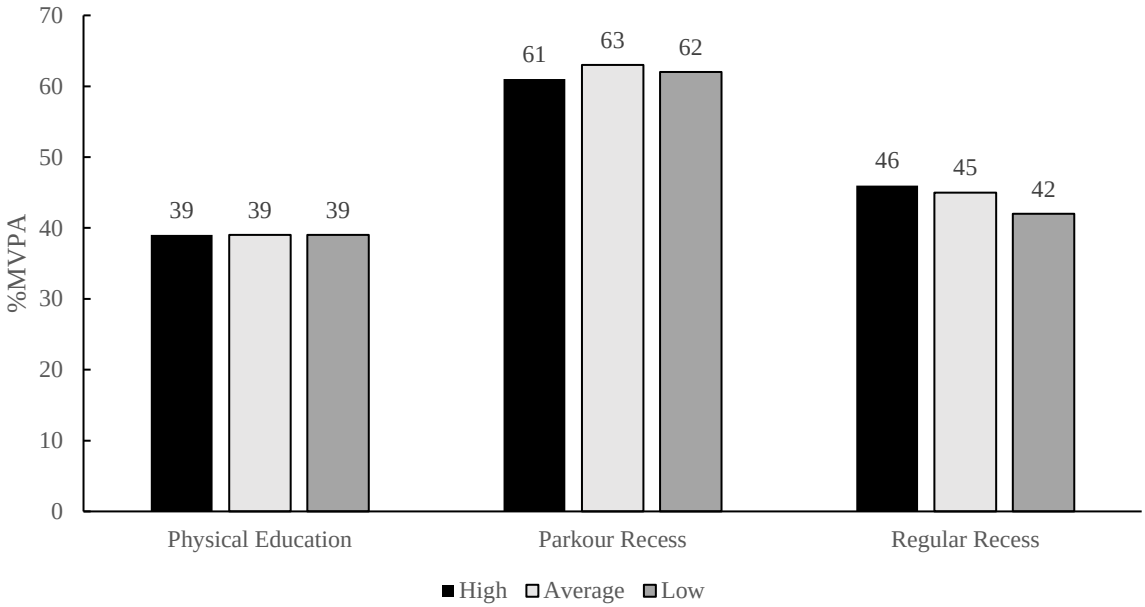

Figure 3. MVPA levels of high, average and low skilled children in physical education, parkour recess and traditional recess

DISCUSSION AND CONCLUSION

The purpose of this study was to investigate voluntary participation and MVPA in parkour recess during generalization and maintenance phase for higher, average, and lower skilled children. In addition, physical activity levels during physical education and regular recess were assessed.

Participation in Parkour Recess

For voluntary participation, average skilled children tended to participate more (74%) compared to higher skilled children (55%; p=.002), which contrasts previous work where no significant differences were found (Coolkens et al., 2018b; Iserbyt et al., 2022). In only three out of ten parkour recess sessions a significant effect for skill level was found. This contrasts previous work that showed that generally more higher skilled children participated in recess programs (De Meester et al., 2018; Knowles et al., 2018). Research in which physical education was connected with recess programs on average shows different results than programs that are disconnected from physical education, with participation between 19% and 41% (De Meester et al., 2018; Drijvers et al., 2022). Although not significant, lower skilled children showed higher participation rates compared to their higher skilled peers. This is important since children with lower actual motor competence are less likely to meet the daily MVPA guidelines (De Meester et al., 2018). In this study, lower skilled children might have benefited from the connection between parkour recess and physical education, since physical education allowed them to develop the confidence and skills to participate in the activity, which they enjoyed as a consequence. Previous research indicated that during parkour recess children use the skills they learned in physical education (Coolkens et al., 2018b). This supports the notion that some

level of skill competency, developed in physical education, is needed for children to participate in a physical activity program during recess (Drijvers et al., 2022).

During generalization phase, participation was high (71%-82%%), whereas in the maintenance phase this dropped to around 50%. It seems that for half of the children, withdrawing the connection with the physical education curriculum did not affect their participation. Although speculative, these children might maintain their participation because they enjoyed the activity, and liked spending their recess time doing parkour. Future research should investigate children's motives for maintaining or terminating their participation in parkour recess. It is important to note that participation in parkour recess sessions was voluntary and no efforts were made by the teachers nor research team to encourage participation. Besides the announcement by the physical education teacher, who shared the date and place for the next session, no other measures were taken to promote participation. Future research might look into several strategies to promote participation such as promotion through social media, posters in the hallway, formal subscription, and involvement of classroom teachers.

Physical Activity Levels

In this study, there were no differences found in terms of MVPA levels between the three skill levels groups in physical education, parkour, and regular recess. This finding is consistent with previous work examining recess sessions in both elementary and secondary schools (Coolkens et al., 2018b; Iserbyt et al., 2022; Knowles et al., 2018). During physical education, MVPA levels were below 50% and lower than 40% as reported in a review by Hollis et al. (2016). Although teachers followed a workshop, they taught the parkour content for the first time, which might have impacted MVPA levels during physical education. This may also have resulted in more time spent on management due to the organization of the lesson and the use of station work. Repeated teaching of this content could lead to a more fluent enactment of the parkour content for teachers.

In this study during parkour recess, children generated around 12 minutes of MVPA during a 20-minute recess session, which is lower than in a previous parkour study (Coolkens et al., 2018b). The high MVPA levels during parkour recess compared to regular recess shows the added value of these parkour sessions and their potential in contributing to the daily guidelines. In addition, they offer an opportunity for children to apply the skills learned in physical education in another setting, which is a core goal of the CSPAP (Carson and Webster, 2019).

Strengths and Limitations

This study connected physical education content with organized recess sessions which are two components of CSPAP in order to increase children's MVPA. It replicates previous research and adds a maintenance phase to investigate what happens when the intervention has ended. Methodologically, a strength is that all children during all physical education lessons and parkour sessions were observed. Furthermore, the effect sizes for both voluntary participation, showing higher rates during generalization phase, and MVPA, showing higher MVPA levels during parkour recess, reported in this study are all above the U.S. Department of Education's What Works Clearinghouse 0.25 criterion, indicating a substantively important effect (U.S. Department of Education's What Works Clearinghouse, 2014). It is a limitation that teachers taught this content for the first time, which might have impacted MVPA levels as well as other

teaching variables during physical education, which in turn could have impacted voluntary participation and MVPA during parkour recess. Future investigations on children's learning, teacher behavior, and motives as to why children chose to participate or chose not to could assist in teasing out how to promote generalization and maintenance of participation in physical activity from physical education to recess.

RECOMMENDATIONS

Connecting physical activity programs during recess with the content of physical education gives children the opportunity to apply the skills learned in physical education in a different context, which is a core aim of the CSPAP. Therefore, school policy could be informed by CSPAP and create organized recess programs that are connected with physical education. By encouraging children to participate in organized recess, the connection between physical education and organized recess can be actively built. In this study, parkour recess enabled children to achieve more MVPA during recess without adding curricular time or additional costs. Since parkour was taught in physical education to all children, parkour recess was an equitable approach for children whereas traditional programs unconnected with physical education tend to be more exclusionary (i.e., the best players dominate; Drijvers et al., 2022). By connecting physical education content to parkour recess, children generated up to 63% of MVPA during a 20-minute session, while applying skills learned during physical education. Voluntary participation was higher during generalization phase compared to maintenance phase, with no differences based on skill level during generalization phase. Children's skill level did not affect their MVPA during parkour recess, which demonstrates that all children benefit from the increase in physical activity opportunities offered by the recess program.

Conflicts of Interest: The authors declare that they have no conflict of interest.

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SUPPLEMENTARY FILE*

Parkour lesson unit in elementary

Parkour workshop

Before the start of the intervention teachers received an individual, four-hour content knowledge workshop on parkour tailored to their specific context in terms of gymnasium and equipment. They received a syllabus with written lesson plans for all ten lessons. During the workshop teachers were taught the parkour moves (critical elements and how to perform them; Vanluyten et al., 2023). Afterwards, common errors were demonstrated and discussed in order to correct these errors.

Terminology in Parkour

• **Precision**: jumping from object to object, or landing after a vault. • **Stride**: running strides from object to object. • **Balance**: movement or landing in balance.	Lesson 1
• **Vault**: taking obstacles by jumping over them with hands supported on the obstacles. • **Wall-run**: running up an inclined or vertical object. • **Tiktak**: a running and turning movement against the wall.	Lesson 2-4-7
• **Roll**: roll after or over an obstacle. • **Catleap**: jump and land on an obstacle where you hang (feet against obstacle). • **Underbar**: movement between two bars.	Lesson 3-6-8
• **Swing**: swing movement on a bar in order to bridge some distance. • **Spin**: rotate around own body-axis.	Lesson 5-7
During lesson 8-9 the culminating event is prepared. The focus of those lessons is on the combination of different parkour moves in a fluent and efficient routine performed all over the gymnasium.	Lesson 8-9

Parkour Content

During the physical education lessons, parkour moves were taught to the children. Different movement families (spins, vaults…) were given a different color to structure the content. A ribbon in a matching color was attached to an obstacle in order to visualize the movement family (the colors also match the colors of the Olympic rings). During the last lesson children will perform a parkour routine showing at least one movement of each color (and thus movement family). The table below also shows the task progression for each parkour movement.

Blue Precisions & strides	**Precisions**	Precision on the ground (front)
		Precision on the ground (back)
		Precision on big and stable objects
		Precision after jumping off a higher object
		Precision on smaller and instable objects
	Strides	Strides on the ground
		Strides on big and stable objects
		Strides on elevated objects (f.e.; bench)
		Strides on smaller and instable objects
Yellow Spins	**Butt spin**	Butt spin: slide on a bench, no rotation
		Butt spin 180° (bench, chair,…)
		Butt spin 180° (plint)
		Butt spin 180° (small surface)
		Butt spin 360°
	Palm spin	Palm spin (wall bars + horse)
		Palm Spin (wall bars + horse + cord)
		Palm Spin (wall bars + horse + cord + precision)
		Palm spin + precision: hand against the wall
		Palm spin with feet on plinth
		Palm spin (plint)
	Reverse	Side vault (bench)
		Side vault (feet on plint)
		Side vault with half turn (plint)
		Side vault with half turn (no contact with feet on plint)
		Reverse with two hands
		Reverse with one hand
Black VAULTS	**Speedstep**	Speedstep: inclined bench
		Speedstep (foot on plint) walking
		Speedstep (foot on plint) running
	Speed vault	Speed vault: walking
		Speed vault: running
		Speed vault: not preferred side
	Thief	Thiefstep: walking
		Thiefstep: running
		Thiefstep: foot against wall
		Thief: running
	Barrel roll	Barrel roll: rolled mat + helper
		Barrel roll: rolled mat (alone)
		Barrel roll: rolled mat (alone) + arm- and leg movement
		Barrel roll: plint + helper

		Barrel roll: plint (alone)
Green Wall movements	**Tiktak**	Tik: inclined approach, inclined landing, inclined springboard
		Tik: inclined approach, frontal landing, inclined springboard
		Tik: frontal approach, frontal landing, inclined springboard
		Tik: inclined approach, inclined landing, wall
		Tik: inclined approach, frontal landing, wall
		Tiktak: inclined springboard
		Tiktak: wall
	Wall run	Inclined bench + jump off and landing in precision
		Inclined bench + jump off + 90° rotation and landing in precision
		Inclined bench + jump off + 90° rotation and landing in precision + roll
		Higher bench + catleap + + jump off + 90° rotation and landing in precision
		Wall run against wall or mat
	Catleap	Catleap: walking
		Catleap: running, inclined springboard
		Catleap: running straight wall
		Catleap: hands crossed while hanging
		Stride catleap + 90° precision
		Catleap + 180° precision
Red Swings	**Underbar**	Foot on bar or bench
		Underbar oblique (cord)
		Underbar straight (cord)
		Underbar straight (between two bars)
		Underbar (360°): sitting
		Underbar (360°) no contact
	Swing	Jump up, hang on bar and release
		Swing
		Swing + back precision
		Swing + front precision
		Swing 180°: switch hands one by one
		Swing 180°: switch hands during one swing

Example lesson plan: Vaults, wall run and tiktak

<table>
<tr><th colspan="3">Lesson plan : Vaults, wall run and tiktak</th></tr>
<tr><td colspan="3">Warm-up</td></tr>
<tr><td></td><td colspan="2">Children start by moving through the gymnasium on and around the equipment. While doing so they will perform precisions, strides and balance exercises.
Afterwards, during the rest of the lesson, children will work in stations. There will be three different stations, in which all children will practice.</td></tr>
<tr><td colspan="3">LESSON CONTENT</td></tr>
<tr><td></td><td>Station 1 : Strides and tiktak

Equipment : springboard, mat, mat against wall, hoops and spots.

Name the colors of each movement and show the direction of the course.

Critical elements Tik:
Take off with foot closest to the springboard
Put one foot against the springboard and push
Landing: running (left-right or right-left)</td><td>General
Start with a tik against an inclined springboard (against wall bars). You can use chalk to draw feet on the springboard as an environmental cue for children to place their feet. Afterwards the more difficult progressions can be implemented depending on the quality of performance.

Task progression
Informing task:
Tik = one foot against the springboard, inclined approach and inclined landing
Extending task: inclined approach, straight landing, inclined springboard
Extending task: straight approach, straight landing, inclined springboard
Extending task: one of the previous tasks against a straight object (mat or well)
Refining task: Keep short contact with the springboard
Refining task: Stay low</td></tr>
<tr><td></td><td>Station 2 : Wall run & precisions

Equipment : Bench in wall bars, bench upside down, hoops, several mats

Name the colors of each movement and show the direction of the course.

Critical elements Wall run:
Run the inclined bench without using hands
Jump (take off with two feet)
Landing: two feet</td><td>General
Wall run is running up an inclined or vertical object. Start with an inclined bench.

Task progression
Informing task:
Wall run: run the inclined bench, jump off and land in precision
Extending task: wall run + jump off and rotate 90°
Extending task: wall run + jump off and rotate 90° + roll after landing
Refining task: Bend through your knees while landing</td></tr>
</table>

	Station 3 : Speedstep & balance **Equipment :** Plint, elevated bench, balance boards, stepping stones, several mats Name the colors of each movement and show the direction of the course. **Critical elements Speedstep:** • Take off on one foot • Crossed coordination: hand and foot on the plint • Other leg swings between hand and foot (plint) • Landing: running (left-right or right-left)	**General** The speedstep is a vault. **Task progression** • **Informing task**: Speedstep: foot on plint: walking (focus on right coordination) • **Extending task**: Same execution, however more fluently (running if possible) • **Extending task**: try the not preferred side. • **Refining task**: Try to execute the exercise with a fluent flow (approach in a fluent way and fluent take off after landing)
End of the lesson		
	Children can combine the newly learned parkour moves (speedstep, wall run and tik tak) in a parkour routine moving across the whole gymnasium. During this exercise special attention is given to fluently moving from one obstacle to another.	

*****The Supplementary file was taken from Vanluyten et al. (2023).

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Examining the Relationship between International Sports Organizations and Sports Awareness

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Abstract

The focus of this study is to look into the relationship between international sports organizations and sports awareness, taking into account factors such as gender, education level, individual engagement with sports, and family involvement. The research study group comprised 168 individuals, 77 female and 91 male, who were picked utilizing an easily available selection technique. The study used a personal information form developed by the researcher, an Attitude Scale towards International Sports Organizations, and a Sports Awareness Scale. The data was descriptively evaluated using the independent samples T-test, one-way ANOVA, Pearson Correlation analysis, and SPSS 25.0 software. The t-test results revealed a significant difference in attitudes towards sports awareness based on gender ($p<.05$). One-way ANOVA analysis revealed substantial variations in attitudes towards international sports organizations and sports awareness based on education level, relationship with sports, and family interest in sports ($p<.05$). The correlation analysis used to explore the relationship between the participants' opinions towards international sports organizations and their degrees of sports awareness found a high positive correlation. According to the study's conclusions, it is necessary to host more international sports organizations and conduct research to raise public awareness in order to create sports consciousness.
Keywords: International sports organizations, Sports awareness, Sports

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INTRODUCTION

International sporting events play a vital role in bringing people together and fostering international relationships. Specifically, the nations that create these organizations want several benefits including as economic, reputation, prestige, social, and infrastructure potential. Furthermore, it contributes significantly to the development of sports culture among its own people. National or international sports organizations can benefit from intercultural integration, boosting nation-state understanding, and increasing sports awareness. Sports organizations impact society in several ways including social, cultural, physical, physiological, and psychological elements. They are also considered a separate industry from an economic and commercial standpoint (Özgür, 2018; Yiğit, 2018). It is possible that nations and cities, particularly those that organize sporting events, contribute to tourism while also introducing their own image to the globe. In addition to this possibility, there are sponsorships, broadcast income, and so on in mega-sports economies. It may also generate commercial revenue opportunities for the country hosting the event (Houlihan, 1997). Another key link between sports groups is their political component. Governments and politicians may utilize sports groups to spread political propaganda. Politicians desire to host sports groups as a stepping stone to their political careers, governments to better their connections with society, sports authorities and commercial organization corporations, and local and national governments to demonstrate their economic, political, and cultural understanding (Can and Değirmen, 2017).

Sporting organizations provide benefits such as enhanced urban infrastructure, restored sporting facilities, a worldwide tourism profile, and experienced sports activities that are inherited by the country or city (Jeong et al., 2020; Veal et al., 2012). For example, the World Junior Alpine Ski Championships, with over 50 countries participating, might be considered a small-scale international sports event. Such organizations can provide valuable experience for countries before they apply for large sports organizations (Bazzanella et al., 2019). In addition to this experience, it plays a vital role in socio-cultural interaction. Following the 1992 Olympic Games in Barcelona, there was a huge rise in social and sporting involvement among locals (Malfas et al., 2004). International sports organizations, in particular, produce long-term socio-cultural outcomes by allowing the host area or country to transmit local values and traditions to other countries (Konstantaki, 2009). As a result, sports organizations of all sizes may profit from the growth and diffusion of sports awareness and employment in the sports industry.

Each national or international sports organization develops public awareness of sports and encourages participation, whether actively or passively. While active involvement allows individuals to compete in sports organizations, passive participation allows people to watch tournaments or contests as spectators. As a result, towns with sports organizations see not only economic, tourist, and cultural growth, but also increased sports knowledge, physical competence, and awareness of a healthy lifestyle (Kuş, 2014). In other words, sports awareness focuses on raising people's awareness of sports in society. Athletics-based awareness indicates society's understanding of the issue by utilizing athletics as a method to address social concerns (Uyar and Uyar, 2020). When the literature was examined, Hotchkiss, Moore and Zobay (2002) examined the effects of the Atlanta Summer Olympic Games on regional employment and stated that it increased regional employment by 17% in the short term. Owen (2005) stated in his study that the economic impact of the Olympic Games on the city of Beijing differs from

the economic impacts created in previous games and has more growth potential in the tourism sector. In accordance with the findings of their study on the impact of the 17th Mediterranean Games on Mersin province, Yavuz and Çakıcı (2014) determined that the expectations of the games to contribute to the tourism development of the city, the promotion of the city, the recognition of the existing cultural mosaic of Mersin province and the improvement of the outlook of the city showed up to the front point. Among the research conducted on international sports organizations there are some subjects existed in the following; economic growth (Bonollo De Zwart and Gilligan, 2009), good governance in directing sports in the sports world (Geeraert et al., 2013), integration, increasing economic and social harmony (Gratton et al., 2005), socio-cultural values (Schenk, 2011). As a consequence, it is possible to conclude that the studies are primarily concerned with national or international sports policy. In research on sports awareness these topics are found; situation awareness in sports (Huffman et al., 2022), cognitive skills, visual behaviors, decision-making, foresight (Caserta and Singer 2007; McCrozier et al., 2015; McGuckian et al., 2020; Murray, 2018), etc. It has been monitored that studies have been realized on these subjects. The literature research reveals that there are just a few studies on international sports organizations and sports awareness.

Istanbul Formula 1 Turkish Grand Prix, UEFA Champions League Final, European Indoor Athletics Championship, Modern Pentathlon Junior A World Championship, World Wrestling Championship, World Archery Cup final, Intercontinental Eurasia Marathon, WTA Championships and THY Europa League Final Four have been held by several major sporting events, including the Women's Volleyball European Continental Qualifiers, FIFA U-20 World Cup, World Women's Basketball Championship, and European Judo Championship (Spor Haber, 2011). Cities that host international sports organizations are regarded as having a favourable impact on tourism, the economy, jobs, and municipal recognition, as well as raising sports awareness. Hence, it is anticipated that our study, which was created in line with the positive effects, will contribute to the field of sports sciences by determining the effect of sports organizations on sports awareness in Istanbul.

METHODS

Research Model

The research investigation used a relational survey paradigm to investigate the link between international sports organizations and sports awareness. Relational survey studies study the link between many variables without interfering with them (Tekbıyık, 2014).

Population-Sample

The study's volunteers are those who live in the Istanbul/Beşiktaş district and participate or do not participate in international sports organizations. The study group consists of 176 people, 77 females and 91 males, chosen using a basic random sampling procedure (Table 1).

Table 1. Demographical information belongs to sample group

Variables		f	%
Gender	Female	77	45,8
	Male	91	54,2
Profession	Student	41	24,4
	Worker	56	33,3
	Officer	22	13,1
	Retired	18	10,7
	Other	31	18,5
Educational Status	Secondary School	16	9,5
	High school	38	22,6
	University	101	60,1
	Master	13	7,7
What is your relationship with sports?	Participator	95	56,5
	Spectator	48	28,6
	I have no relationship	25	14,9
Is there anyone in your family that is interested in sports?	Yes	94	56,0
	No	74	44,0

According to Table 1, which displays socio economicin formation about the sample group, 45.8% of those participating in thestudy are women, while 54.2% are men. Considering the occupational distribution of the participants, 24.4% are students, 33.3% are workers, and 10.7% are retired people. In terms of education, 9.5% are middle school graduates, 22.6% are high school graduates, 60.1% are college graduates and 7.7% are master graduates. When looking at their relationship with sports, it is seen that 56.5% of them are participants in sports, 28.6% are spectators, and 14.9% have no relationship with sports. Is anyone in the family interested in sports? When asked, it was observed that 56.0% answered yes and 44.0% answered no.

Data Collection Tools

The researcher's personal information form, as well as the Attitude Scale for International Sports Organizations and Sports Awareness Scale, were utilized in this research.

Attitude Scale towards International Sports Organizations: Aktaş and Kan (2018) developed the Attitude Scale towards International Sports Organizations, which consists of 20 questions and three sub-dimensions (Favorable Feelings Unfavorable Feelings and Cognitive). "Attitude Scale towards International Sports Organizations" was utilized in this research. In the study, the five-point Likert type, which was analyzed for reliability, was used as "Completelyagree (5), agree (4), unsure (3), disagree (2), completely disagree (1)."Negative expressions in the scale (items 6, 7, 10, 12, 15, 17) were reverse coded and included in the research.

***Sports Awareness Scale*:** Sports Awareness Scale (SAS) was improved by Uyar and Sunay (2020) to determine sports awareness levels. The scale is a 5-point Likert type and consists of 30 items and 2 subscales. While the dimension called "Sports Knowledge and Distinguishing Information" consists of 21 items, the dimension called "Social and Individual Benefit" consists of 9 items.

The scale's lowest and highest scores are 30 and 150, respectively. The level of sports awareness grows as the scale score rises, and decreases as the scale score falls. As a result, the scale's score ranges are: "not informed at all" (30-53 points), "not aware" (54-77 points), "moderately aware" (78-102 points), "informed" (103-126 points), and "completely informed" (127-150 points). It was determined that there are no reverse-scored items on the scale.

Table 2. Reliability results of the research

	Cronbach's Alpha	N of Items
Attitude Scale towards International Sports Organizations	0,91	20
Sports Awareness Scale	0,95	30

The Cronbach α internal consistency value for the attitude scale towards international sports organizations, consisting of 20 items and included in Table 2, was determined as 0.91, and the Cronbach α internal consistency value for the sports awareness scale, consisting of 30 items, was determined as 0.95.

Ethical Approval

Approval for the research was acquired by Istanbul Topkapı University's Academic Research and Publication Ethics Board on 08.09.2023, number 2023/09.

Data Collection Tools

Following consideration of the research ethics, individuals living in the Beşiktaş district were interviewed in person. Throughout the data collecting stage, the personal information form was used as the appropriate information about the queries for the Attitude Scale Towards International Sports Organizations and the Sports Awareness Scale had been submitted as well.

Analysis of Data

To confirm the normality assumption, the skewness and kurtosis coefficients, as well as the values produced by dividing the skewness and kurtosis coefficients by the standard error, were assessed. The skewness and kurtosis scores ranged from -2 to +2. As a consequence, it was assumed that the data had a normal distribution, and parametric tests were used in comparisons between independent groups. For pairwise comparisons, an independent samples t-test was utilized, whereas a one-way ANOVA test was used for multiple comparisons. To investigate the association, the Pearson correlation test was performed in the correlation inquiry.

FINDINGS

The findings resulting from the examination of individuals' attitudes towards international sports organizations and sports awareness by gender are pointed out in Table 3.

Table 3. Examining individuals' attitudes towards sports organization and sports awareness according to gender variable

	Gender	**N**	**X̄**	**S**	***t***	**p**
Attitude Towards Sports Organizations Average Score	Female	77	3,61	0,79	-0,150	0,881
	Male	91	3,63	0,81		
Positive Emotion	Female	77	3,88	0,86	0,255	0,799
	Male	91	3,85	0,92		
Negative Emotion	Female	77	3,90	1,02	-0,605	0,546
	Male	91	3,99	0,91		
Behavioural	Female	77	3,09	0,95	-0,071	0,944
	Male	91	3,10	1,09		
Sports Awareness Total Score	Female	77	105,58	23,70	-2,443	0,016*
	Male	91	114,20	21,96		
Sports Knowledge and Distinguishing Information	Female	77	67,04	20,47	-2,914	0,004*
	Male	91	75,52	17,24		
Social and Individual Benefit	Female	77	38,55	6,89	-0,134	0,893
	Male	91	38,68	6,23		

* p<0,05.

Table 3 shows the results of the independent groups t test, which compares the attitudes of the research participants towards sports organizations and their sports awareness based on gender. According to the findings, there was no substantial variation in sentiments about sports organizations based on gender. According to the sports awareness scale total scores, the awareness level of men (x=114.20±21.96) was considerably higher than the awareness level of women (x=105.58±23.70). Similarly, in the sports knowledge and discrimination sub-dimension of the same scale, men's awareness level (x=75.52±17.24) is higher than women's awareness level; (x=67.04±20.47) was specified to be higher with a considerable difference (p<0.05).

Table 4. Examining individuals' attitudes towards sports organization and sports awareness according to the variable of education level

	Educational Status	**N**	**X̄**	**S**	***F***	**p**	**Difference**
Attitude Towards Sports Organizations Average Score	Secondary	16	2,80	0,70	7,115	0,000*	2 > 1 3 > 1 4 > 1
	High school	38	3,64	0,80			
	University	101	3,74	0,76			
	Master	13	3,65	0,72			
Positive Emotion	Secondary	16	2,83	1,12	9,273	0,000*	2 > 1 3 > 1 4 > 1
	High school	38	4,00	0,77			
	University	101	3,98	0,79			
	Master	13	3,82	0,89			
Negative Emotion	Secondary	16	3,04	1,02	6,694	0,000*	2 > 1 3 > 1 4 > 1
	High school	38	3,84	1,12			
	University	101	4,10	0,83			
	Master	13	4,21	0,66			
Behavioural	Secondary	16	2,56	1,02	1,835	0,143	
	High school	38	3,11	1,11			
	University	101	3,19	1,00			
	Master	13	2,99	0,86			

Table 4 (Continue). Examining individuals' attitudes towards sports organization and sports awareness according to the variable of education level

	Educational Status	**N**	**X̄**	**S**	***F***	**p**	**Difference**
Attitude Towards Sports Organizations Average Score	Secondary	16	2,80	0,70	7,115	0,000*	2 > 1 3 > 1 4 > 1
	High school	38	3,64	0,80			
	University	101	3,74	0,76			
	Master	13	3,65	0,72			
Positive Emotion	Secondary	16	2,83	1,12	9,273	0,000*	2 > 1 3 > 1 4 > 1
	High school	38	4,00	0,77			
	University	101	3,98	0,79			
	Master	13	3,82	0,89			
Negative Emotion	Secondary	16	3,04	1,02	6,694	0,000*	2 > 1 3 > 1 4 > 1
	High school	38	3,84	1,12			
	University	101	4,10	0,83			
	Master	13	4,21	0,66			
Behavioural	Secondary	16	2,56	1,02	1,835	0,143	
	High school	38	3,11	1,11			
	University	101	3,19	1,00			
	Master	13	2,99	0,86			
Sports Awareness Total Score	Secondary	16	99,25	26,81	1,726	0,164	
	High school	38	108,37	23,28			
	University	101	112,79	22,96			
	Master	13	109,54	15,62			
Sports Knowledge and Distinguishing Information	Secondary	16	64,94	20,83	0,986	0,401	
	High school	38	70,74	19,12			
	University	101	73,31	19,78			
	Master	13	69,46	10,60			
Social and Individual Benefit	Secondary	16	34,31	8,54	3,586	0,015*	3>1
	High school	38	37,63	6,39			
	University	101	39,49	5,96			
	Master	13	40,08	6,46			

*p<0.05.

Table 4 shows the conclusions of theone-way ANOVA test, which compares participants' views towards sports organizations and sports awareness based on their educational level. According to the data obtained, there were differences between the groups in the general average of attitude towards sports organizations and the positive emotion sub-dimension and negative emotion sub-dimension. In the average scores of attitudes towards sports organizations, there is a significant difference in the attitudes of people with high school (x = 3.64), university (x = 3.74) and postgraduate education (x = 3.65) compared to those with secondary school education (x = 2.80). In the positive emotion sub-dimension, the attitudes of people with high school (x=4.00), university (x=3.98) and postgraduate education (x=3.82) are significantly higher than those with secondary school education (x=2.83). In the negative emotion sub-dimension, the attitudes of people with high school (x=3.84), university (x=4.10) and postgraduate education (x=4.21) are significantly higher than those with secondary school education (x=3.04). It was specified to be high (p<0.05).

The total findings of the sports awareness scale and the sub-dimension of sports knowledge and information discrimination showed no considerable difference between the groups depending on their level of education. In the social benefit and personal benefit sub-dimension of this scale, the awareness level of the participants whose education level is university is higher (x=39.49) than the participants whose education level is secondary school; (x=34.31) was specified as higher with an impressive difference (p<0.05).

Table 5. Examining individuals' attitudes towards sports organization and sports awareness according to the variable of relationship with sports.

	Sports Relationship	**N**	**X̄**	**S**	***F***	**p**	**Difference**
Attitude Towards Sports Organizations Average Score	Participator	95	3,79	0,76	14,191	0,000*	1 > 3 2 > 3
	Spectator	48	3,66	0,74			
	No relationship with sports	25	2,90	0,69			
Positive Emotion	Participator	95	3,96	0,91	5,913	0,003*	1 > 3 2 > 3
	Spectator	48	3,96	0,83			
	No relationship with sports	25	3,31	0,75			
Negative Emotion	Participator	95	4,08	0,97	6,129	0,003*	1 > 3 2 > 3
	Spectator	48	4,00	0,89			
	No relationship with sports	25	3,35	0,83			
Behavioural	Participator	95	3,37	0,94	18,028	0,000*	1 > 3 2 > 3
	Spectator	48	3,08	0,87			
	No relationship with sports	25	2,11	1,02			
Sports Awareness Total Score	Participator	95	115,40	21,25	18,817	0,000*	1 > 3 2 > 3
	Spectator	48	112,31	20,68			
	No relationship with sports	25	86,72	20,48			
Sports Knowledge and Distinguishing Information	Participator	95	75,51	16,98	18,767	0,000*	1 > 3 2 > 3
	Spectator	48	74,21	17,32			
	No relationship with sports	25	51,96	19,36			
Social and Individual Benefit	Participator	95	39,89	6,59	6,784	0,001*	1 > 3
	Spectator	48	38,10	5,75			
	No relationship with sports	25	34,76	6,20			

* p<0.05.

Table 5 presents the findings of the one-way ANOVA test, which compares participants' views about sports organizations and sports awareness based on their involvement with sports. According to the data obtained, considerable differences were found between the groups in all sub-dimensions of attitudes towards sports organizations and sports awareness. In the general average scores for sports organizations, the level of those who are involved in sports (x = 3.79) and the level of those who are spectators (x = 3.66) are higher than those who are not related to sports; (x=2.90) was found to be higher with a considerable difference (p<0.05). The same situation was observed in the positive emotion, negative emotion and behavioural subscales. In the sports awareness scale total scores, the level of those who are involved in sports (x = 115.40) and the level of those who are spectators (x = 112.31) are higher than those who are

not related to sports; (x=86.72) was found to be higher with a considerable difference (p<0.05). The same situation was monitored in the sub-dimension of sports knowledge and information discrimination. In the social and individual benefit sub-dimension, the level of those who are interested in sports is higher (x=39.89) than those who are not interested in sports; (x=34.76) was found to be considerably higher (p<0.05).

Table 6. Examining individuals' attitudes towards sports organization and their sports awareness according to the variable of interest in sports within the family.

	People interested in sports in the family	**N**	**X̄**	**S**	***t***	**p**
Attitude Towards Sports Organizations Average Score	Yes	94	3,84	0,73	4,187	0,000*
	No	74	3,34	0,79		
Positive Emotion	Yes	94	4,06	0,86	3,385	0,001*
	No	74	3,61	0,86		
Negative Emotion	Yes	94	4,10	0,99	2,282	0,024*
	No	74	3,76	0,89		
Behavioural	Yes	94	3,40	0,88	4,463	0,000*
	No	74	2,72	1,07		
Sports Awareness Total Score	Yes	94	114,23	22,13	2,560	0,011*
	No	74	105,19	23,49		
Sports Knowledge and Distinguishing Information	Yes	94	75,61	16,96	3,100	0,002*
	No	74	66,58	20,76		
Social and Individual Benefit	Yes	94	38,63	7,41	0,019	0,985
	No	74	38,61	5,23		

*p<0.05.

Table 6 shows the results of the one-way ANOVA test, which compares the attitudes of participants in the study toward sports organizations and their sports awareness based on whether there are members in the family engaged in sports. In accordance with the data obtained, considerable differences were observed between the groups in attitudes towards sports organizations and all their sub-dimensions. Based on the average scores of attitudes towards sports organizations, the level of those in the family who are interested in sports (x = 3.84) was considerably higher than those who were not interested in sports (x = 3.34) (p < 0.05). Similarly, in the positive emotion, negative emotion and behavioural sub-dimensions, it was observed that the levels of individuals whose families are interested in sports were statistically higher than those who were not interested in sports.

In the total scores of sports awareness, it was reviewed that the levels of individuals who are interested in sports in the family (x = 114.23) were considerably higher than those who were not interested (x = 105.19) (p < 0.05). Likewise, in the sports knowledge and discrimination sub-dimension, it was observed that the levels of individuals in the family who are interested in sports (x = 75.61) were considerably higher than those who were not interested (x = 66.58) (p < 0.05).

Table 7. Examining the relationship between individuals' attitudes towards sports organization and sports awareness.

		Sports Awareness Total Score	Sports Knowledge and Distinguishing Information	Social and Individual Benefit
Attitude Towards Sports Organizations Average Score	Pearson Correlation	,683**	,644**	,525**
	Sig. (2-tailed)	,000	,000	,000
	N	168	168	168
Positive Emotion	Pearson Correlation	,621**	,566**	,534**
	Sig. (2-tailed)	,000	,000	,000
	N	168	168	168
Negative Emotion	Pearson Correlation	,328**	,267**	,376**
	Sig. (2-tailed)	,000	,000	,000
	N	168	168	168
Behavioural	Pearson Correlation	,719**	,728**	,403**
	Sig. (2-tailed)	,000	,000	,000
	N	168	168	168

** p<0.01.

In the correlation analysis carried out to look at the relationship between the attitudes of the people participating in the research towards international sports organizations and their level of sports awareness, the Pearson correlation coefficient was examined and the results are given in Table 7. According to the data obtained, it was observed that there was a high positive relationship (r = 0.683, p = 0.000) between attitude towards sports organizations and sports awareness. In other words, we can say that the attitudes of the people participating in the research towards sports organizations have a high positive effect on their sports awareness.

When we examine the sub-dimensions of the sports awareness scale, we find a strong positive relationship (r=0.644, p=0.000) between the sports knowledge and information discrimination dimension and attitudes toward sports organizations, as well as a moderately positive relationship between the social and individual benefit dimension and attitudes toward sports organizations. There was a correlation (r = 0.525, p = 0.000).When we review the sub-dimensions of the attitude scale toward sports organizations, we see that there is a high positive relationship between the positive emotion dimension and sports awareness (r=0.621 p=0.000), a weak positive relationship between the negative emotion dimension and sports awareness (r=0.328 p=0.000), and a high positive relationship (r=0.719 p=0.000) between the behavioural dimension and sports awareness.

DISCUSSION and CONCLUSION

Analyses were conducted to examine if the link between international sports organizations and sports awareness varied depending on characteristics such as gender, education level, individual's involvement with sports, and persons interested in sports within their families.

When the research findings were evaluated, it was discovered that there was no considerable difference in the total scores of participants in sports groups based on their gender. This finding

suggests that men and women have similar positive and negative emotions, as well as behavioural attitudes. When sports awareness is evaluated, men's sports awareness levels are greater than women's; similarly, males were shown to be higher than women in the sub-dimension of sports knowledge discrimination. According to these findings, males are more engaged in sports than women, and as a result, they can better discern between sports and information. In other words, it can be thought that men's knowledge of sports is related to sports. When the literature was examined, Demirci (2021) found that while there was a considerable difference in the awareness total score of gender, men's awareness total scores were higher. He stated that male fans being more fanatical emerged as a result of male fans' interest and passion for football in Turkey. Ayyıldız (2021) stated in his study on society's perspective on international sports organizations that he concluded that women's interest in sports organizations is more positive, while men have a more negative attitude. According to these findings, people's opinions about sports organizations are connected to their level of sports involvement and interest in sports. According to Yalçın et al. (2021), men and women have similar attitudes regarding international sports organizations.

There was a considerable difference in the overall scores of sports organizations, positive emotion, and negative emotion sub-dimensions based on the participants' education level; however, there was no considerable difference in the behavioural sub-dimension. This finding revealed that those with high school, university, and postgraduate degrees had a greater education level than those with secondary school degrees. We may conclude that an individual's favourable or negative attitude about sports groups is determined by their degree of education. In sports awareness, it was found out that there was no considerable difference between the total scores of the scale according to education level and the sub-dimensions of sports knowledge and information discrimination. It has been determined that individuals with a university degree have a higher education level in the social and individual benefit sub-dimensions than individuals with a secondary school degree. In the light of these results, it can be stated that individuals' education levels affect both their attitudes towards sports organizations and their attitudes towards sports awareness. When the body of literature is evaluated, it becomes clear that researches realized on sports awareness are restricted. According to Ayyıldız's (2021) study on sports organizations, high school graduates outperformed associate, undergraduate, and graduate participants in terms of positive emotion and behavior, while undergraduate graduates outperformed associate and graduate participants. Additionally, associate degree graduates outnumbered graduate participants considerably.

Depending on the participants' relationship with sports variables, the overall scores of sports organizations, positive and negative emotions, and behavioural sub-dimensions of participants and spectators were greater than those who were not associated to sports. Similarly, in terms of sports awareness, persons who were participants and spectators scored better on the scale's overall score as well as the sub-dimensions of sports knowledge and information discrimination scores than those who were not involved in sports. In the social and individual benefit sub-dimension, it has been established that those who are active in sports participate more than those who are not. On the basis of this finding, it is possible to conclude that awareness can occur in an individual through conscious, perceptual, or physical means, and that awareness is related to the individual's attitude toward the events he encounters as a result of the knowledge

or experiences he has gained, as well as his relationship with sports (Acar 2009). When the literature was reviewed, Keskin (2022) stated that, according to the findings of his study, the number of people who do sports with a license is significantly higher than other variables, that they actively participate in more sports organizations because of the sports branches they do, and that the difference could be due to this.

Among other factors, it has been shown that persons in the family who are interested in sports have more positive sentiments toward sports organizations than those who are not. A similar pattern was seen in the negative emotion, positive emotion, and behavioural sub dimensions. In other words, it has been established that those who participate in family sports have more positive and negative emotions, as well as behavioural attitudes toward sports groups, than those who do not participate. In terms of sports awareness, individuals who are interested in sports in the family have higher levels than those who are not interested in sports; however, there was no significant difference in the social and individual benefit sub-dimensions. According to the findings, the presence of family members who are actively (participant) or passively (spectator) involved in sports influences both their views about sports organizations and their sports awareness viewpoint.

In accordance with the results of the analysis conducted to examine the relationship between the participants' attitudes towards sports organizations and their levels of sports awareness, it was determined that there was a high level of positive relationship between attitudes towards sports organizations and sports awareness. This condition may also have an impact on people's views about sports organizations and their degree of sports knowledge. When the sports awareness sub-dimensions are examined, it is discovered that there is a positive relationship between individuals' sports knowledge and information discrimination and their attitudes toward sports organizations. It has also been determined that there is a moderate relationship between social and individual benefits and attitudes toward sports organizations. Similarly, opinions about sports organizations were identified in their sub-dimensions. While a favourable and high-level association was seen in the positive emotion and behavioural sub-dimensions, a weak relationship was discovered in the negative emotion sub-dimension. In general, individuals' opinions regarding sports organizations are connected to and can influence their sports awareness levels.

When the body of the literature is reviewed, it is clear that studies on international sports organization and sports awareness are scarce. When studies that differ from our research are examined, it is discovered that international sports organizations influence the advertising perceptions of intercultural students (Andrews and Lysonski, 1991), affect financial support and development (Aninat, 2002), contribute to the sports economy (Baade, 2008), and develop international promotion and strategy (Dunn, 1976), among other things. The findings, though indirect, do have an impact on sports awareness. Sports organizations benefit the country's economy by increasing sponsorships, enhancing sports marketing, increasing interest in sports, increasing global recognition of the country or city, and facilitating the development of tourism through sports awareness. Vrondou et al. (2017) stated that the results of their study on the evaluation of sponsor awareness in the Athens Olympic Games revealed that individuals who participated in the sports organization remembered the sponsors in the Athens Olympic Games, and that these sponsorships developed long-term brand awareness in people.

In accordance with the study's findings, it is recommended that more international sports organizations be hosted, as well as efforts be made to raise public awareness about sports. Future study might examine the awareness-raising techniques of international sports organizations in greater depth. Particular attention might be paid to which forms of organizations are more effective and why. Researchers may also explore other aspects that affect sports awareness. Deeper analyses, for example, can be undertaken on aspects such as the involvement of the media, athletes' social image, and motivation to participate in sporting events.

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Investigation of Decision Making Styles and Problem Solving Skill Levels of School Administrators Doing Sports and Non-Sports*

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Abstract

The aim of this study is to examine the decision-making styles and levels of problem-solving skills among school administrators who do and do not do sports. For this purpose, the study was conducted using the quantitative research method, specifically the descriptive survey model. The research was conducted with a sample group of 358 among 2334 school administrators working in Bursa in the 2021-2022 academic year. Personal Information Form, Problem Solving Scale (PSS) and Melbourne Decision Making Scale (MDMS) were used to collect study data. In the analysis of the data, SPSS 21.0 package program was used, and the significance level was taken as $\alpha = 0.05$. Shapiro-Wilk Normality Test was used to distribute the total and subscale scores obtained from PSS and MDMS. In conclusion, it was determined that there were no significant differences between the groups of administrators who engage in sports and those who do not, based on variables such as the duration of their leadership, whether they received administrative training, and the type of school where they work. Administrators with a history of licensed sports participation had a higher rate of engagement in sports. In the sports group, administrators exhibited a preference for a cautious decision-making style and had higher levels of self-esteem. They also demonstrated lower levels of avoidant, procrastinative, and panicked decision-making styles. Furthermore, it was concluded that the impact of engaging in sports on the perception of problem-solving skills was not significant between administrators who engage in sports and those who do not.
Keywords: School managers, Style of making decisions, Problem solving, Doing sports

Spor Yapan ve Yapmayan Okul Yöneticilerinin Karar Verme Stilleri ve Problem Çözme Beceri Düzeylerinin İncelenmesi

Öz

Bu çalışmanın amacı, spor yapan ve yapmayan okul yöneticilerinin karar verme stillerinin ve problem çözme beceri düzeylerinin incelenmesidir. Bu amaç doğrultusunda, çalışma nicel araştırma yöntemlerinden betimsel tarama modeline göre yürütülmüştür. Araştırma, 2021-2022 eğitim-öğretim yılında Bursa'da görev yapan 2334 okul yöneticisi arasından 358 kişilik örneklem grubu ile gerçekleştirilmiştir. Araştırma verilerinin toplanmasında Kişisel Bilgi Formu, Problem Çözme Ölçeği (PÇO) ve Melbourne Karar Verme Ölçeği (MKVÖ) kullanılmıştır. Verilerin analizinde SPSS 21.0 paket programı kullanılmış olup anlamlılık düzeyi α=0,05 olarak alınmıştır. PÇO ve MKVÖ'den elde edilen toplam ve alt ölçek puanlarının dağılımında Shapiro-Wilk Normallik Testi kullanıldı. Sonuç olarak; spor yapan- yapmayan gruplar arasında, yöneticilik süresi, yöneticilik eğitimi alıp almama, görev yapılan okul türü değişkenine göre anlamlı farklılık olmadığı saptanmıştır. Sporcu geçmişinde lisanslı olarak spor yapan yöneticilerinin spor yapma oranının yüksek çıktığı, spor yapan grupta olan yöneticilerinin dikkatli karar verme stilini tercih ettiği ve öz saygı düzeylerinin yüksek olduğu; kaçıngan, erteleyici ve panik karar verme stillerinin düşük olduğu anlaşılmıştır. Ayrıca spor yapan yöneticilerin problem çözme becerisi bağlamında istendik-olumlu yaklaşım biçimlerini kullandıkları anlaşılırken spor yapan-yapmayan gruplar arasında problem çözme becerisi algısı bağlamında spor yapmanın etkisinin olmadığı sonucuna varılmıştır.
Anahtar kelimeler: Okul yöneticisi, Karar verme stili, Problem çözme becerisi, Spor yapan

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INTRODUCTION

In all institutions and organizations, the people who take on the most serious duties and responsibilities are undoubtedly managers (Vural, 2013). A manager is defined as a superior who can take responsibility for the execution of services in an institution or organization, and who, from time to time, supervises and supervises decisions regarding issues other than certain transactions while performing tasks and transactions related to his/her duty (Bozkurt and Ergun, 1998). While performing these duties, the manager should also provide his employees with a sense of belonging (Atılgan and Ergun, 2022). Corporate managers may face decision-making and problem-solving situations while performing their management duties. Managers have to make a decision to solve these problems (Zembat et al., 2018). Administrators with problem solving, management drivers and problem classification skills play an important role in increasing the quality of the educational environment and achieving the goals of the educational institution (Leithwood and Steinbach, 1991). One of the most important duties of individuals at the head of education management is to fulfill the determined goals of the institution, to increase the quality of education by making educational environments functional, and to keep up with innovations by following educational developments. For this reason, it is very important for educational administrators, especially school administrators, to be administratively equipped (Özgenel, 2018). In order to create an effective and efficient institutional structure, it is of great importance that school administrators have a solid management approach (Çiçek, 2019).

Similar methods may not always yield results in solving the problems encountered. While sometimes there is difficulty and complexity in this regard, the solution to the problems can sometimes be very easy and short-term. Therefore, managers having certain characteristics can provide them with great convenience in decision-making and problem solving. The most important of these features is a healthy mood (Karaca, 2021). One of the important stakeholders in creating a healthy mood is sports.

Social-sports activities have an important place in raising biologically healthy individuals. Sports enable individuals, especially those who have been involved in sports activities from an early age, to live a quality life. In addition to its physical and biological benefits, sports also have an aspect that affects people's social development and contributes to the strengthening of their competence in this field (Emamvirdi, 2013). Additionally, due to the nature of sports, some elements occur in the form of indirect learning. Especially in individual and team sports, the athlete's attitude towards his opponent, his attitude, and his tendency to comply with the rules also affect his life outside of sports. In particular, the necessity of acting with a collective spirit in working life is very effective in the emergence of harmonious individuals who are prone to teamwork, successful in social relations (Demirtaş, 2018).

Today, sports have gone much further than just contributing to the psychological and physical development of individuals and have made significant contributions to the socialization of individuals by clarifying their ability to maintain responsibility, cooperation and order (Toprak, 2019). Starting sports at a young age has a great impact and importance in gaining responsibility awareness and raising individuals with strong communication skills (Yazarer et al., 2004). When we look at the literature, we see that the research findings generally support

this view. However, when we look at the literature, it is understood that the number of studies on the decision-making styles and problem-solving skills of managers who have sports as their social capital is insufficient and limited in number.

In this context, the aim of this study is; The aim is to determine whether school administrators, who are primarily responsible for coordinating education and training activities, have a sports background in their social capital and whether their sports background has an impact on making successful decisions and problem solving in their managerial life. Based on this, the aim is to examine the decision-making styles and problem-solving skill levels of school administrators who do and do not do sports in terms of some variables. At this point, the sub-goals of the research can be expressed as follows:

1- What are the tendencies of school administrators according to demographic characteristics and sports participation?
2- What are the trends of school administrators' Melbourne Decision Making Scale and subscale scores according to their sports activities?
3- What is the tendency of school administrators' problem-solving scale and subscale scores according to their sports activities?

METHOD

Research Model

The planning and execution of this research study was designed according to the quantitative research method. In this context, the study was conducted according to the descriptive survey design, one of the non-experimental designs. Survey design is the study carried out on a sample determined within the universe that is thought to represent the entire planned study. Within the scope of these studies, it is expressed as the quantitative description of opinions, attitudes and tendencies about the general universe (Creswell, 2013; Karasar, 2005). Descriptive survey design, these are processes that enable the collection, description and statistical interpretation of numerical data regarding variables (Büyüköztürk, 2010).

Participants

The population of this study consists of 2334 school administrators working in central and district schools within the Bursa Provincial Directorate of National Education. The sample of the study consists of 358 school administrators who participated in the study from this universe. Stratified random sampling method was used when creating the sample. Stratified random sampling method; each unit belongs to only one layer. It is divided into small sub-main masses, provided that no unit is left out. If simple random sampling is applied to each stratum, such sampling is called stratified sampling (Serper vd., 2016). In the stratified sampling model, the universe must be divided into homogeneous layers, and samples are selected from each separated layer and combined. Stratified sampling is generally preferred when there are sub-layers or sub-groups within the universe with clear boundaries. The advantage of this sampling selection is that the results will be more precise if the variables we investigate are related to the

stratification sample. In other words, some variables that we think may affect the result with simple random sampling, especially age and gender distribution; The possibility of such elements not being distributed equally across groups due to chance can be reduced by stratified sampling (Kılıç, 2013). In this thesis study, the central districts in Bursa were considered as a layer and a sample group was created from each district using a simple random method.

Ethical Approval

The information, scale and survey form regarding the research process were approved by the decision of Bursa Uludag University Social and Human Sciences Research and Publication Ethics Board, session number 2021-01, dated 29.01.2021.

Data Collection Tools

In order to collect research data, first of all, the "Personal Information Form" created by the researcher by taking expert opinions was given to school administrators in order to determine demographic information, the "Melbourne Decision Making Scale" to determine Decision Making Styles and the "Problem Solving Scale" to determine perception of problem solving skills has been implemented. The tools used to collect research data are generally introduced as follows.

Melbourne Decision Making Scale I-II (MDMS I-II): The scale was adapted from Mann et al., (1998) and consists of two parts. The scale is a 3-point Likert type scale and consists of two dimensions. Each dimension is scored on its own. The first dimension consists of six items and measures self-esteem in decision making. The highest score that can be obtained for the first dimension is 12 and the lowest score is 0. Getting a high score from the first dimension indicates that self-esteem in decision making is also high. The second dimension of the scale consists of 22 items measuring decision-making styles. There are four subscales in the second dimension. These; avoidant, panic, procrastinator and careful decision-making styles. Depending on the type of score obtained from the styles, it indicates that the relevant decision-making style is used more (Uygur, 2018). Internal consistency coefficients of the Melbourne decision-making scale range between .65 and .80 (Kelecek et al., 2013).

Problem Solving Inventory: Problem Solving inventory developed by Heppner and Peterson (1982) adapted to Turkish by Sahin et al. (1993). This inventory, which measures an individual's problem-solving skills, is a 6-point Likert-type scale consisting of a total of 35 items and evaluated according to a scoring system between 1-6. An increase in the score obtained from the scale means that the individual's problem-solving skill level decreases. In the evaluation of the problem-solving inventory, 3 items (9, 22, 29) are excluded from evaluation and items 1, 2, 3, 4, 11, 13, 14, 15, 17, 21, 25, 26, 30 and 34 are scored in reverse order. A minimum of 32 and a maximum of 192 points can be obtained from the scale. The scale has six subscales: Hasty approach, thinking approach, avoidant approach, evaluative approach, self-confident approach and planned approach (Saracaloğlu, 2001). Sahin et al. (1993), as a result of the factor analysis conducted by the inventory; In PSI factor analysis, Kaiser-Meyer-Olkin (KMO) was found to be significant at 0.79 and Bartlett's Test of Sphericity was found to be significant at 0.01. Cronbach Alpha coefficient for the overall scale was found to be 0.85 (Yazıcı, 2017).

Data Analysis

The suitability of the total and subscale scores obtained from the Melbourne decision-making scale and problem-solving scales to normal distribution was examined with the Shapiro Wilk test. If scale scores comply with normal distribution, mean and standard deviation; if it does not comply with normal distribution, it is given with median, minimum, and maximum values. The reliability of the scales was evaluated using Cronbach's alpha coefficient. In comparisons of scale scores between groups, Mann Whitney U test was used if there were two groups and no normal distribution was observed, and Kruskal Wallis test was used if the number of groups was more than two groups, and no normal distribution was observed. If overall significance was found after the Kruskal Wallis test, subgroup analyzes were conducted using the Dunn-Boenferroni test. Categorical variables were compared between groups using the chi-square test, Fisher's exact test and Fisher Exact test. The analyzes were carried out using the SPSS. Program, and the significance level in the analyzes was taken as $\alpha = 0.05$.

FINDINGS

In this section, the data obtained as a result of the research and the analysis results of school administrators, one of the most important stakeholders in education and training, are included.

Table 1. Distribution of participants by demographic characteristics

Age (years) (n=358)	
25-30 age	17(4.70%)
31-35 age	42(11.70%)
36-40 age	95(26.50%)
41-46 age	106(29.60%)
>47 age	98(27.40%)
Gender (n=358)	
Woman	94(26.30%)
Male	264(73.70%)
Graduation Department (n=358)	
Physical Education and Sports	41(11.50%)
Other	317(88.50%)
Management Time (n=358)	
1-5 years	138(38.50%)
6-10 years	103(28.80%)
11-15 years	67(18.70%)
16-20 years	18(5%)
>21 years	32(8.90%)
Receiving Management Training (n=358)	261(72.90%)
Type of School Worked (n=358)	
Pre-school	13(3.60%)
Primary school	75(20.90%)
Middle school	134(37.40%)
High school	136(38%)

Data are expressed as n%.

Table 1 (Continue). Distribution of participants by demographic characteristics

Perspective on Sports (n=358)	
Positive	349(97.50%)
Negative	9(2.50%)
Doing Sports (n=358)	226(63.10%)
Frequency of Exercising (n=358)	
Every day	31(8.70%)
3 days in a week	67(18.70%)
2 days in a week	65(18.20%)
1 day a week	77(21.50%)
I don't do it at all	118(33%)
Doing Sports in Primary and Secondary Education Years (n=358)	261(72.90%)
Status of Doing Sports with a License (n=358)	121(33.80%)
District of Duty (n=358)	
Yıldırım	146(40.80%)
Osmangazi	137(38.30%)
Nilüfer	46(12.80%)
Kestel	17(4.70%)
Gürsu	12(3.40%)

When Table 1 is examined, among the participants in the study, the rate of those in the 25-30 age group is 4.70%, the rate of those in the 31-35 age group is 11.70%, the rate of those in the 36-40 age group is 26.50%, the rate of those in the 41-46 age group is The rate of people over the age of 47 was determined as 29.60% and the rate of those over the age of 47 was determined as 27.40%. When the distribution by gender status is examined, the rate of female participants is 26.30% and the rate of male participants is 73.70%. When the distribution of the participants according to their graduation department was examined, the rate of those who graduated from Physical Education and Sport School (PESS) was determined as 11.50% and the rate of those who graduated from other departments was determined as 88.50%. When the distribution of participants according to management tenure is examined, the rate of those in the 1-5 year group is 38.50%, the rate of those in the 6-10 year group is 28.80%, the rate of those in the 11-15 year group is 18.70%, and the rate of those in the 16-20 year group is The rate of those aged over 21 years is 5% and 8.90%. The rate of those receiving management training was determined as 72.90%. When the distribution of the participants according to the type of school where they worked was examined, the rate of those in the preschool group was determined as 3.60%, the rate of those in the primary school group was 20.90%, the rate of those in the secondary school group was 37.40% and the rate of those in the high school group was 38%. When the distribution of the participants according to their perspective on sports was examined, the rate of those who had a positive perspective on sports was determined as 97.50% and the rate of those who had a negative perspective was determined as 2.50%. The rate of people doing sports was determined as 63.10%. When the distribution of the participants according to the frequency of doing sports is examined, the rate of those who do sports every day is 8.70%, the rate of those who do sports 3 days a week is 18.70%, the rate of those who do sports 2 days a week is 18.20%, the rate of those who do sports 1 day a week is 21.50%. and the rate of those who do not do any sports is determined as 33%. The rate of those who do sports in primary and secondary education years is determined as 72.90%. When the distribution of participants according to the districts where they worked is examined, the rate of those working in Yıldırım district is 40.80%, the rate of those working in Osmangazi district is 38.30%, the rate of people working in Nilüfer district is 12.80%, the rate of people working in Kestel district is 4.70%, the rate of people working in Gürsu district is 4.70%. The rate of those working was determined as 3.40%.

Table 2. Comparison of demographic characteristics according to sports activity

	Sports status		
	Yes (n=226)	**No (n=132)**	**p-value**
Age (years)			
25-30 age	14(6.20%)	3(2.30%)	
31-35 age	30(13.30%)	12(9.10%)	
36-40 age	57(25.20%)	38(28.80%)	**0,001[a]**
41-46 age	78(34.50%)	28(21.20%)	
>47 age	47(20.80%)	51(38.60%)	
Gender			
Woman	55(24.30%)	39(29.50%)	0,320[a]
Male	171(75.70%)	93(70.50%)	
Graduation Department			
Physical Education and Sports	37(16.40%)	4(3%)	**<0,001[a]**
Other	189(83.60%)	128(97%)	
Management Time			
1-5 years	89(39.40%)	49(37.10%)	
6-10 years	71(31.40%)	32(24.20%)	
11-15 years	39(17.30%)	28(21.20%)	0,198[a]
16-20 years	12(5.30%)	6(4.50%)	
>21 years	15(6.60%)	17(12.90%)	
Receiving Management Training	161(71.20%)	100(75.80%)	0,389[a]
Type of School Worked			
Pre-school	6(2.10%)	7(5.30%)	
Primary school	42(18.60%)	33(25%)	0,227[a]
Middle school	90(39.80%)	44(33.30%)	
High school	88(38.90%)	48(36.40%)	
Perspective on Sports			
Positive	226(100%)	123(93.20%)	**<0,001[b]**
Negative	0	9(6.80%)	
Doing Sports in Primary and Secondary Education Years	172(76.10%)	89(67.40%)	0,085[a]
Status of Doing Sports with a License	95(42%)	26(19.70%)	**<0,001[a]**

Data are expressed as n(%).; a:Chi-square Test, b:Fisher's Exact Chi-square Test, c:Fisher Exact Test

When Table-2 is examined, there is a difference between the groups that do and do not do sports according to age distribution (p = 0.001). There was no statistically significant difference between the sports and non-sports groups according to gender distribution (p = 0.320). There is a difference between the graduation department groups according to their participation in sports (p<0.001). In subgroup analyses, it was determined that the rate of those who graduated from the PESS department in the group doing sports was higher than the rate of those who graduated from the PESS department in the group that did not do sports (16, 40% and 3%). On the other hand, it was determined that the rate of graduates from other departments in the non-sports group was higher than the rate of graduates from other departments in the sports group (97% and 83.60%). There is no difference between the groups that do sports and do not do sports according to the distribution of management time (p = 0.198). It was determined that the rates of receiving management training did not differ between groups that do sports and those that do not do sports (p = 0.389). There is no difference between the groups that do sports and those that do not do sports according to the distribution of the school type (p = 0.227). There is a difference between the groups according to their perspective on sports (p<0.001). All participants who do sports have a positive perspective on sports. According to the distribution of those who did sports in primary and secondary school years, there was no statistically significant difference between the groups that did sports and did not do sports (p = 0.085).

According to the distribution of licensed sportspeople, there is a statistically significant difference between the groups that do sports and those that do not (p<0.001).

Table 3. Comparison of Participants' Melbourne decision making scale and subscale scores according to sports engagement status

	Sports Status		
	Yes (n=226)	**No (n=132)**	**p-value**
Melbourne Decision Making Scale			
Self-Respect in Decision Making	11(4:12)	11(5:12)	0,055[d]
Careful Decision Making Style	11(5:12) *(10,80±1,65)*	11(5:12) *(10,05±2,09)*	**0,001[d]**
Avoidant Decision Making Style	2(0:12)	3(0:8)	0,124[d]
Procrastinator Decision Making Style	2,50(0:9)	2(0:9)	0,660[d]
Panic Decision Making Style	2(0:9)	2(0:7)	0,491[d]

Data are expressed as median (minimum-maximum) and mean ± std. deviation, d: Mann Whitney U Testi

When Table-3 is examined, there is no difference between the groups according to the median scale score obtained from the self-esteem in decision-making scale, which is the sub-dimension of the Melbourne decision-making scale (p=0.055). The median scale score obtained from the self-esteem subscale of those who do sports and those who do not do sports was determined as 11. It is seen that the average scale score obtained from the careful decision-making style subscale is higher in the sports group (p=0,001). The average scale score of the participant group doing sports is 10.80. The average scale score of the non-sports group was determined as 10.05. There is no difference between the groups according to the median scale score obtained from the avoidant decision-making style scale (p=0.124). The median scale score obtained from the avoidant decision-making style subscale of athletes is 2. The median scale score obtained from the avoidant decision-making style subscale of the non-sports group was determined as 3. There is no difference between the groups according to the median scale score obtained from the procrastinatory decision-making style scale (p=0.660). The median scale score obtained from the procrastinatory decision-making style subscale of athletes is 2.50. The median scale score obtained from the procrastinatory decision-making style subscale of the non-sports group was determined as 2. There is no difference between the groups according to the median scale score obtained from the panic decision-making style scale, which is the sub-dimension of the Melbourne decision-making scale (p=0.491). The median scale score obtained from the panic decision-making style subscale of those who do sports and those who do not do sports was determined as 2.

Table 4. Comparison of participants' problem solving scale and subscale scores according to sports activity

	Sports Status		
	Yes (n=226)	**No (n=132)**	**p-value**
Problem Solving Scale			
Total Score	106(58:161)	107(56:180)	0,256[d]
Hasty Approach	42(16:54)	40(19:54)	**0,042[d]**
Thinking Approach	10(5:25) *10,04±3,66*	10(5:27) *11,14±4,25*	**0,013[d]**
Avoidant Approach	22(8:24)	21(7:24)	0,057[d]
Evaluative Approach	6(3:16)	6,5(3:18)	**0,006[d]**
Self-Confident Approach	19(11:37)	20(10:40)	**0,001[d]**
Planned Approach	7,50(4:20)	8(4:21)	**0,007[d]**

Data are expressed as median(minimum: maximum) and mean ± st.deviation, d:Mann Whitney U Testi

When Table-4 is examined, it is seen that the total score obtained from the problem solving scale does not differ between the study groups (p = 0.256). The median score of the total scale score of the sports group is 106. The median score of the group that does not do sports was determined as 107. It is seen that the median scale score obtained from the hasty approach scale is higher in the group doing sports (p = 0.042). The median scale score of the participant group doing sports was determined as 42, and the median scale score of the participant group not doing sports was determined as 40. It is seen that the average scale score obtained from the reflective approach scale is higher in the group that does not do sports (p = 0.013). The average scale score of the participant group who does sports was determined as 10.04, and the average scale score of the participant group who did not do sports was 11.14. There is no difference between the groups according to the median scale score obtained from the avoidant approach scale (p=0.057). The median scale score obtained from the avoidant approach subscale of those who do sports was determined as 22, and the median scale score obtained from the avoidant approach subscale of those who do not do sports was determined as 21. It is seen that the median scale score obtained from the evaluative approach scale, which is the sub-dimension of the problem-solving scale, is higher in the group that does not do sports (p = 0.006). The median scale score of the participant group that does sports was determined as 6, and the median scale score of the participant group that does not do sports was determined as 6.50. It is seen that the median scale score obtained from the self-confident approach scale is higher in the group that does not do sports (p = 0.001). The median scale score of the participant group doing sports was determined as 19, and the median scale score of the participant group not doing sports was determined as 20. It is seen that the median scale score obtained from the planned approach scale is higher in the group that does not do sports (p = 0.007). The median scale score of the participant group who does sports was determined as 7.50, and the median scale score of the participant group who did not do sports was determined as 8.

DISCUSSION and CONCLUSION

In this part of the research, discussions, interpretations and suggestions were made according to the data obtained as a result of examining the decision-making styles and problem-solving skill levels of school administrators who do and do not do sports. The data obtained was tried to be supported with results related to problem solving and decision-making skills by using the literature. As a result of the research, there are many studies under different headings on decision-making styles and problem-solving skill levels, but no studies have been found that evaluate together the decision-making styles and problem-solving skill levels of school administrators who do and do not do por. The research results and study findings were evaluated together and tried to be supported in terms of differences and similarities.

When the demographic characteristics of school administrators were compared according to the age variable of whether they do sports or not, it was determined that there was a significant difference, but this difference was only in one group. In the subgroup analyses, it was determined that this difference was higher among those in the 41-46 age group who do sports compared to those in the 41-46 age group who do not do sports. It can be said that the main reason for this difference in the 41-46 age group is the tendency towards sports for health reasons. According to the study conducted by Var (2018), which supports our study, when the reasons for doing sports of the participants were examined, it was determined that the primary reason was health. Physical factors such as being fit, having a fit body, relieving stress, getting rid of excess weight and delaying aging are other reasons.

When looking at whether school administrators do sports or not in the context of the gender variable, it was determined that there was no significant difference. However, in the study conducted by Damar and Uçan (2021), there is a significant difference according to gender between individuals who do and do not do sports; It has been concluded that men have a higher rate of doing sports and accordingly, men's self-confidence is higher than women. As a result of our research, we think that the reason for this difference is due to the low number of female managers.

When the managers participating in the research were evaluated according to whether they were sports science graduates or not, a statistically significant difference was found. When looked at, it is understood that the rate of sports science graduates doing sports is higher than managers who do not have a department degree. This result can be interpreted that sports science graduate managers have high sports awareness and physical respect stimuli. When the literature is examined, there are studies supporting the study findings (Karacam et al 2016; Kara et al. 2021).

When the school administrators participating in the research were compared as groups that do sports and those that do not; When looked at statistically, it was observed that there was no significant difference according to the variables of management tenure, whether or not they received management training, and the type of school where they worked. When looking at the literature, no studies finding similar or different findings were found.

When looked at according to the variable of managers' perspectives on sports, it is understood that there is no significant difference between the groups. While all participants who do sports

have positive perspectives on sports, it was determined that 6.80% of the group who did not do sports did not have a positive perspective on sports. It is thought that especially the fact that school administrators have a positive perspective towards sports is a very good result in the context of the management dimension, which is among the important stakeholders of the education system. In support of the research findings, the study conducted by Gökdağ (2019) examined the attitudes of school administrators towards sports and concluded that the administrators had positive attitudes. It is understood that this result is parallel to our study findings.

It was observed statistically that there was no significant difference in the title of those who do sports or those who do not, in the context of the status of doing sports during primary and secondary education and the district variables. In the literature review, no similar or different results supporting this information were found.

It was determined that there was a significant difference in the analyzes made according to the variable of whether the participants were licensed to do sports or not. It was concluded that the rate of doing sports was high among the managers who were in the group that did sports with a license in the past years. Such a result can be shown in the study conducted by Çon et al. (1997). According to the study; tendency to do sports in the future; It is shown that the circle of friends comes first, followed by sports clubs. From this perspective, it is understood that there is parallelism between the two studies in terms of results.

When examined under the heading of decision-making styles of school administrators who do and do not do sports, no statistically significant difference was found in the subscale evaluations of self-esteem, avoidant decision-making style, procrastinator decision-making style and panic decision-making style. Despite this, it is understood that the average scale score of the careful decision-making style subscale of managers in the sports group is high. This result strengthens our interpretation that administrators in the sports group are more careful. There are examples in the literature to support our study findings. Especially in the study conducted by Kelecek (2013), our results reached similar results. According to the research, when the decision-making styles of athletes from various sports branches are examined, it has been concluded that they least use the procrastinating decision-making style and prefer the careful decision-making style the most. Supporting these findings, Akpınar's (2015) study also reached similar results. In this study, it was concluded that participants who do sports have high levels of self-esteem in careful decision-making and decision-making, and low levels of avoidant, procrastinating and panic decision-making styles. In their study, Senduran and Amman (2015) concluded that individuals who do sports regularly are more self-confident than those who do not do sports. It was also concluded that people who do sports are more careful in solving the problems they encounter. Apart from this, Karabağ's (2019) study reached different results than the findings of our study.

The problem solving scale and subscale scores of school administrators were compared according to their sports activities. As a result of the comparison, no statistically significant difference was found according to the total score of the problem solving scale. This result concluded that it had no effect on the perception of problem solving skills between groups that do or do not do sports. However, a similar study concluded that team sports had an impact on

the development of the problem-solving paradigm (Myszka et al. 2023; Taşçı et al 2022; Pekel et al. 2021). It was concluded that the total score points of managers in the non-sports group with positive-desired approaches (thinking, evaluative, self-confident, planned approaches) were high. On the other hand; The interpretation of the scale is different depending on whether the score is low or high. When we look at the table, it is understood that the total score of the school administrators in the sports group is low. According to this result, it was concluded that school administrators in the sports group used subscales measuring desired-positive approach styles. When the literature is examined, there are studies supporting the study findings (Çağlayan et al. 2008; Çakır et al. 2020; Mirzeoğlu et al. 2010). It was observed that the problem solving skill perception levels of the students in the sports group were relatively higher than those who did not do sports. However, contrary to the study findings, Akın and Çakto (2020) concluded in their study that doing sports is not an effective factor in problem solving.

Conflict of Interest: Regarding this study, the authors and/or their family members do not have any relationships with scientific and medical committee members or members, consultancy, expert witness, employment in any company, shareholding or similar situations that may have the potential for conflict of interest.

Declaration of Contribution of Researchers: Research Design FA, HAG, AK; Data Collection FA; Statistical Analysis HAG, FA; Preparation of the article FA, HAG, AK.

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Effects of Resistance Exercise on Total and Regional Body Composition in Overweight Sedentary Males

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Abstract

The purpose of this study was to examine the effects of 12 weeks of resistance exercise training on body weight (BW), body mass index (BMI), total fat mass (FM), trunk, arm, and leg fat mass, and total lean body mass (LBM), arm, and leg lean mass of sedentary overweight healthy males. Twenty-nine sedentary overweight healthy males, aged 18-30 years, with a BMI ≥ 25, were enrolled in the study. The subjects were randomly assigned to either a resistance exercise group (REG, n=15) or an aerobic exercise group (AEG, n=14). Randomized subjects followed resistance (3 sessions/wk 60 min 2 sets × 12 repetitions of 5–7 exercises at 65% 1 repetition maximum in 1-4 weeks, 3 sets × 10 repetitions of 5–7 exercises at 75% 1 repetition maximum in 5-8 weeks, and 4 sets × 8 repetitions of 5–7 exercises at 85% 1 repetition maximum in 9-12 weeks,) and aerobic exercise programs (3 sessions/wk 60 min aerobic exercises at 40-50% heart rate reserve in 1-6 weeks and 70%–75% maximal heart rate in 5-8 weeks). At baseline and after the intervention session, total and regional body composition measurements were assessed using the Jawon make body composition analyzer (model IOI-353 Yuseong, South Korea). After the intervention study, there were significant differences observed between the groups regarding the investigated variables (BW, BMI, LBM, trunk, arm, leg lean mass, and arm fat mass $p < .05$). Both REG and AEG were significantly decreased the amount of total FM, BF, trunk fat mass, arm fat mass, and leg fat mass ($p < .05$). Trunk and arm lean mass were significantly improved only in the REG ($p < .05$). In conclusion, resistance exercise training is an efficient training protocol, which produced a better improvement in regional lean mass.

Keywords: Fat mass, Lean mass, Hypertrophy, Obesity

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INTRODUCTION

Today, it is widely accepted by everyone that obesity is a global public health issue and has reached pandemic proportions. Besides being a significant global health issue, obesity serves as a risk factor for numerous chronic and life-threatening conditions (Williams et al., 2015). It has been recently reported that excessive weight and obesity, a disease that affects most body systems, are associated with more than 50 medical conditions, including metabolic, cardiovascular, respiratory, neurological, gastrointestinal, renal, rheumatological, cancer, musculoskeletal, skin, infection, mental, and pregnancy-related conditions (Lam et al., 2023) at every stage of life (Phelps et al., 2024). According to the World Health Organization (WHO), more than 1 billion people worldwide are obese, and by the year 2035, the number of people living with obesity globally is expected to reach 1.9 billion (WHO, 2022). The recent rise in obesity is mainly attributed to the increased consumption of high-fat and high-sugar foods, as well as the growing prevalence of physical inactivity and sedentary lifestyles (WHO, 2024). Therefore, the relationship between an increase in physical activity levels and the management of overweight and obesity is considered an important factor for public health worldwide (Bull et al., 2020).

Previous research has demonstrated that regular physical activity effectively manages and treats obesity by promoting weight loss (Alexander et al., 2022; Chin et al., 2016; Oppert et al., 2023; Wiklund, 2016). Overweight and obese individuals typically prefer aerobic exercises to reduce fat mass and improve body composition (Davis et al., 2022; Oppert et al., 2023). However, recent findings from studies have shown that resistance exercises can be included in weight management programs due to the positive effects they have on body composition (Lopez et al., 2022; Ribeiro et al., 2023; Tan et al., 2023; Zouita et al., 2023). Resistance exercise training, also known as strength or weight training have the potential to improve body composition by increasing muscle mass (Sharma et al., 2022) and reducing fat mass (Lopez et al., 2022; Orange et al., 2020; Wewege et al., 2022). This effect is explained as a decrease in total body fat tissue due to the increase in resting metabolic rate and 24-hour energy expenditure, which are results of the development of muscle mass (Donnelly et al., 2009; Roh et al., 2020). In a recent study providing a systematic review and meta-analysis of randomized controlled trials (Lopez et al., 2022), it has been reported that resistance exercises applied to overweight and obese individuals in different age groups led to positive changes in body fat percentage and body fat mass. In another study, it has been reported that resistance exercises alone can be included in exercise prescriptions aimed at promoting fat loss in overweight and obese individuals (Rodriguez-Lopez et al., 2022). In addition, it has been reported that determining the effect of resistance exercises on overweight and obese individuals is challenging due to the emphasis on body weight rather than body composition (Lopez et al., 2022).

In the literature, there are studies on the impact of resistance exercises on body composition in obese individuals conducted in various ways: alone (without caloric restriction) (Khalafi et al., 2021; Miller et al., 2018), in different exercise modalities (resistance + aerobic exercise) (Pieczynska et al., 2023; Rejeki et al., 2023), and in combination with both resistance and aerobic exercise + calorie restriction (Aneis et al., 2023; Oh et al., 2018). Although research on resistance exercises is increasing, the isolated effect of resistance exercises alone and in different exercise modalities on body fat is still debated (Wewege et al., 2022). Therefore, it

has been reported that more research is needed to investigate the effectiveness of the most suitable exercise for obese individuals (Davis et al., 2022).

This study aimed to determine the effects of a 12-week resistance exercise training on body weight (BW), body mass index (BMI), total fat mass (FM), trunk, arm, and leg fat mass, and total lean body mass (LBM), arm, and leg lean mass of sedentary overweight healthy males. We hypothesized that resistance exercise training would result in more effective reductions on both total and regional fat mass.

METHODS

Research Model

In this research, a pretest-posttest experimental design was used.

Participants

This was a parallel-group study with the non-probabilistic sample, conducted in a private fitness center in the city of Uşak, Turkey. The study lasted 12 weeks, and participants were assessed at baseline and after 12 weeks. The primary outcomes were body composition variables (BW, BMI, FM, BF, LBM, trunk, leg, and arm fat and lean mass). The evaluators were not blind to the intervention assignment. From the 44 potential participants assessed for eligibility, 5 refused to participate, and 39 were randomly assigned for one of the two study arms (REG: n=15; age=25.4±3.44; height=1.77±5.15; AEG: n=14; age=24±4.73; height=1.84±9.08). During the study protocol, 10 participants (REG: 4; AEG: 6) dropped out because of injuries (3 from the REG and 1 from AEG) and non-compliance with 80% of the exercise sessions (1 from REG and 5 from the AEG). In the end, 29 overweight males, aged 18-30 years, were enrolled in the study.

In this study, 29 participants (from a total of 44 assessed for eligibility) with new registrations at fitness center, male sex, body mass index (BMI) ≥25, physically inactive (within the last 6 months), not currently undergoing any pharmacological intervention, adhering to a standard dietary regimen, abstaining from smoking, and not experiencing any major illnesses were able to participate. All subjects provided written informed consent and were informed about the purpose and experimental procedures before being involved in the study. After invitation, verification of eligibility criteria, and signature of the informed consent, participants underwent the baseline assessment. In this assessment, sociodemographic and body composition variables were gathered. Thereafter, participants were randomly allocated to either the resistance exercise (REG; n=15) or aerobic exercise (AEG; n=14) group (Figure 1).

Procedures

Dietary regimen: For both groups, a dietitian provided all participants with a 1-hour individual nutrition session on appropriate food selection and preparation. All participants were asked to follow a weight maintenance diet (55-60% carbohydrate, 15-20% protein, and 20-25% fat) for the duration of the exercise interventions to allow for the assumption that any changes in anthropometrics and body composition were the result of the effects of regular exercise alone without caloric restriction. Whether this regimen was adhered to was determined by examining body weight before each exercise session. For body weights that deviated significantly (0.4% of baseline weight in two consecutive weeks), nutritional counseling was given to determine the deviation (Lee et al., 2012).

Aerobic exercise training: Participants underwent a continuous aerobic exercise program, lasting 60-minutes per day, 3 days a week for 12 weeks. Intensity was gradually increasing (Table I). In each exercise session, warm-up, cool-down, and flexibility exercises were included. Loading was performed at 40-50% of heart rate reserve (HRR: maximal heart rate - resting heart rate) for the first 6 weeks (weeks 1- 6) and 70-80% for weeks 7-12. A polar watch (Polar RS300X, Finland) was used to determine the target heart rate (Chih-Hui Chiu et al., 2017; Gert-Jan van der Heijden et al., 2010; Saremi et al., 2010).

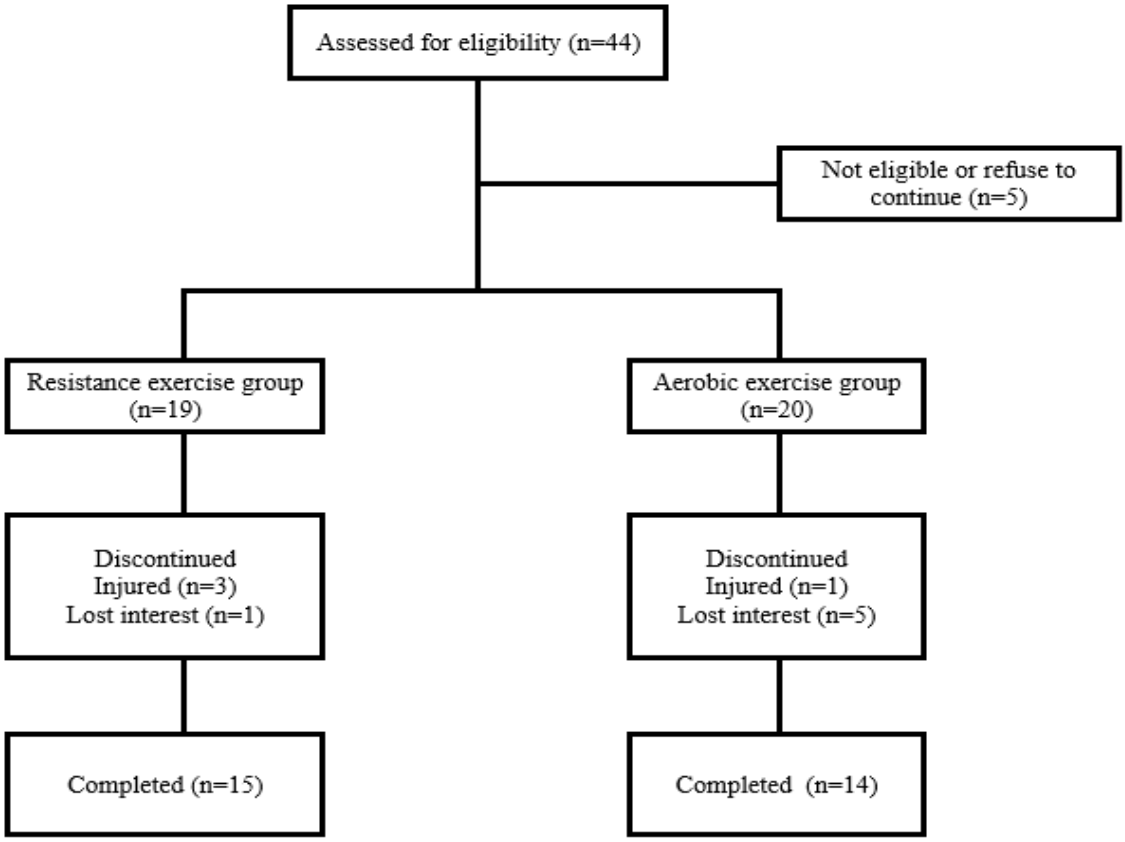

Figure 1. Study flowchart

Table 1. Aerobic exercise program

1-6 weeks	5-8 weeks
Frequency: 3 sessions/wk 60 min/session	**Frequency:** 3 sessions/wk 60 min/session
Intensity: 40-50% of HRR	**Intensity:** 70-80% of HRR
Type of exercise	
Treadmill Elliptical Biking Walking Climbing steps	Treadmill Elliptical Biking Rower X-c skiing Stair-climber

wk: week; HRR: maximal heart rate - resting heart rate

Resistance exercise training: Resistance exercise training was performed 3 days a week, with sessions lasting 60-minute each, for 12 weeks. Sessions include a 10-minute warm-up, 45-minute of resistance exercises, 5-minute of flexibility, followed by cool-down exercises. Resistance exercises were performed using resistance machines and free weights, and sessions were grouped in 3 mesocycles. The first one (weeks 1 to 4) started with 2 sets of 12 repetitions at a load of 65% one-repetition maximum (1-RM). The second cycle (weeks 5 to 8) was made of 3 sets of 10 repetitions at 75%, and the last one (weeks 9 to 12) was of 4 sets of 8 repetitions at 85 of 1-RM. Regardless the mesocycles, resting interval was 3 minutes between exercises and 90 seconds between sets (Table 2) (Akbarpour-Beni and Alishirazi, 2021; Guelfi et al., 2013). The 1-RM in kilograms was estimated by considering the maximum number of repetitions completed with a specific load, employing the formula as follows (Bryzicki, 1998):

$$1RM = load / [1.0278 - (0.0278 \times repetitions)]$$

Following this, each exercise session was conducted using the estimated 1-RM until only one repetition could be completed, at which point the load was identified as the 1-RM. Adequate rest was given between each attempt to determine the 1-RM.

Table 2. The 12 weeks resistance exercise program

1-4 weeks	5-8 weeks	9-12 weeks
Frequency: 3 sessions/wk 60 min/session	**Frequency:** 3 sessions/wk 60 min/session	**Frequency:** 3 sessions/wk 60 min/session
Intensity: 65% of 1-RM	**Intensity:** 75% of 1-RM	**Intensity:** 85% of 1-RM
Sets × Duration: 2 sets x 12 reps	**Sets × Duration:** 3 sets x 10 reps	**Sets × Duration:** 4 sets x 8 reps
The rest interval was 3 minutes between each exercise and 90 seconds between each set	The rest interval was 3 minutes between each exercise and 90 seconds between each set	The rest interval was 3 minutes between each exercise and 90 seconds between each set
Type of exercise		
Power clean Bench press Incline bench press Incline fly Hang pulls (Clean grip) Push press High pulls (Snatch grip) Seated shoulder press Power dumbbell shrugs Dumbbell front raise Triceps pushdowns Trunk and abdominal routine	Squat Power snatch Dead lift Leg extensions Leg curls Standing calf raises Lat pulldown Seated row Hammer curls Dumbbell biceps curls Triceps dumbbell extensions Trunk and abdominal routine	Barbell Back Squat Fixed Barbell Walking Lunge Plank Pull-Up / Pulldown Dumbbell Chest Press Barbell Incline Bench Press Cable Row Barbell Reverse Lunge Barbell Hip Thrust Machine Seated Leg Curl Machine Standing Calf Raise Dumbbell Incline Chest Press Cable Pulldown (close grip) Hanging Knees Raise

wk: week; 1-RM: one-repetition maximum

Data Collection Tools

Body mass and Body mass index: Both body mass (kg) was assessed with bioelectrical impedance scale (Jawon, model IOI-353, Yuseong, South Korea). Measurements were taken in the morning, three hours after waking up, and after the last meal and drink. Height (m) was measured to the nearest 0.1 cm using a wall-mounted stadiometer (Model S100, Ayrton Corp., Prior Lake, MN, USA) with participants wearing surgical scrubs and bare feet. Therafter, body mass index (BMI) was computed as kg/cm^2.

Body composition: Body composition variables were assessed with bioelectrical impedance sclale (Jawon, model IOI-353, Yuseong, South Korea), following recommendations for bioelectrical impedance analysis REF, and immediately after body mass measurement. The subjects then stood on the scales with their bare feet and hands at the marked locations. Based on differences in the ability of body tissues to conduct electric current (different resistance) due to different water content, the device analyzes body composition. BW, BMI, FM, BF, LBM, trunk, leg, and arm fat and lean mass were used in the study analysis.

Ethical Approval

The study was approved by the Uşak University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee (21.09.2023/171-171-04) and all procedures were conducted according to the Helsinki declaration.

Analysis of Data

Data analysis was perfomed including only the participants who fully accomplished the interventions and who undertook all the evaluations over the 2 assessment periods. The data were presented as median and interquartile range. For comparisons between groups at baseline (REG vs. AEG), Wilcoxon test was used. Mann Whitney U test was carried out to analyze statistically significant differences within groups. The data were processed using SPSS Statistics 23.0 (IBM, 2015). Significance level was set as $p< .05$.

FINDINGS

Baseline characteristics: The two groups of participants were similar with respect to baseline variables investigated (p> .05) (Table 3).

Table 3. Parameters [median (interquartile range)] at baseline and after intervention

Parameters	Groups	Pre test	Post test
		Median (IQR)	Median (IQR)
BW (kg)	AEG	85.1 (2.6)	82 (3.4)*
	REG	84.6 (15.1)	85.9 (14.35)*#
BMI (kg/m^2)	AEG	25.2 (5.7)	24.4 (4.5)*
	REG	25.8 (3.52)	27.1 (3.3)*#
Trunk Fat Mass (kg)	AEG	9.3 (3.7)	8.7 (2)*
	REG	11.4 (8.4)	10 (7.5)*
Leg Fat Mass (kg)	AEG	2.45 (1.6)	1.95 (1.7)*
	REG	2.7 (1.65)	2.2 (1.85)*
Arm Fat Mass (kg)	AEG	0.85 (0.4)	0.75 (0.3)*
	REG	0.9 (0.9)	0.75 (0.8)*#
FM (kg)	AEG	17.3 (5.6)	14.9 (4.4)*
	REG	26.78 (13.25)	15.9 (12.8)*
BF (%)	AEG	20.3 (6)	18.1 (4.7)*
	REG	21.5 (11.95)	18.5 (12.15)*
Trunk Lean Mass (kg)	AEG	35.6 (2.9)	35.8 (2.7)
	REG	34.9 (5.2)	36.8 (4.65)*#
Arm Lean Mass (kg)	AEG	3.65 (0.55)	3.55 (0.3)
	REG	4.09 (1.03)	4.1 (1.13)*#
Leg Lean Mass (kg)	AEG	11.15 (1.3)	11.4 (0.8)*
	REG	11.05 (1.75)	11.85 (2.15)*#
LBM (kg)	AEG	64.4 (2.8)	65.6 (2.8)*
	REG	63.4 (10.3)	67 (10.35)*#

** Difference within groups; # Difference between groups*
Data presented are median (IQR), median change (IQR), and overall effect
BW: Body Weight; BMI: Body Mass Index; FM: Fat Mass; BF: Body Fat; LBM: Lean Body Mass

Changes in anthropometry and body composition: Anthropometrics and body composition at baseline and following the interventions are demonstrated in Table 3. After the 12 weeks intervention period, REG and AEG groups showed significant differences in anthropometry and body composition variables, which included BW, BMI, FM, BF, LBM, trunk, leg, and arm fat and leg lean mass between pre- and post-test (p< .05). Trunk and arm lean mass were significantly improved only in REG (p< .05).

Changes in body weight and BMI: Figure 2 shows changes in BW and BMI after the intervention among the 2 groups. BW increased significantly in REG by 2% (p< .05) and decreased significantly by **%=** -3% (p< .05) in AEG. The total weight gain for the REG was 1.3 kg and the weight loss for the AEG was -3.1 kg. Similarly, BMI decreased significantly in AEG by **%=** -3% (p< .05) and increased significantly by **%=** 3% (p< .05) in REG. Furthermore, there were statistical differences in BW and BMI between groups (p< .05).

Changes in lean mass: Total LBM, trunk, leg, and arm lean mass increased significantly in REG by 8%, 6%, 8%, and 15% (p< .05) respectively. In the AEG, LBM, and leg lean mass increased significantly by 1% and 4% (p< .05), whereas arm lean mass was unchanged (p> .05). Trunk lean mass decreased by -1% in AEG (p> .05; Fig 2).

Changes in fat mass: Total FM reduced significantly (-25% vs. -21%, for REG and AEG, respectively, p< .05). In regard to regional adiposity, trunk, leg, and arm fat mass decreased significantly in REG and AEG by -6%, -35% and -35%, and -1%, -32% and -18%, respectively, (p< .05; Figure 2). Total BF decreased more in REG than in AEG (-28% vs. -18%, respectively, p< .05; Figure 2).

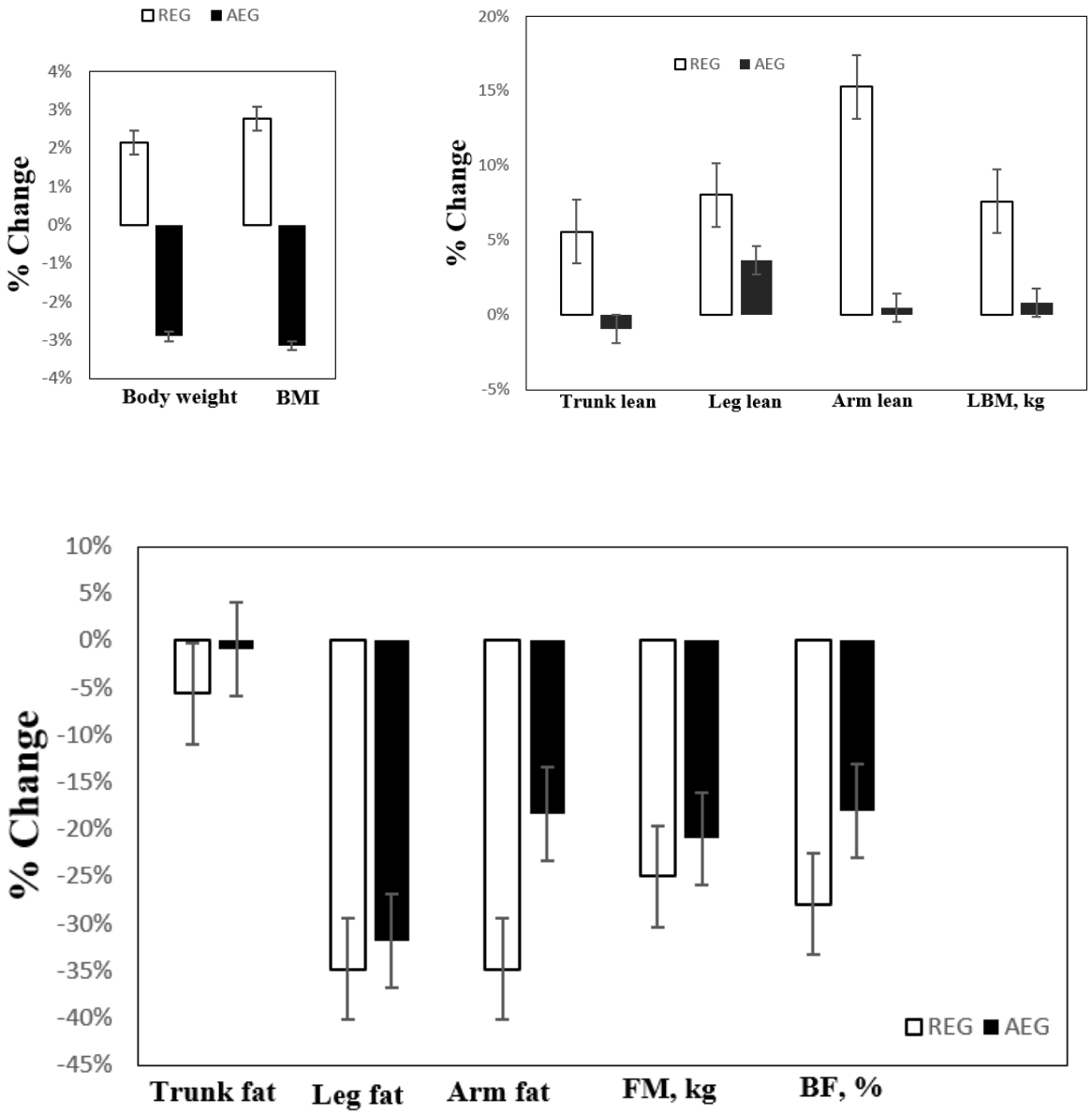

Figure 2. Changes in total and regional change in the resistance exercise group (REG) and aerobic exercise group (AEG). *p< .05 significant difference between groups.

DISCUSSION and CONCLUSION

The current study indicated that 12 weeks of resistance exercise training without caloric restriction increases body weight, BMI, and total and regional lean and decreases fat mass in healthy sedentary overweight males. The outcomes for this current study were body weight and BMI, lean body mass, and fat mass. As a result of this current study, we found that: (ı) BW and BMI increased significantly in REG, but decreased significantly in AEG; (ıı) significant decreases in the amount of FM, BF, trunk, arm, and leg fat mass were detected in both REG and AEG; (ııı) significant increases in the amount of trunk and arm lean mass were observed only in REG; and (ıv) the results indicated that the changes in the amount of BW, BMI, LBM, trunk, leg, and arm lean mass, and arm fat mass significantly differed within 2 groups. For this reason, it can be said that resistance exercise training performed without calorie restriction in overweight individuals causes an increase in muscle mass and has positive effects on general health by causing a decrease in fat mass. This provides evidence for the concept of body recombination and supports previous research demonstrating the benefits of resistance exercise training.

BW and BMI: Resistance exercise trainings induced significant gains in the amount of BW and BMI, whereas the participants in AEG decreased both BW and BMI values significantly from pre-to post-test. The amount of change in BW and BMI demonstrated by the REG in the current study is in parallel with previous findings (Donges and Duffield, 2012; Mohammadi et al., 2018). It may be said that the change in BW and BMI means in REG was driven by the increase in total and regional lean body mass induced by resistance exercise. It has also been stated before that there is a positive relationship between the amount of upper extremity muscle and body weight detected. In a study, Donges and Duffield (2012) conducted with sedentary overweight middle-aged adults for 10-week, showed that the resistance exercise training group (2-4 sets × 8-10 repetitions of 5-7 exercises at 70%-75% 1 repetition maximum) increased the amount of body mass, whereas aerobic endurance training group (30-50 min cycling at 70%-75% maximal heart rate) reduced the amount of body mass. Considering that BMI value is affected by both body fat percentage and lean body mass (Mohammadi et al., 2018), it can be said that the difference between the two groups obtained in this current study is due to the difference in muscle mass at the end of the study.

Lean Mass: Measures of LBM, trunk, leg, and arm lean mass were significantly increased in REG, but not in AEG. When analyzing the changes in the percentage values between groups, the total and regional lean mass in REG were significantly greater than that in AEG. These significant increases in total and regional lean mass in the REG mostly be explained by the growth of the contractile proteins actin and myosin within the skeletal muscle which results in induced muscle hypertrophy (Versic et al., 2021). Our results are supported by previous findings from this trial that indicate resistance training without calorie restriction significantly induces muscle mass increase more than aerobic exercises in sedentary men (Mohammadi et al., 2018; Shepherd et al., 2012; Willis et al., 2012).

In their study, Adıgüzel and Canlı (2019) reported that resistance exercises program without a calorie restriction for 12 weeks increased LBM in sedentary men without a calorie restriction. Furthermore we found 2 recent meta-analyses that examined the resistance training effects on

body composition. Benito et al., (2020) concluded that resistance training programs increase muscle mass in avarege 1.53 kg with a wide range of heterogeneity (from 0 to 7.2 kg) in healthy males. Another study by Lopez et al. (2022) examined one-hundred-sixteen articles describing 114 trials (n=4184 individuals with overweight/obesity). They stated that resistance training alone was the most effective for increasing lean mass with changes of 0.8 kg, consistently observed across age and sex groups. Willis et al., (2012) also compared 8-month of resistance training vs. aerobic training in overweight adults, showing resistance training group increased lean body mass more than the aerobic training group. Thus based on this current data we may say that resistance training was the more efficient method for favorable changes in muscle mass.

Fat Mass: Total and regional body fat adiposity significantly decreased after 12 weeks of intervention in both groups. However, there were no significant differences found in changes in the percentage values of FM, BF, trunk, leg, and arm fat mass percentage between the groups. This provides evidence for the notion of body recomposition and adds to the previous literature demonstrating the benefits of RT. Willis et al., (2012) stated that there are conflicting reports in the literature about whether resistance training induces fat mass loss, and in their study without the calorie restriction they indicated that aerobic exercises were more effective for optimal fat mass loss. However, more recent studies (Benito et al., 2020; Lopez et al., 2022) have shown that resistance-based exercise training decreased body fat percentage, total body fat mass, and regional body fat mass, regardless of age and gender, in overweight and obese participants found that adiposity measures significantly decreased after exercise programs.

Wewege et al., (2022) indicated that resistance training, without caloric restriction, dietary alteration, and supplementation reduces body fat percentage and body fat mass in healthy adults. Furthermore, Shepherd et al., (2012) examined resistance training (three training sessions per week for 6 weeks) without calorie restriction in healthy sedentary men (BMI= 24.8 kg/cm^2). They observed a significant reduction in absolute fat mass and relative fat mass. In another study, Mohammadi et al., (2018) examined strength vs. aerobic training for 12 weeks without calorie restriction in sedentary middle-aged men, where both strength and aerobic training groups showed a significant reduction in fat percentage. Our results agree with later studies, which showed a positive effect of a resistance exercise program without calorie restriction on total and regional body fat in sedentary overweight males. The increased metabolism for hours following a resistance exercise may require additional calories, providing significant cumulative energy expenditure (Schuenke and Mikat, 2002; Westcott, 2012). Possible explanations for total and regional body fat loss in our study may include the increased resting metabolic rate after the resistance exercise. Increased body fat is associated with several health-related risk factors including type 2 diabetes and cardiovascular disease (Westcott, 2012). For this reason, a significant decrease in total and regional body fat loss in the REG supports the efficiency of resistance exercise programs for total and regional adiposity of overweight/obese males.

There are also some methodological limitations that exist in our study, including inadequate measurement parameters (i.e., strength and waist circumference). The current study did not quantify the 1-RM muscular strength and circumference measurements changes after resistance vs. aerobic exercise. Waist circumference and waist-to-hip ratio which are indicators of central

obesity are correlated with the cardiovascular disease more than measures of BMI (Savva et al., 2000). Furthermore, another limitation of our study was not using DXA, which provides information on fat mass, lean mass or fat-free soft tissue, and bone mineral content (Nana et al., 2015).

The current research would be that resistance exercise without calorie restriction leads to greater improvements in anthropometric and body composition which include BW, BMI, total and regional fat loss, and muscle gain in sedentary overweight males. Such improvements can be beneficial in enhancing several important aspects of physical and mental health. Therefore, if fat loss is the goal with muscle mass gain of the exercise program, individuals must be aware of the specificity of resistance exercise traning.

Practical Application

Based on the results obtained in this study, sedentary overweight males aiming to lose weight under the supervision of a trainer or individually can increase muscle mass and reduce body fat over 12 weeks of resistance training without caloric restriction. In future studies, the effects of 12 weeks of resistance training on body composition can be investigated in sedentary overweight males with different BMI values or in sedentary overweight females. Additionally, similar approaches can be applied in scientific studies involving athletes.

Conflicts of Interest: There is no financial or personal conflict of interest among the authors of the article within the scope of the study.

Authors' Contribution: Study Design - Bahar Ateş, Halil Tanır & Jorge Mota Data Collection - Bahar Ateş & Halil Tanır Statistical Analysis - Bahar Ateş & Lucimere Bohn Manuscript Preparation - Bahar Ateş, Halil Tanır, Jorge Mota & Lucimere Bohn. All authors read and approved the final manuscript.

Ethical Approval

Ethics Committee: Uşak University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee

Date / Protocol number: 21.09.2023 / 171-171-04

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Correlation of Isocapnic Buffering Phase with Aerobic and Anaerobic Power in Athletes*

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Abstract

The aim of the study was to detect the relationship of isocapnic buffering phase values with the values of both aerobic and anaerobic power. A total of 14 athletes, five females and nine males, with ages between 18 and 25 volunteered to participate in the present study. At the beginning, the values of height, body mass, and body fat ratio of the volunteers were collected as required. Then, a maximal exercise test was applied to the volunteers and during the test, the values of maximal oxygen consumption capacity (VO_{2max}), amount of oxygen consumed (VO_2), amount of carbon dioxide produced (VCO_2), ventilatory threshold, respiratory compensation point, and maximal heart rate were determined. Isocapnic buffering and hypocapnic hyperventilation phases were determined from the ventilatory threshold and respiratory compensation point values. One week after the maximal exercise test, the Wingate anaerobic test was applied to the volunteers and anaerobic power values were calculated. A significant relationship was found between the values of isocapnic buffering and hypocapnic hyperventilation, and the values of maximal heart rate (beats/min), ventilatory threshold VO_2 (ml/kg/min), ventilatory threshold heart rate (beats/min), ventilatory threshold speed (km/hour), respiratory compensation point heart rate (beats/min), and respiratory compensation point speed (km/hour) in both male and female volunteers. The findings collected hereby indicate that as the VO_{2max} levels of athletes increase, both their cardiopulmonary data and anaerobic power values and also their ability to resist the intensity of exercises applied after entering anaerobic threshold, increase.
Keywords: Anaerobic power, Aerobic capacity, Isocapnic buffering phase

* This study was produced from master thesis of Burçin OKUR titled "The Relationship of Isocapnic Buffering Phase with Aerobic and Anaerobic Power in Athletes".

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INTRODUCTION

Both aerobic capacity and anaerobic power are key features that determine the athletic performance (Armstrong and Welsman, 2020). Furthermore, although the level of anaerobic threshold is another factor affecting the performance of an athlete, the ability to resist the exercise intensities applied after entering anaerobic threshold is very much important in athletes for continuing their performances (Ghosh, 2004). Anaerobic threshold can be found by means of the blood lactate measurements during exercises and it can also be predicted during the maximal exercise testing by the methods of non-invasive gas exchange called as ventilatory threshold (Beaver et al., 1986). Carbon dioxide is produced, in addition to carbon dioxide produced by aerobic metabolism after a certain point of exercise practices, also as a result of buffering hydrogen ions (H^+) dissociated from accumulated lactic acid with bicarbonate. Ventilation phase begins to accelerate in response to this non-metabolic carbon dioxide exposed by buffering H^+ (Chicharrro et al., 2000). Ventilatory threshold corresponds to the point where the linearity between both minute ventilation (VE) and carbon dioxide production (VCO_2) and oxygen uptake (VO_2) is spoiled. If H+ rises above the buffering capacity of circulating bicarbonate, it causes the pH level of blood to shift towards the acid side, and the acidosis revealed stimulates the carotid bodies, causing hyperventilation (Chicharrro et al., 2000). The slope of curve indicating correlation between VE and VCO_2 becomes steeper with hyperventilation. This additional ventilation reaction is called the Respiratory Compensation Point (RCP) (Meyer et al., 2004). The area between ventilatory threshold, determined during maximal exercise test, and respiratory compensation point is referred to as the isocapnic buffering phase. Isocapnic buffering phase reflects the compensation for exercise-induced metabolic acidosis (Whipp et al., 1989). The area between the respiratory compensation point and the end of exercise is known, on the other hand, as the hypocapnic hyperventilation phase (Chicharrro et al., 2000).

Evaluation of isocapnic buffer phase during maximal exercise test has significance since it provides non-invasively estimated data about buffering capacity of athletes. It has been reported that the length of isocapnic buffering phase in athletes competing in unlike sports may vary depending on intensity and coverage aspects of training (Hasanli et al., 2015; Hirakoba and Yunoki, 2002). It has been declared, therefore, that the length of isocapnic buffering phase may be related to buffering capacity, lactate kinetics, and sensitivity of carotid substances to exercise-induced metabolic acidosis (Bentley et al., 2005).

Some scholars have reported that the athletes with higher aerobic capacities also have higher isocapnic buffering phases (Hirakoba and Yunoki, 2002; Oshima et al., 1997). There are studies, meanwhile, claiming also that the isocapnic buffering phase has no concern with endurance performance (Eryılmaz et al., 2018; Lenti et al., 2011). It has recently been indicated that the isocapnic buffering phase can be utilized to assess both aerobic and anaerobic capacities of athletes (Hasanli et al., 2015). It has been reported that the increases in blood lactate values during the isocapnic buffering phase are higher in athletes practicing anaerobic training than in athletes practicing aerobic endurance training (Hasanli et al., 2015; Hirakoba and Yunoki, 2002).

There is restricted literature available on this topic. However, there are contradictions in the results of studies reviewing the correlations of isocapnic buffering phase with both aerobic and anaerobic power. This study was accomplished, therefore, on the grounds revealing the correlation of isocapnic buffering phase with aerobic or anaerobic power.

METHOD

Research Model

This research is an experimental research model with a single group and the relationship between single measurement results was examined.

Study Group

The volunteer athletes, comprised of 5 females and 9 males, who have actively engaged in sports for at least five years and aged between 18 and 25, participated in this study.

Ethical Approval

Approval for the study was obtained from the Non-Interventional Clinical Research Ethics Committee of the Sivas Cumhuriyet University dated 25.05.2022 with decision number 2022-05/06 prior to the start of the study.

Experimental Design

Measurements of the volunteers participated in the study were carried out, as required, in the Performance Measurement Laboratory, Faculty of Sports Sciences, Sivas Cumhuriyet University. Initially, the values of height, body weight, and body fat ratio, of which the measurement procedures were explained below, were collected from the volunteers. Then, the maximal exercise test was applied to the volunteers, and during the test, the capacity of maximal oxygen consumption (VO_{2max}), amount of oxygen consumed (VO_2), amount of carbon dioxide produced (VCO_2), maximal heart rate, ventilatory threshold, respiratory compensation point, isocapnic buffering, and hypocapnic hyperventilation values were determined accordingly. A week after the aforesaid measurements, the Wingate anaerobic test was applied to the volunteers and as a result of the test, the levels of maximum power, minimum power, average power, and power drop were detected as required.

Data Collection Tools

Height and Body Weight Measurements: The heights of volunteers involved in the study were measured, while they were barefoot, using a tape measure with an accuracy level of 0.1 cm. The body- weights, on the other hand, were measured while they were again barefoot and in only shorts using a brand Tanita BIA device with an accuracy level of 0.1 kg.

Body Fat Ratio Measurement: The body fat ratio measurement was implemented utilizing a brand TANITA Body Composition Analyser. The volunteers were asked not to eat anything for at least 4 hours prior to the measurement; not to drink anything including alcohol and

caffeinated drinks; not to use saunas or baths for at least 2 hours prior to the measurement, and not to engage in any physical activity during the day.

Maximal Exercise Test

The test was started with a running speed of 7 km/h on a terrain having an inclination level of 5% and afterwards the speed was increased by 1 km/h per minute, allowing the volunteers to continue exercising until they were completely exhausted. Reaching the maximal heart rates during the test (maximum heart rate – age = maximum performance), having a respiratory exchange rate (RER), which was expressed as the instantaneous ratio of consumed carbon dioxide (VCO_2) and breathed in oxygen (VO_2), to be risen above 1.10, and having an oxygen uptake level remaining at a plateau despite the gradually increased exercise intensities, were all accepted as the criteria for attaining VO_{2max}. The highest 15-second oxygen uptake value, where at least two of the relevant criteria happened simultaneously, was confirmed as the VO_{2max} (ml/kg/min). Time to Exhaustion was determined as the total duration of test (Eryılmaz and Polat, 2021).

Ventilatory Threshold, Respiratory Compensation Point, Maximal Heart Rate

Ventilatory threshold values of the volunteers were determined non-invasively by means of the V-Slope method (Hirakoba and Yunoki, 2002). Depending on this method, the position of VO_2 curve was evaluated with regard to VCO_2. While VCO_2 and VO_2 increase proportionally to each other at the beginning of exercises, the slope of VCO_2 to VO_2 curve is roughly equal to 1. After a certain point of exercises, however, the correlation between VCO_2 and VO_2 indicates a much steeper inclination because of the non-metabolic CO_2 released as a result of buffering the accumulated lactic acid, in addition to CO_2 produced by aerobic metabolism, with bicarbonate. After plotting the VO_2 curve (x-axis) corresponding to VCO_2 (y-axis), the linear regression analysis was accomplished to sketch two regression lines with slopes equal to or above 1 (or closer). The values of VO_2 (ml/kg/min), heart rate, and running speed (km/hour) corresponding to ventilatory threshold point were determined, accepting the intersection of aforegiven two regression lines as ventilatory threshold hereby. The point where VE/VCO_2 value started to increase while $PETCO_2$ value started to decrease was found in order to determine the respiratory compensation point values, and this point was recorded as the value of respiratory compensation point. Values of VO_2 (ml/kg/min), heart rate, and running speed (km/h) corresponding the to respiratory compensation point were determined accordingly. The highest pulse level attained by the volunteers during the test was recorded as the maximum heart rate.

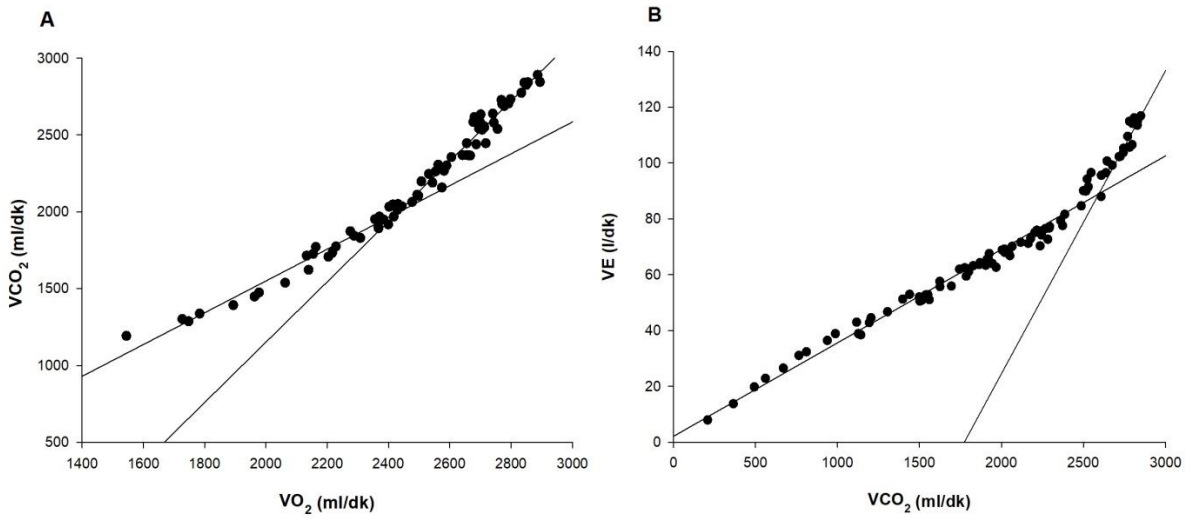

Figure 1. Examples indicating an athlete's ventilatory threshold (A) and respiratory compensation point (B).

Determination of Isocapnic Buffering and Hypocapnic Hyperventilation Phases

The isocapnic buffering phase was computed as the difference between the respiratory compensation point and ventilatory threshold, and it was represented by the values of both absolute VO_2 (ml/kg/min) and running speed (km/h) (Beaver et al., 1986). The hypocapnic hyperventilation phase was computed as the difference between the end of exercise and respiratory compensation point, and it was represented by the values of both absolute VO_2 (ml/kg/min) and running speed (km/h) (Beaver et al., 1986).

Wingate Anaerobic Power Test

The Wingate anaerobic power test was implemented using a bicycle ergometer, brand Monark Ergomedic 894 E. After the volunteers warmed up adequately, a resistance level about 7.5% of an athlete's body weight was adjusted. The volunteers cycled pedals at maximum rates against a predetermined resistance for 30 seconds. Following the test, the values of maximum power, minimum power, average power, and power drop were estimated.

Data Analysis

Initially, the descriptive statistical calculations of the data collected in the present study were performed. Then, the Shapiro-Wilk test, the graphs of skewness, kurtosis, histogram, Q-Q, and P-P were utilised to find whether the data were distributed normally. Since the relevant data did not indicate a normal distribution, the Spearman correlation analysis was applied to determine the correlation of aerobic and anaerobic power data with the isocapnic buffering data. The significance level was accepted as $p < 0.05$.

FINDINGS

In this section of the study, the findings obtained as a result of the analysis are presented.

Table 1. Descriptive informations about the volunteers

	Female (n=5)			Male (n=9)		
	$\overline{X}$ ± SD	Min.	Max.	$\overline{X}$ ± SD	Min.	Max.
Age (Years)	19,40 ± 2,40	17	22	18,1 ± 1,83	16	22
Height (cm)	167,80 ± 6,26	161	173	174,33 ± 3,57	171	180
Body Weight (kg)	63,00 ± 4,84	57	68	78,44 ± 7,36	64	87

The descriptive information about the volunteers are submitted in Table 1. According to the data given, the average age of the female volunteers was determined as 19.40 ± 2.40 (years), height 167.80 ± 6.26 (cm), and body weight 63.00 ± 4.84 (kg). Average age of the male volunteers, on the other hand, was estimated as 18.1 ± 1.83 (years), height 174.33 ± 3.57 (cm), and body weight 78.44 ± 7.36 (kg).

Table 2. Ventilatory threshold, respiratory compensation point, and maximal oxygen consumption values of volunteers

Variables	Female		Male	
	Median	(25% - 75%)	Median	(25% - 75%)
VO_{2max} (ml/kg/min)	42,70	39,75 - 47,50	51,80	48,60 - 54,00
Maximal Heart Rate (Beats/min)	204,00	185,00 - 205,00	202,00	198,50 - 206,50
Maximal Speed (km/hours)	12,00	11,00 -13,00	14,00	13,00 - 14,50
Time to Exhaustion (sec)	343,00	276,50 - 392,00	434,00	364,00 - 479,50
Ventilatory Threshold VO_2 (ml/kg/min)	34,80	32,50 - 42,30	48,80	36,50 - 51,25
Ventilatory Threshold Heart Rate (beats/min)	162	155 - 183	181	173 -183
Ventilatory Threshold Speed (km/h)	8,00	8,00 - 11,00	13,00	9,00 - 13,00
Respiratory Compensation Point VO_2 (ml/kg/min)	40,40	38,30 - 45,50	50,40	45,20 - 53,35
Respiratory Compensation Point Heart Rate (beats/min)	183	176 - 192	194	186 - 195
Respiratory Compensation Point Speed (km/h)	10,00	9,50 - 12,00	14,00	11,00 - 14,50

The values of anaerobic threshold, ventilatory threshold point, and maximal oxygen consumption of the volunteers took part in the study are available in Table 2. When the relevant values were reviewed, the VO_{2max} (ml/kg/min) values of the female volunteers were found as 42.70 (39.75 - 47.50), the maximal heart rate (beats/min) values 204.00 (185.00 - 205.00), the maximal speed (km/hour) values 12.00 (11.00-13.00), and the time to exhaustion (sec) values 343.00 (276.50 - 392.00). Therefore, the ventilatory threshold VO_2 (ml/kg/min) values were calculated as 34.80 (32.50 - 42.30), the ventilatory threshold heart rate (beats/min) values 162 (155 - 183), and the ventilatory threshold speed (km/h) values 8.00 (8.00 - 11.00). Accordingly, the respiratory compensation point VO_2 (ml/kg/min) values were determined as 40.40 (38.30 - 45.50), the respiratory compensation point heart rate (beats/min) values 183 (176 - 192), and the respiratory compensation point speed (km/h) values 10.00 (9.50 - 12.00).

For the male volunteers, on the other hand, the VO_{2max} (ml/kg/min) values were calculated as 51.80 (48.60 - 54.00), the maximal heart rate (beats/min) values 202.00 (198.50 - 206.50), the maximal speed (km/h) values 14.00 (13.00 - 14.50), and the time to exhaustion (sec) values 434.00 (364.00 - 479.50). Meanwhile, the ventilatory threshold VO_2 (ml/kg/min) values were

computed as 48.80 (36.50 - 51.25), the ventilatory threshold heart rate (beats/min) values 181 (173 - 183), and the ventilatory threshold speed (km/h) values 13.00 (9.00 - 13.00). Therefore, the respiratory compensation point VO_2 (ml/kg/min) values were 50.40 (45.20 - 53.35), the respiratory compensation point heart rate (beats/min) values 194 (186 - 195), and the respiratory compensation point speed (km/h) values 14.00 (11.00-14.50).

Table 3. Isocapnic buffering and hypocapnic hyperventilation values of volunteers

Variables	Female		Male	
	Median	(25% - 75%)	Median	(25% - 75%)
Isocapnic Buffering Phase VO_2 (ml/kg/min)	3,20	2,30 - 7,90	2,30	1,75 - 6,15
Isocapnic Buffering Speed (km/h)	1,00	1,00 - 2,00	1,00	1,00 - 2,00
Hypocapnic HyperventilationVO_2 (ml/kg/min)	2,00	1,30 - 2,30	1,10	0,5 - 2,40
Hypocapnic Hyperventilation Speed (km/h)	1,00	1,00 - 2,00	1,00	1,00 - 2,00

The isocapnic buffering and hypocapnic hyperventilation values of the volunteers participated in the present study are available in Table 3. When the values collected were reviewed, the isocapnic buffering phase VO_2 (ml/kg/min) values of the female volunteers were found as 3.20 (2.30 - 7.90), the isocapnic buffering speed (km/hour) values 1.00 (1.00 - 2, 00), the hypocapnic hyperventilation VO_2 (ml/kg/min) values 2.00 (1.30 - 2.30), and the hypocapnic hyperventilation speed (km/hour) values 1.00 (1.00 - 2.00) accordingly. On the other hand, the isocapnic buffering phase VO_2 (ml/kg/min) values of the males were calculated as 2.30 (1.75 - 6.15), the isocapnic buffer speed (km/hour) values 1.00 (1.00 - 2.00), the hypocapnic hyperventilation VO_2 (ml/kg/min) values 1.10 (0,5 - 2.40), and finally the hypocapnic hyperventilation speed (km/hour) values 1.00 (1.00 - 2.00).

Table 4. Wingate test values of volunteers

Variables	Female		Male	
	Median	(%25 - %75)	Median	(%25 - %75)
Maximal Power (W/kg)	11,12	11,12 - 12,27	15,33	13,48 - 16,33
Average Power (W/kg)	7,20	7,20 - 7,69	9,75	9,17 - 10,09
Minimum Power (W/kg)	4,35	4,35 - 5,37	5,90	5,80 - 6,28
Power Drop (%)	60,82	56.21- 60,82	61,55	56,98 - 64,27

The Wingate test results of the volunteers participated in this study are available in Table 4. When the values acquired were examined, the maximum power (W/kg) values of the females were calculated as 11.12 (11.12 - 12.27), average power (W/kg) values 7.20 (7.20 - 7.69), minimum power (W/kg) 4.35 (4.35 - 5.37), and power drop (%) 60.82 (56.21 - 60.82). On the other hand, the maximal power (W/kg) values of the males were found as 15.33 (13.48 - 16.33), average power (W/kg) 9.75 (9.17 - 10.09), minimum power (W/kg) 5.90 (5.80 - 6.28), and power drop (%) 61.55 (56.98 - 64.27).

Table 5. Correlation of values of isocapnic buffering and hypocapnic hyperventilation with performance variables in female volunteers

Variables		Isocapnic Buffering VO_2 (ml/kg/min)	Isocapnic Buffering Speed (sec)	Hypocapnic Hyperventilation VO_2 (ml/kg/min)	Hypocapnic Hyperventilation Speed (sec)
VO_{2max} (ml/kg/min)		,111	-,304	,111	-,304
Maximal Heart Rate (beats/min)		**-1,000****	**-,913***	**-1,000****	**-,913***
Maximal Speed (km/h)		,859	,619	,859	,619
Time to Exhaustion (sec)		0,111	-,304	,111	-,304
Ventilatory threshold VO_2 (ml/kg/min)	**r**	-,667	**-,913***	-,667	**-,913***
Ventilatory threshold Heart Rate (beats/min)		-,667	**-,913***	-,667	**-,913***
Ventilatory threshold Speed (km/h)		-,667	**-,913***	-,667	**-,913***
Respiratory Compensation Point VO_2 (ml/kg/min)		,111	-,304	,111	-,304
Respiratory Compensation Point Heart Rate (beats/min)		-,667	**-,913***	-,667	**-,913***
Respiratory Compensation Point Speed (km/h)		-,667	**-,913***	-,667	**-,913***

*** p<0.05 ** p<0.01**

The relationship of the isocapnic buffering and hypocapnic hyperventilation values with the performance variables in the female volunteers participated in the present study are available in Table 5. The review accomplished on the values revealed a negative correlation between the values of maximal heartbeat (beats/min) and the values of isocapnic buffering VO_2 (ml/kg/min), isocapnic buffer speed (sec), hypocapnic hyperventilation VO_2 (ml/kg/min), and hypocapnic hyperventilation speed (sec). A negative correlation was, meanwhile, observed between the values of ventilatory threshold VO_2 (ml/kg/min) and the values of isocapnic buffering speed (sec) and hypocapnic hyperventilation speed (sec). A negative relationship was detected between the values of ventilatory threshold heart rate (beats/min) and the values of isocapnic buffering speed (sec) and hypocapnic hyperventilation speed (sec), as well as again a negative correlation between the values of ventilatory threshold speed (km/h) and the values of isocapnic buffering speed (sec) and hypocapnic hyperventilation speed (sec). Furthermore, a negative relationship was observed between the respiratory compensation point heart rate (beats/min) values and the values of isocapnic buffering speed (sec) and hypocapnic hyperventilation speed (sec), as well as again a negative relationship between the respiratory compensation point speed (km/h) values and the values of isocapnic buffering speed (sec) and hypocapnic hyperventilation speed (sec).

Table 6. Correlation of the values of isocapnic buffering and hypocapnic hyperventilation with performance variables in male volunteers.

Variables		Isocapnic Buffering VO_2 (ml/kg/min)	Isocapnic Buffering Speed (sec)	Hypocapnic Hyperventilation VO_2 (ml/kg/min)	Hypocapnic Hyperventilation Speed (sec)
VO_{2max} (ml/kg/min)	**r**	-,385	,175	-,609	**-,832****
Maximal Heart Rate (beats/min)		**-,812****	**-,877****	**-,858****	-,647
Maximal Speed (km/h)		-,450	,178	-,652	**-,843****
Time to Exhaustion (sec)		-,402	,175	**-,670***	**-,832****
Ventilatory Threshold VO_2 (ml/kg/min)		-,573	-,351	**-,884****	**-,832****
Ventilatory Threshold Heart Rate (beats/min)		**-,846****	-,526	-,627	**-,832****
Ventilatory Threshold Speed (km/h)		-,667	**-,913***	-,667	**-,913***
Respiratory Compensation Point VO_2 (ml/kg/min)		-,385	,175	-,609	**-,832****
Respiratory Compensation Point Heart Rate (beats/min)		**-,795***	-,175	-,369	**-,832****
Respiratory Compensation Point Speed (km/h)		**-,787***	-,207	**-,734***	**-,982****

*** p<0.05 ** p<0.01**

The correlation of the isocapnic buffering and hypocapnic hyperventilation values with the performance variables in the male volunteers participated in this study is available in Table 6. The review carried out in the relevant values revealed a negative correlation between the values of VO_{2max} (ml/kg/min) and Hypocapnic Hyperventilation speed (sec) and likewise again a negative correlation between the Maximal Heart Rate (beats/min) values and the values of isocapnic buffering VO_2 (ml/kg/min), isocapnic buffering speed (sec), and hypocapnic hyperventilation VO_2 (ml/kg/min) for the males. Furthermore, there was a negative relationship between the values of Maximal Speed (km/h) and Hypocapnic Hyperventilation Speed (sec), and again a negative relationship between the values of Time to Exhaustion (sec) and the values of both Hypocapnic Hyperventilation VO_2 (ml/kg/min) and Hypocapnic Hyperventilation Speed (sec). The study revealed a negative correlation between the Ventilatory threshold VO_2 (ml/kg/min) values and the values of both hypocapnic hyperventilation VO_2 (ml/kg/min) and hypocapnic hyperventilation speed (sec), as well as again a negative correlation between the Ventilatory threshold Heart Rate (beats/min) values and the values of both Isocapnic Buffering VO_2 and Hypocapnic Hyperventilation Speed (sec). There was, meanwhile, a negative correlation between the Ventilatory threshold Speed (km/h) values and the values of both Isocapnic Buffering Speed (sec) and Hypocapnic Hyperventilation Speed (sec), as well as a negative correlation between the values of Respiratory Compensation Point VO_2 (ml/kg/min) and Hypocapnic Hyperventilation Speed (sec). The present study revealed a negative correlation between the Respiratory Compensation Point Heart Rate (beats/min) values and the values of both Isocapnic Buffering VO_2 (ml/kg/min) and Hypocapnic Hyperventilation Speed (sec), as well as again a negative correlation between the Respiratory Compensation Point Speed (km/h) values and the values of Isocapnic Buffering VO_2 (ml/kg/min), Hypocapnic Hyperventilation VO_2 (ml/kg/min), and Hypocapnic Hyperventilation Speed (sec).

Table 7. Correlation of the values of isocapnic buffering, hypocapnic hyperventilation, and VO_2max with Wingate test results in female volunteers

Variables		Isocapnic Buffering VO_2 (ml/kg/min)	Isocapnic Buffering Speed (km/h)	Hypocapnic Hyperventilation VO_2 (ml/kg/min)	Hypocapnic Hyperventilation Speed (sec)	VO_2maks (ml/kg/min)
Maximal Power (W/kg)	**r**	-,304	-,667	-,330	-,570	**,913***
Average Power (W/kg)		-,280	-,612	-,270	-,645	**,921***
Minimum Power (W/kg)		-,260	-,510	-,250	-,590	**,890***
Power Drop (%)		,260	,550	,240	,680	**-,930***

*** p<0.05**

The correlation of the values of isocapnic buffering, hypocapnic hyperventilation, and VO_{2max} with the results of Wingate test in the female volunteers is shown in Table 7. When the relevant values were reviewed, whereas the study revealed a positive relationship between the VO_{2max} (ml/kg/min) value and the values of maximal power (W/kg), average power (W/kg), and minimum power (W/kg), a negative relationship was detected between VO_{2max} (ml/kg/min) and power drop (%).

Table 8. Relationship of the values of isocapnic buffering, hypocapnic hyperventilation, and VO_2max with Wingate test results in male volunteers

Variables		Isocapnic Buffering (ml/kg/min)	Isocapnic Buffering Speed (km/h)	Hypocapnic Hyperventilation VO_2 (ml/kg/min)	Hypocapnic Hyperventilation Speed (km/h)	VO_{2max} (ml/kg/min)
Maximal Power (W/kg)	**r**	-,350	-,351	,189	,092	-,504
Average Power (W/kg)		-,043	,000	,318	,092	-,197
Minimum Power (W/kg)		-,299	,175	-,180	-,647	**,778***
Power Drop (%)		,026	-,351	,361	,555	**-,897****

*** p<0.05 ** p<0.01**

The correlation of the values of isocapnic buffering, hypocapnic hyperventilation, and VO_{2max} with the results of Wingate test in the male volunteers is available in Table 8. When the values were examined, the study revealed, in the male volunteers, a positive relationship between the VO_{2max} (ml/kg/min) value and minimum power (W/kg), and a negative relationship between the values of VO_{2max} (ml/kg/min) and power drop (%).

DISCUSSION AND CONCLUSION

It is crucial to measure the maximum oxygen consumption and anaerobic threshold in order to detect the optimal training intensity for an athlete and assess his/her reaction to training (Allen et al., 1985). Meanwhile, all factors that determine the rate and amount of total oxygen consumed must be taken into account in order to evaluate the aerobic performance of an athlete. Maximum oxygen consumption, anaerobic threshold, also called ventilatory threshold, and respiratory compensation values, all of which are the most important criteria for finding the aerobic endurance, enable athletes to practice for longer periods of time under homeostatic conditions (Hirakoba and Yunoki, 2002).

The knowledge of the values of maximum oxygen consumption, anaerobic threshold, respiratory compensation point, and isocapnic buffering phase of athletes plays a crucial part in order to make contributions as required for familiarizing with the needs of and the differences in athletes. It becomes, hence, important to understand whether the isocapnic buffering values are correlated with the values of the oxygen consumption and anaerobic performance. Although the studies reviewing the correlation between the values of isocapnic buffering phase and maximum oxygen consumption are available in the literature, the studies reviewing their correlation with anaerobic performance remain fairly limited.

Lenti et al., (2011) have claimed that the duration of the isocapnic buffer phase decreases as a person gets older and also it is higher in trained individuals with high endurance, regardless of age. Having a higher isocapnic buffering phase suggests that it indicates an athlete's ability to resist after entering the anaerobic threshold and it positively affects an athlete's capacity to continue exercise practices. Having higher isocapnic buffering values bring to mind, on the other hand, that the stimuli for anaerobic training promote the H+ buffering capacity and such an improvement may contribute to the ability to sustain the loading efforts above the anaerobic threshold for relatively longer periods. Röcker et al., (1994) have reported that the exclusive 400 m runners had possessed higher isocapnic buffering phases compared to the athletes of aerobic endurance training. They have reported, furthermore, that there was no statistically significant difference ($p>0.05$) in terms of the maximal running speed and VO_{2max} values between the 400m runners and aerobic training athletes who took part in their research.

A negative correlation was observed between the values of Hypocapnic Hyperventilation Rate (sec) and VO_{2max} (ml/kg/min) in the male volunteers participated in the present study. Furthermore, a negative correlation was found between the ventilatory threshold VO_2 (ml/kg/min) values and the values of both hypocapnic hyperventilation VO_2 (ml/kg/min) and hypocapnic hyperventilation rate (sec). However, the study revealed again a negative correlation between the values of Respiratory Compensation Point VO_2 (ml/kg/min) and Hypocapnic Hyperventilation Rate (sec). Again a negative correlation was determined between the values of Hypocapnic Hyperventilation VO_2 (ml/kg/min) and Hypocapnic Hyperventilation Rate (sec). A negative correlation was observed, once more, between the Time to Exhaustion (sec) values and the values of Hypocapnic Hyperventilation VO_2 (ml/kg/min) and Hypocapnic Hyperventilation Rate (sec).

The data collected hereby suggest that as the VO_{2max} levels increase, athletes can perform at higher speeds and reach fatigue level later, and also, as the VO_{2max} levels go up, athletes get to the levels of ventilatory threshold and respiratory compensation point later. Measuring aerobic capacity using the cardiopulmonary exercise testing during exercises can be considered as a reflection of the performance of organ systems, which can be a measure of the amount of oxygen consumed (Wasserman et al., 2010). The VO_{2max} value, determined through the exercise protocols to be increased gradually, is the major criterion affecting the aerobic endurance performance (Eryılmaz and Polat, 2021). During the cardiopulmonary exercise testing, the level of lactic acid begins to increase after reaching the anaerobic threshold (Oshima et al., 1998). The circulating bicarbonate ions compensate for the lactic acidosis (Wasserman, 1984). The lactic acid production begins, following a certain point, to be compensated by circulating bicarbonate and thereby by hyperventilation. This point is called the ventilatory threshold, known also as the anaerobic threshold (Whipp et al., 1989). The ventilatory threshold is the point where the balance between the amount of air exhaled and the amount of oxygen consumed changes depending on increased effort. An increase in anaerobic glycolysis as a result of insufficiency of aerobic energy sources during exercises causes an increase in lactate level and then the state of lactic acidosis develops. To buffer the lactic acidosis resulted, CO_2 excretion increases and the balance of CO_2/O_2 is deteriorated. Accordingly, intense utilization of the anaerobic energy systems begins at ventilatory threshold, and this value rises depending upon increased training intensity. It has been determined that the athletes with higher ventilatory thresholds would also have increased aerobic properties (Wasserman et al., 2010) Having rises also in the isocapnic and hypocapnic valueswhen the VO_{2max} value goes up, suggests, on the other hand, that such a state improves the buffering capacity of H^+ and this improvement may contribute to sustain the exercises for a relatively longer time above ventilatory threshold. Hasanli et al., (2015) have reported, in their study, a negative correlation between the relative increase in lactate and aerobic capacity during isocapnic buffering. It has been declared, on the other hand, that the isocapnic buffer periods were longer and the exercise tolerances above the threshold were higher.

Therefore, though utilizing the anaerobic energy systems after entering the ventilatory threshold is related to the aerobic systems, the athletes with well enough anaerobic capacities are expected to be able to continue exercise practices above the ventilatory threshold for a longer period of time. Specific metabolic adaptations improved during anaerobic training allow the buffering capacity to improve and ensure training practices to be sustained for a bit longer time. Adaptations to the relevant anaerobic training may be a major point for ensuring a relatively longer isocapnic buffer phase after the ventilatory threshold is exceeded and hence for enabling increased tolerance to the high-intensity exercise practices (Hasanli et al., 2015).
Additionally, in this study, a positive correlation, giving support to aforespecified findings, was determined between the VO_{2max} (ml/kg/min) values and minimum power (W/kg) values resulted from the Wingate anaerobic test, and a negative correlation between the values of VO_{2max} (ml/kg/min) and power loss (%) in the volunteers. The fact of having a negative correlation between the values of power drop (%) and VO_{2max} reflects that as the VO_{2max} values of the volunteers participated in the study increase, their fatigue levels, on the contrary, decrease. Aforesaid correlations between the VO_{2max} value and the Wingate test results suggest that the VO_{2max} level affects the resistance ability observed after entering the anaerobic threshold and that having both aerobic and anaerobic capacities at higher levels positively

affects the athletic performance. It has been declared, therefore, that the levels of increased lactate during isocapnic buffering phase were higher in anaerobic athletes than aerobic athletes (Hirakoba and Yunoki, 2002). Intense anaerobic exercises raise, according to Chicharro et al. (2000), the buffering capacity in metabolism and provide contributions to extend the duration of isocapnic buffer phase. Hirakoba and Yunoki (2002) have determined that the rises in blood lactate levels during the isocapnic buffer phase were at higher levels in sprinters than long-distance runners. Hasanli et al. (2015) have reported, meanwhile, that the isocapnic buffer phase was higher in anaerobic athletes compared to aerobic endurance athletes. The findings collected indicate similarities to the findings acquired in the present study.

A negative correlation was observed between the ventilatory threshold VO_2 (ml/kg/min) values and the values of both isocapnic buffer speed (sec) and hypocapnic hyperventilation rate (sec) in the female volunteers took part in the study. The study revealed a negative correlation between the ventilatory threshold heart beat (beats/min) values and the values of isocapnic buffering speed (sec) and hypocapnic hyperventilation rate (sec), as well as a negative correlation between the ventilatory threshold speed (km/h) values and again the values of isocapnic buffering speed (sec) and hypocapnic hyperventilation rate (sec). A negative correlation was, meanwhile, detected between respiratory compensation point heart beat (beats/min) values and the values of both isocapnic buffering speed (sec) and hypocapnic hyperventilation rate (sec), as well as again a negative correlation between the respiratory compensation point speed (km/h) values and the values of isocapnic buffering speed (sec) and hypocapnic hyperventilation (sec).

The data aforespecified point out that the rises in the amount of oxygen consumed at anaerobic threshold level in the female volunteers, as well as in male volunteers, cause significant increases also in the isocapnic and hypocapnic values. Therefore, whereas a positive correlation was observed between the VO_{2max} (ml/kg/min) values and the values of maximal power (W/kg), average power (W/kg), and minimum power (W/kg) collected from the results of Wingate test in the female volunteers, a negative correlation was detected between the values of VO_{2max} (ml/kg/min) and power drop (%).

It is considered, based on the data collected, that as the maximum oxygen consumption increases, also the amount of oxygen an athlete can consume goes up, and hence the time for an athlete to enter the anaerobic threshold takes longer. It has been considered, therefore, that the time required for athletes to reach the anaerobic threshold and the resistance capabilities of athletes after entering the anaerobic threshold, are directly correlated with VO_{2max}.

Relevant results collected from both the male and female volunteers support the fact that the rises in VO_{2max} level positively affect both the cardiopulmonary data and anaerobic power values of athletes. It has been clearly indicated that especially as the VO_{2max} level increases, the anaerobic permanence and power drop values of athletes are affected positively. Though the dominant energy requirements during exercise practices which house predominant anaerobic requirements are covered by the anaerobic system, the higher VO_{2max} levels reduce the load on anaerobic system in such exercise practices. Therefore, an athlete's talents to maintain his/her performance for a longer period of time, can be improved (Beaver et al., 1986) Furthermore, the fact of having a negative correlation between maximum oxygen consumption

and power drop (%), suggests that as the maximum amount of oxygen consumption increases, the rate of fatigue index decreases and so an athlete becomes exhausted later.

Conflicts of interest

The authors have no conflicts of interest to declare.

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