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The Effect of Teachers' Free Time Facilitators on Job Satisfaction and Related Factors

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Ethical Statement: It is declared that scientific and ethical principles were followed while conducting and writing this study and that all sources used were properly cited.

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Abstract

This study was conducted to determine the effect of leisure facilitators on the job satisfaction of teachers working in public schools. A total of 201 teachers participated in the study voluntarily. In the study, demographic information was used in the first part, in the second part, the Leisure Facilitators Scale (LFS) developed by Kim, Heo, Chun, and Lee (2011) and adapted in Turkish by Gürbüz, Öncü, and Emir (2015), and in the third part, the Minnesota Job Satisfaction Scale developed by Weiss et al. (1967) and adapted in Turkish by Baycan (1985) were used as data collection tools. SPSS 25.0 package programme was used for data analysis. Statistically, frequency analysis, reliability coefficient calculations, Pearson correlation analysis, hierarchical regression analyses and Manova analysis were performed. The analyses were performed according to the 95% confidence interval. As a result of the analysis between the participants' leisure facilitators and age variable, a significant difference was found between the dimensions of personal facilitators and interpersonal facilitators. There was a significant difference between the participants' job satisfaction and gender variable in the extrinsic satisfaction sub-dimension. As a result of the analysis between the leisure facilitators and the branch variable, it was determined that there was a significant difference only in the structural facilitators sub-dimension. As a result of the analysis between leisure time facilitators and professional experience variables, it was found that there was a significant difference only in the personal facilitators sub-dimension. It was determined that there was a significant differentiation between personal facilitators and structural facilitators sub-dimensions and leisure time evaluation variables ($p<0.05$). As a result, it was found that leisure facilitators had a significant and positive effect on intrinsic satisfaction ($p<0.05$).

Keywords: Leisure, Leisure Facilitators, Satisfaction, Job Satisfaction, Teacher.

Özet
Öğretmenlerin Serbest Zaman Kolaylaştırıcılarının İş Doyumu Üzerindeki Etkisi ve İlişkili Faktörler

Bu çalışma devlet okullarında görev yapan öğretmenlerin serbest zaman kolaylaştırıcılarının iş doyumu üzerindeki etkisinin belirlenmesi amacıyla yapılmıştır. Araştırmaya 201 öğretmen gönüllü olarak katılmıştır. Araştırmada veri toplama aracı olarak birinci bölümde demografik bilgiler, ikinci bölümünde Kim, Heo, Chun ve

Lee (2011) tarafından geliştirilen ve Türkçe geçerlilik güvenirliğini Gürbüz, Öncü ve Emir (2015) tarafından yapılan serbest zaman kolaylaştırıcıları Ölçeği (SZKÖ) ve üçüncü bölümde Weiss ve diğerleri (1967) tarafından geliştirilen, Türkçe geçerlilik güvenirliğini Baycan (1985) tarafından yapılan Minnesota İş Doyum Ölçeği kullanılmıştır. Verilerin analizinde SPSS 25.0 paket programı kullanılmıştır. İstatistiksel açıdan, frekans analizi, güvenirlik katsayısı hesaplamaları pearson korelasyon analizi ve hiyerarşik regresyon analizleri ve Manova analizi yapılmıştır. Analiz yapılırken %95 güven aralığına göre analiz yapılmıştır. Katılımcıların serbest zaman kolaylaştırıcıları ile yaş değişkeni arasında yapılan analizi sonucu kişisel kolaylaştırıcılar ve kişilerarası kolaylaştırıcılar boyutları arasında istatistiksel yönden anlamlı farklılaşma olduğu, Katılımcıların iş doyumları ile cinsiyet değişkeni arasında dışsal doyum alt boyutunda anlamlı farklılaşma olduğu, serbest zaman kolaylaştırıcıları ile branş değişkeni arasında yapılan analizi sonucu sadece yapısal kolaylaştırıcılar alt boyutunda anlamlı farklılaşma olduğu, serbest zaman kolaylaştırıcıları ile mesleki tecrübe değişkeni arasında yapılan analizi sonucu sadece kişisel kolaylaştırıcılar alt boyutunda arasında istatistiksel yönden anlamlı farklılaşma olduğu, serbest zaman kolaylaştırıcıları ile serbest zaman değerlendirme değişkeni arasında yapılan Manova analizi sonucu kişisel kolaylaştırıcılar ve yapısal kolaylaştırıcılar boyutları arasında istatistiksel yönden anlamlı farklılaşma olduğu görülmektedir ($p<0.05$). Sonuç olarak araştırmada bulgularında serbest zaman kolaylaştırıcılarının içsel doyum üzerinde anlamlı ve pozitif bir etkisinin olduğu tespit edilmiştir ($p<0.05$).

Anahtar Kelimeler: Serbest Zaman, Serbest Zaman Kolaylaştırıcıları, Doyum, İş Doyumu, Öğretmen.

INTRODUCTION

In our country, which has a population of approximately 84 million according to the data of the Ministry of National Education in November 2022, 1.201.138 teachers are working in Turkey in the 2022-2023 academic year, including public and private institutions (33). One of the most essential aspects of education and training is the teacher. The efficiency of the teacher is closely related to his/her job satisfaction (1).

Job satisfaction is an employee's attitude towards all aspects of work in the working environment (Bin, 2015). More specifically, it means the degree to which a person feels that his/her job-related needs are fulfilled (43).

Several factors affect job satisfaction. Malinen and Savolainen (32) classified the variables affecting job satisfaction in teachers in three dimensions organisational aspects (working conditions, relationships, perceived autonomy and support), cognitive factors (efficacy beliefs) and emotional factors (stress, burnout). Factors affecting job satisfaction are associated with many factors such as wages, financial and social rights, and the working environment (20). Besides, job satisfaction is a highly researched area in various disciplines such as organisational psychology, general psychology, economics and sociology (16).

Teachers' attitudes towards the profession, their ambition to work, the attitude of the school administration, and economic factors are among the important factors affecting job satisfaction. Moreover, the leisure time that teachers allocate for themselves outside of work is also a factor affecting their job satisfaction. Leisure is defined as the activities that are outside the compulsory occupations of the individual and that are completely free, without the purpose of providing any material gain, varying according to the individual and applied entirely to individual preferences (6). Individuals can relax both mentally and physically by dealing with the negativities that develop in their professional life with leisure activities outside of work life. For this reason, facilitating as well as removing the constraints on teachers' participation in these activities plays an important role (7). These facilitators are explained in the literature with the concept of leisure facilitators (26). Swinton et al. (38) have defined leisure facilitators as individual facilitators such as friends and family who encourage participation in activities, and structural facilitators such as gender, money, and sex.

The ability of teachers, who usually spend their time in schools, to relax both mentally and physically and to increase their professional satisfaction is closely related to their participation in activities outside their work life. In this context, our study aimed to examine the effect of teachers' leisure facilitators on job satisfaction and related factors.

METHOD

This study was conducted to determine the effect of leisure facilitators on the job satisfaction of teachers working in public schools. In the method section of the study, information about the research model, population and sample size, data collection process and data analysis were given.

Research Model

This research aimed to determine the relationship between teachers' leisure facilitators and job satisfaction by using the relational survey model following the survey model. Relational survey model aims to determine the existence and/or degree of change between two or more variables (Karasar, 2015; Fraenkel & Wallen, 2009).

Study Group

The study group of our research consists of permanent teachers, 82 female and 119 male, between the ages of 22-65, working in public schools in Aydın province in the 2022-2023 academic year.

Data Collection Method

The data was delivered to the teachers participating in the research through Google forms, which allow faster data collection at less cost. The survey form of the research was based on voluntary participation and 201 participants completed the survey.

Data Collection Tools

The questionnaire used in the research consisted of three parts. The first part consisted of demographic information, then the Leisure Facilitators Scale, and the last part consisted of the Minnesota Job Satisfaction Scale.

Leisure Facilitators Scale (LFS)

While the scale developed by Kim et al. (29) to measure leisure time facilitators and whose Turkish validity and reliability was tested by Gürbüz et al. (27) consists of 27 items and 3 sub-factors in its original form, it consists of 16 items and three dimensions in its Turkish form. The internal consistency coefficient was calculated as 0.86 in the Turkish adaptation of the scale with a 5-point Likert rating. In this study, the Cronbach Alpha reliability coefficient of the scale was calculated as 0.92 for the 'Personal Facilitators' dimension, 0.85 for the 'Interpersonal Facilitators' dimension, and 0.87 for the 'Structural Facilitators' dimension.

Minnesota Job Satisfaction Scale

In order to reveal the participants' job satisfaction level, Weiss et al. (44) and Turkish validity and reliability tests were conducted by Baycan (10). The scale consists of 20 items and two sub-dimensions. In the Turkish validity and reliability study of the scale, which has a 5-point Likert rating, the Cronbach's alpha coefficient of the scale was found to be 0.77. In our research, the Cronbach Alpha reliability coefficient of the scale was calculated as 0.92 for internal satisfaction and 0.85 for external satisfaction.

Statistical Analysis

SPSS 25.0 package program was used to analyze the data. From a statistical perspective, frequency analysis, reliability coefficient calculations, correlation coefficient calculations to determine the relationship between dependent independent variables, hierarchical regression analysis to calculate the effect of the dependent variable on the independent variable, and Manova analysis for difference test calculations were performed.

Ethical approval and institutional permission

In this article, the journal writing rules, publication principles, research and publication ethics, and journal ethical rules were followed. The responsibility belongs to the authors for any violations that may arise regarding the article. "Ethics Committee approval dated 21.03.2023 and decision number 7 was obtained from Aydın Adnan Menderes University Institute of Social Sciences Ethics Committee for this study.

FINDINGS

Table 1. Demographic Variables

Variables		f	%
Gender	Female	82	40,8
	Male	119	59,2
Age	30 and below	25	12,4
	31-35	42	20,9
	36-40	56	27,9
	41-45	34	16,9
	46 and older	44	21,9
Branch	Special talent	61	30,3
	Verbal	50	24,9
	Numeric	32	15,9
	Language	19	9,5
	Class-pre-school	39	19,4
Job experience	5 years and below	22	10,9
	6-10 years	50	24,9
	11-15 years	45	22,4
	16-20 years	35	17,4
	21 years and above	49	24,4
Leisure Evaluation	Sports activities	43	21,4
	Artistic and cultural activities	10	5
	Book reading	37	18,4
	Social activities	66	32,8
	Social media	22	10,9
	Other	23	11,4
Total		201	100

(Special talent= Special talent group course teachers; Verbal= Teachers of verbal group courses, Numeric= Teachers of numerical group courses; Language= Teachers of foreign language group courses, Class-pre-school= Pre-school group teachers)

In Table 1, the highest percentages in categorical variables were given in the descriptive statistics obtained from the participants. According to these results, male participants in the gender variable were (59,2%), special ability group branch in the branch variable was (27,2%), 6-10 years in the professional experience variable was (24,9%) and social cultural activities in the leisure time evaluation variable was (32,8%).

Table 2. Distribution of Scores of Leisure Facilitators and Job Satisfaction Scales

Dimensions	**n**	**Mean**	**Sd**	**Skewness**	**Kurtosis**
Personal Facilitators	201	4,08	,71	-,723	1,202
Interpersonal Facilitators	201	3,53	,89	-,265	-,379
Structural Facilitators	201	3,97	,68	-,701	1,254
Intrinsic Satisfaction	201	3,72	,69	-,535	,885
Extrinsic Satisfaction	201	3,37	,72	,009	-,111

According to Table 2, it was seen that the participants had high scores in the sub-dimensions of the leisure facilitators scale. The highest mean among these dimensions was Personal Facilitators. In the scores of the sub-dimensions of the job satisfaction scale, it was seen that the intrinsic satisfaction score was high and the extrinsic satisfaction score was at a medium level.

Table 3. Pearson Correlation Analysis Results for Variables

	1-	2-	3-	4-	5-
1- Personal Facilitators	1 -				
2- Interpersonal Facilitators	,766** ,000	1 -			
3- Structural Facilitators	,444** ,000	,406** ,000	1 -		
4- Intrinsic Satisfaction	,438** ,000	,448** ,000	,644** ,000	1 -	
5- Extrinsic Satisfaction	,479** ,000	,403** ,000	,766** ,000	,702** ,000	1 -

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

According to the results of Table 3, a moderate significant and positive relationship was found between participants' Intrinsic satisfaction and personal facilitators (r=,438); interpersonal facilitators (r=,448); and a highly significant and positive relationship was found between Intrinsic Satisfaction and structural facilitators (r=,644). A moderate significant and positive relationship between participants' extrinsic satisfaction and personal facilitators (r=,479) and interpersonal facilitators (r=,403); there is a highly significant and positive relationship between Intrinsic satisfaction and structural facilitators (r=,766).

Table 4. Hierarchical Regression Analysis Results to Determine the Effect of Leisure Facilitators on Intrinsic Satisfaction

	Independent variable	Dependent variable	R2	F	Beta	t	p
Model 1	Constant	Intrinsic Satisfaction	,193	48,768	-	7,645	,000
	Personal Facilitators				,444	6,983	,000
Model 2	Constant	Intrinsic Satisfaction	,229	30,690	-	7,611	,000
	Personal Facilitators				,276	3,395	,001
	Interpersonal Facilitators				,261	3,213	,002
Model 3	Constant	Intrinsic Satisfaction	,247	22,818	-	6,306	,000
	Personal Facilitators				,141	1,438	,152
	Interpersonal Facilitators				,171	1,934	,055
	Structural Facilitators				,251	2,374	,019

Hierarchical regression analysis was performed to explain the effect of leisure facilitators on job satisfaction. While personal facilitators explained 19.3% of intrinsic satisfaction in the first model; when interpersonal facilitators were added to the second model, the rate of explaining the variance increased to 22.9%. Moreover, when structural facilitators were added to the model, 24.7% of the variance was explained (Table 4).

In the first model, a 1-unit increase in the personal facilitators variable caused a significant increase of .444 in intrinsic satisfaction (β=,444); in the second model, a 1-unit increase in the personal facilitators variable caused a significant increase of .276 in intrinsic satisfaction (β=,276) and a 1-unit increase in the interpersonal facilitators variable caused an increase of .261 on intrinsic satisfaction (β=,261); In the third model, a 1-unit increase in the structural facilitators variable caused a significant increase of .251 on intrinsic satisfaction (β=,251). In the third model, no significant relationship was detected between personal facilitators and interpersonal facilitators and intrinsic satisfaction (p>0.05).

Table 5. Hierarchical Regression Analysis Results to Determine the Effect of Leisure Facilitators on Extrinsic Satisfaction

	Independent Variable	Dependent Variable	R2	F	Beta	t	p
Model 1	Constant	Extrinsic Satisfaction	,160	39,227	-	6,280	,000
	Personal Facilitators				,406	6,263	,000
Model 2	Constant	Extrinsic Satisfaction	,217	28,647	-	6,251	,000
	Personal Facilitators				,200	2,443	,015
	Interpersonal Facilitators				,320	3,906	,000
Model 3	Constant	Extrinsic Satisfaction	,215	19,214	-	5,558	,000
	Personal Facilitators				,159	1,588	,114
	Interpersonal Facilitators				,293	3,232	,001
	Structural Facilitators				,076	,704	,482

Hierarchical regression analysis was performed to explain the effect of leisure facilitators on job satisfaction. While personal facilitators explained 16% of intrinsic satisfaction in the first model when interpersonal facilitators were added to the second model, the rate of explaining the variance increased to 21.7%, and when structural facilitators were added to the model, the rate of explaining the variance decreased to 21.5% (Table 3).

In the first model, a 1-unit increase in the personal facilitators variable caused a significant increase in extrinsic satisfaction as .406 (β=,406); in the second model, a 1-unit increase in the personal facilitators variable caused a significant increase in extrinsic satisfaction as .200 (β=,200) and a 1-unit increase in the interpersonal facilitators variable caused an increase in extrinsic satisfaction as .320 (β=,320). In the third model, 1 unit increase in the interpersonal facilitators variable caused a significant increase of .293 in extrinsic satisfaction (β=,293). In the third model, no significant relationship was detected between personal facilitators and structural facilitators and extrinsic satisfaction (p>0.05).

Table 6. Manova Analysis Results of Teachers' Leisure Facilitators and Job Satisfaction Regarding Age Variable

Dimensions	Age	N	$\bar{X}$	SD	F	p	Bonferonni
Personal Facilitators	(1)30 and below	25	4,39	,49	2,636	**,035***	1>5
	(2)31-35	42	3,98	,78			
	(3)36-40	56	4,16	,66			
	(4)41-45	34	4,12	,76			
	(5)46 and older	44	3,87	,71			
Interpersonal Facilitators	(1)30 and below	25	3,76	,75	2,621	**,036***	1>5
	(2)31-35	42	3,55	,79			
	(3)36-40	56	3,65	,92			
	(4)41-45	34	3,63	,93			
	(5)46 and older	44	3,17	,92			
structural facilitators	(1)30 and below	25	4,15	,46	1,880	,115	-
	(2)31-35	42	3,93	,77			
	(3)36-40	56	4,09	,66			
	(4)41-45	34	3,94	,76			
	(5)46 and older	44	3,77	,63			
Intrinsic Satisfaction	(1)30 and below	25	3,77	,80	1,315	,266	-
	(2)31-35	42	3,53	,67			
	(3)36-40	56	3,75	,73			
	(4)41-45	34	3,67	,72			
	(5)46 and older	44	3,86	,54			
Extrinsic Satisfaction	(1)30 and below	25	3,51	,85	,628	,643	-
	(2)31-35	42	3,35	,56			
	(3)36-40	56	3,43	,81			
	(4)41-45	34	3,32	,68			
	(5)46 and older	44	3,26	,68			
Wilks Lamda=,804 F=2,167							
p<0,05*							

In Table 6, as a result of the Manova analysis between the participants' leisure facilitators and the age variable, a statistically significant difference was detected between the dimensions of personal facilitators and interpersonal facilitators (p<0.05). According to these results, it was seen that both personal facilitators and interpersonal facilitators scores of participants aged 30 and below were higher than participants aged 46 and older. No significant difference was found between the participants' job satisfaction and age variable (p>0.05).

Table 7. Manova Analysis Results of Teachers' Leisure Facilitators and Job Satisfaction Regarding Gender Variable

Dimensions	Gender	N	$\bar{X}$	SD	F	p
Personal Facilitators	Female	82	4,15	,71	1,390	,240
	Male	119	4,03	,71		
Interpersonal Facilitators	Female	82	3,47	,91	,780	,378
	Male	119	3,58	,88		
Structural Facilitators	Female	82	4,07	,63	3,036	,083
	Male	119	3,90	,71		
Intrinsic Satisfaction	Female	82	3,65	,73	1,208	,273
	Male	119	3,76	,66		
Extrinsic Satisfaction	Female	82	3,23	,70	5,006	**,026***
	Male	119	3,46	,71		
Wilks Lamda=,907 F=4,007						
p<0,05*						

According to Table 7, as a result of the Manova analysis between the participants' leisure facilitators and gender variable, no significant difference was detected (p>0.05). A significant difference was seen between the participants' job satisfaction and gender variable in favour of male participants in the extrinsic satisfaction sub-dimension (p<0.05).

Table 8. Manova Analysis Results of Teachers' Leisure Facilitators and Job Satisfaction Regarding Branch Variable

Dimensions	Branch	N	$\bar{X}$	SD	F	p	Bonferonni
Personal Facilitators	(1) Special talent	61	4,18	,73	2,303	,060	-
	(2)Verbal	50	3,83	,74			
	(3)Numeric	32	4,06	,69			
	(4)Language	19	4,22	,70			
	(5) Class-pre-school	39	4,20	,59			
Interpersonal Facilitators	(1) Special talent	61	3,69	,92	1,838	,123	-
	(2)Verbal	50	3,41	,83			
	(3)Numeric	32	3,25	,87			
	(4)Language	19	3,53	1,03			
	(5) Class-pre-school	39	3,69	,83			
Structural Facilitators	(1) Special talent	61	4,09	,75	2,417	**,050***	1>2
	(2)Verbal	50	3,77	,70			
	(3)Numeric	32	3,83	,57			
	(4)Language	19	4,05	,79			
	(5) Class-pre-school	39	4,11	,49			
Intrinsic Satisfaction	(1) Special talent	61	3,93	,66	2,775	**,028***	1>2
	(2)Verbal	50	3,54	,65			
	(3)Numeric	32	3,59	,84			
	(4)Language	19	3,59	,59			
	(5) Class-pre-school	39	3,78	,63			
Extrinsic Satisfaction	(1) Special talent	61	3,57	,62	3,232	**,014***	1>2
	(2)Verbal	50	3,16	,78			
	(3)Numeric	32	3,24	,76			
	(4)Language	19	3,19	,64			
	(5) Class-pre-school	39	3,49	,69			
Wilks Lamda=,873 F=1,331							
p<0,05*							

As a result of the Manova analysis conducted between the participants' leisure facilitators and the branch variable in Table 8, a significant difference was detected only in the structural facilitators sub-

dimension (p<0.05). According to this result, it was revealed that the mean scores of the participants with special talent branches were higher than the participants with verbal group branches. As a result of the Manova analysis between the job satisfaction of the participants and the branch variable, a significant difference was detected in both intrinsic satisfaction and extrinsic satisfaction sub-dimensions (p<0.05). According to this result, it was revealed that the mean scores of the participants with special ability branches were higher than the participants with verbal group branches.

Table 9. Manova Analysis Results of Teachers' Leisure Facilitators and Job Satisfaction Regarding Professional Experience Variable

Dimensions	Experience	N	$\bar{X}$	SD	F	p	Bonferonni
Personal Facilitators	(1)5 years and below	22	4,42	,51	2,790	**,028***	**1>5**
	(2)6-10 years	50	4,12	,75			
	(3)11-15 years	45	4,04	,65			
	(4)16-20 years	35	4,18	,70			
	(5)21 years	49	3,86	,75			
Interpersonal Facilitators	(1)5 years and below	22	3,69	,80	2,253	,065	-
	(2)6-10 years	50	3,66	,78			
	(3)11-15 years	45	3,50	,82			
	(4)16-20 years	35	3,73	1,11			
	(5)21 years	49	3,23	,87			
Structural Facilitators	(1)5 years and below	22	4,16	,40	1,701	,151	-
	(2)6-10 years	50	4,03	,75			
	(3)11-15 years	45	3,98	,63			
	(4)16-20 years	35	4,03	,78			
	(5)21 years	49	3,76	,65			
Intrinsic Satisfaction	(1)5 years and below	22	3,81	,73	,480	,751	-
	(2)6-10 years	50	3,66	,72			
	(3)11-15 years	45	3,63	,72			
	(4)16-20 years	35	3,74	,76			
	(5)21 years	49	3,79	,56			
Extrinsic Satisfaction	(1)5 years and below	22	3,53	,78	,863	,487	-
	(2)6-10 years	50	3,44	,66			
	(3)11-15 years	45	3,30	,70			
	(4)16-20 years	35	3,41	,82			
	(5)21 years	49	3,25	,68			
Wilks Lamda=,847 F=1,632							
p<0,05*							

As a result of the Manova analysis conducted between the participants' leisure facilitators and the professional experience variable in Table 9, a statistically significant difference was observed only in the personal facilitators sub-dimension (p<0.05). According to these results, it was seen that the scores of the participants with 5 years and below professional experience were higher than the participants with 21 years and above. No significant difference was found between participants' job satisfaction and professional experience (p>0.05).

Table 10. Manova Analysis Results of Teachers' Leisure Facilitators and Job Satisfaction Regarding Leisure Evaluation Variable

Dimensions	Evaluation	N	$\bar{X}$	SD	F	p	Bonferonni
Personal Facilitators	(1) Sports activities	43	4,24	,61	3,671	,003*	**1.3.4>6**
	(2) Artistic and cultural activities	10	4,18	,64			
	(3) Book reading	37	4,18	,70			
	(4) Social activities	66	4,14	,59			
	(5) Social media	22	3,92	,71			
	(6)Other	23	3,55	,99			
Interpersonal Facilitators	(1) Sports activities	43	3,54	1,05	1,133	,344	-
	(2) Artistic and cultural activities	10	3,42	,76			
	(3) Book reading	37	3,46	,83			
	(4) Social activities	66	3,69	,79			
	(5) Social media	22	3,60	,86			
	(6)Other	23	3,20	1,01			
Structural Facilitators	(1) Sports activities	43	4,04	,74	2,953	**,014***	**1,3,4>6**
	(2) Artistic and cultural activities	10	3,94	,88			
	(3) Book reading	37	4,03	,52			
	(4) Social activities	66	4,06	,57			
	(5) Social media	22	3,96	,56			
	(6)Other	23	3,47	,93			
Intrinsic Satisfaction	(1) Sports activities	43	3,75	,66	1,912	,094	-
	(2) Artistic and cultural activities	10	3,66	,52			
	(3) Book reading	37	3,86	,60			
	(4) Social activities	66	3,79	,69			
	(5) Social media	22	3,36	,60			
	(6)Other	23	3,57	,91			
Extrinsic Satisfaction	(1) Sports activities	43	3,47	,77	1,387	,231	-
	(2) Artistic and cultural activities	10	3,23	,53			
	(3) Book reading	37	3,41	,64			
	(4) Social activities	66	3,43	,75			
	(5) Social media	22	3,02	,72			
	(6)Other	23	3,32	,64			
Wilks Lamda=,804 F=1,721							
p<0,05*							

In Table 10, as a result of the Manova analysis between the participants' leisure time facilitators and the variable of leisure time evaluation, a statistically significant difference was observed between the dimensions of personal facilitators and structural facilitators ($p<0.05$). According to these results, it can be seen that both the personal facilitators' and structural facilitators' scores of the participants who do sports, read books, and participated in social activities during their leisure were higher than the participants who spend their leisure with other activities. No significant difference was found between the participants' job satisfaction and age variable ($p>0.05$).

DISCUSSION AND CONCLUSION

This study aimed to determine the effect of leisure facilitators on the job satisfaction of teachers working in public schools. The research findings show that there is a significant relationship between leisure facilitators and job satisfaction, and that leisure facilitators affect job satisfaction.

When the correlation analysis results for the variables of our study were analysed, a significant and positive relationship was detected between the participants' intrinsic satisfaction and interpersonal facilitators. In this context, it was concluded that teachers' leisure facilitators had a positive effect on their job satisfaction

levels, and as the ease of participation in leisure activities increased, job satisfaction also increased. When the literature was examined, some studies were in parallel with our study. In the study conducted by Bilgili (12), it was concluded that there was a low-level, positive and significant relationship between leisure facilitators and the job satisfaction scale. Turan et al. (41) found a negative relationship between life satisfaction and leisure time constraints in their study. Balaban and Saç (9) concluded that there was a significant and positive relationship between perceived freedom in leisure and life satisfaction.

As a result of the analysis conducted to determine the effect of leisure time facilitators on intrinsic satisfaction and extrinsic satisfaction, in the first model, the variable of personal facilitators caused a significant increase in intrinsic satisfaction and extrinsic satisfaction. In the second model, the variables of personal facilitators and interpersonal facilitators caused a significant increase in intrinsic satisfaction and extrinsic satisfaction. In the third model, the structural facilitators variable caused a significant increase in intrinsic satisfaction. In the third model, the interpersonal facilitators variable caused a significant increase in extrinsic satisfaction. Following these results, it can be said that the facilitation of leisure participation positively affects intrinsic satisfaction and extrinsic satisfaction. When the literature was reviewed, there were similar studies to our study. In the study conducted by Demir Erbil and Çopur (21), a significant and positive relationship was detected between the time management skills and job satisfaction of the participants. Lin et al. (31) concluded that the higher the impact of leisure time constraints and physical and mental health status, the higher the desire to leave the labour force. Working individuals cannot find time to participate in leisure activities and cannot effectively reduce the physical and mental pressure from the workplace that affects their desire to stay in the labour force. In this context, it can be seen that leisure constraints and willingness to stay in the labour force have a significant effect and leisure constraints have a significant effect on employees' willingness to stay in the labour force. When the relationship between physical activity in leisure and job satisfaction was examined by Dallmeyer and others (19), a relationship was observed between participation in physical activity in leisure and job satisfaction, and physical activities in leisure positively affected job satisfaction. Park (36) concluded that as leisure time facilitation increased, psychological satisfaction, life satisfaction and leisure time participation increased and this had positive effects on leisure satisfaction.

In our study, when leisure facilitators were analysed according to the age variable, a significant difference was found in the sub-dimensions of personal facilitators and interpersonal facilitators. When we look at the difference, it can be seen that the personal facilitators and interpersonal facilitators scores of the participants aged 30 and below were higher than the participants 46 and older. It can be said that the energy given by young age, the desire to be in social environments, the desire to look healthy and physically good, and the desire to belong to a social group affect the scores of individuals in this age group. When the literature was examined, studies similar to our study were observed. In the study conducted by Siyahtaş et al. (2018) with university students, they found a significant difference in the age variable of leisure facilitators in the sub-dimension of personal facilitators. In the study conducted by Bilgili (12), a low-level and negative significant relationship was found between interpersonal facilitators and age variables. In the study conducted by Balaban and Saç (9), it was determined that there was a significant difference between the total mean scores regarding the freedom they perceived in leisure according to the age variable. In some studies on leisure facilitators, no significant difference was found in terms of age variable (25).

No significant difference was found between the job satisfaction of the participants and the age variable. It can be thought that the low change in the teaching profession, the practice of the profession in similar environments and environments and the similar levels of professional expectations cause the job satisfaction levels of teachers of different ages to be similar. These results show similarities with the results of other research. Azimi and Durdağı (8) found no significant difference between teachers' job satisfaction and age variable. In the study conducted by Çulha (18) with school psychological counsellors and principals, no significant relationship was found between job satisfaction and age variable. In the study conducted by Burhan (15), no significant difference was found between teachers' job satisfaction and age variable. Similarly, in studies on academics (14,12), a statistically significant difference was found according to the age variable.

As a result of the analysis between the participants' leisure facilitators and gender variable, no significant difference was detected. There are studies similar to our study in the literature. Our study is in parallel with the results of the study conducted by Akbulut et al. (3). In the study conducted by Akbulut (2) with individuals

working within the Provincial Directorate of Youth and Sports, no significance was found between facilitating participation in activities and gender variables. A significant difference was found between the job satisfaction of the participants and the gender variable in favour of male participants in the extrinsic satisfaction sub-dimension. There were studies that were in parallel with our study. When the study conducted by Çulha (18) was examined, a significant difference was found between the job satisfaction of male and female participants. According to the results of Aliyev and Tunc's (5) research, the job satisfaction of psychological counsellors showed a significant difference according to gender. A significant difference was detected in favour of male participants. Moreover, when the results of the studies on teachers (40,30) were examined, no significant difference was found in the job satisfaction levels of teachers in terms of gender variable.

As a result of the analysis between the participants' leisure facilitators and the branch variable, a significant difference was found in the structural facilitators sub-dimension. According to this result, it was revealed that the mean scores of the participants with special talents were higher than the participants in the verbal group. The fact that the leisure time facilitator scores of the teachers in this group are higher than those of the teachers in the verbal group may be explained by the fact that the leisure facilitator scores of the teachers in this group were higher than those of the teachers in the verbal group due to the fact that the workload of the teachers in this group was not as heavy, the lessons were generally taught by teaching by doing and experiencing, the exam anxiety was not present in both the students and the teacher, the exam could be held in open environments and there was no expectation of the exam result. Again, for similar reasons, the fact that job satisfaction scores are higher than the teachers in the verbal group can be explained by these reasons. When we reviewed the literature, there were no studies covering the branch variable related to our main topic.

As a result of the analysis between the participants' leisure facilitators and the professional experience variable, a statistically significant difference was observed in the personal facilitators sub-dimension. According to these results, it can be seen that the scores of the participants with 5 years and below professional experience were higher than the participants with 21 years and above. The high scores of the participants in the group corresponding to the low age group can be explained by the reasons such as being at a young age, being willing to enter social environments, being willing to be included in the social group, not having complete future plans and having children (or if they have children the child is young). When we examine the literature, there were studies parallel to our study. Similarly, when the studies conducted by Alexandris and Carroll (4) were examined, a significant difference was observed in the dimensions between the factors preventing their participation in recreational activities and the age factor. In the study conducted by Özkan (35), a significant relationship was found between leisure facilitators and age factors. At the same time, it was emphasised by various authors that leisure can increase mood (22).

No significant difference between the participants' job satisfaction and the professional experience variable. When we look at similar studies in the literature (34,39,41,17), it can be seen that there was no significant difference between the professional experience variable. In the study conducted by Bilge, Akman and Kelecioğlu (11), it was observed that those with more experience in professional service had higher job satisfaction than those with less experience.

As a result of the analysis between the participants' leisure facilitators and leisure evaluation variables, statistically significant differentiation was observed between the dimensions of personal facilitators and structural facilitators. According to these results, it can be seen that both personal facilitators and structural facilitators' scores of the participants who participated in sports activities, read books and participate in social activities during their leisure were higher than those of the participants who spend their leisure with other activities. The fact that doing sports, reading books and participating in social activities were common and dominant activities explains the high scores of the participants in this area.

No significant difference was observed between the participants' job satisfaction and the variable of leisure evaluation. When we look at the leisure evaluation levels of the participants, although it was seen that they were close to each other, the mean scores of the individuals who spent their leisure by doing sports and reading books were higher. When we examined the literature, although there were studies similar to our study, there were no studies covering the variable of job satisfaction and leisure evaluation.

Suggestions

- Recreational areas can be increased to improve the physical and mental health of teachers.
- Institutions affiliated with national education can plan suitable leisure areas for the staff working in the work environment or with the leisure sports places in the neighbourhood.
- Working individuals can be encouraged to spontaneously participate in leisure sports to reduce stress and improve physical and mental health problems.
- New studies can be planned by expanding the population and sample of the research.

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"Free Spirit, Happy Individual": The Moderating Role of Perceived Freedom in Leisure on the Relationship Between Resilience and Happiness

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Abstract

Although it is known that perceived freedom in leisure has various psychological benefits, there are very limited studies that present the relationships between these benefits as a theoretical model and examine them in depth. In this context, the aim of the study is to investigate the moderating role of perceived freedom in leisure on the relationship between resilience and happiness. The study group of the correlational survey model research consisted of 674 university students, 345 female and 329 male, selected by simple convenience sampling method (Meanage=21,50±1.86). "Perceived Freedom in Leisure Scale (PFLS)", "Brief Resilience Scale (BRS)" and "Oxford Happiness Scale - Short Form (OHQ-SF)" were used to collect data in the study. After testing the basic assumptions of parametric tests, Pearson correlation analysis and confirmatory factor analysis with SPSS AMOS 24 for the reliability and validity of the measurements were performed and it was found that the measurement model fit statistics were within acceptable limits ($\chi2 = 1530.55$, df = 319, $\chi2/df = 4.79$; GFI = 90, NFI = 90; CFI = 91 and RMSEA = 0.075). In order to test the hypotheses created within the scope of the study, a structural equation model was created and analyses were performed using the SPSS Process Macro extension (Model 1). The moderating role of perceived freedom in leisure on the effect of resilience on happiness level was found to be significant ($\beta = 0,13$, $p < 0,01$, $t = 2,25$, [CI = 0,01, 0,25]). When the perceived freedom in leisure is high, the effect of resilience on happiness level is higher ($\beta = 0,45$, $p < 0,01$, $t = 8,85$, [CI = 0,35, 0,55]). A high level of perceived freedom in leisure revealed that the effect of resilience on the level of happiness would be higher. Increasing the level of perceived freedom in leisure in young people has led to the idea that it can make significant contributions to their psychological health.

Keywords: Perceived Freedom in Leisure, Resilience, Happiness, Moderating Role, Psychological Health

Özet

''Özgür Ruh, Mutlu Birey'': Psikolojik Sağlamlık ve Mutluluk İlişkisinde Serbest Zamanda Algılanan Özgürlüğün Düzenleyici Rolü

Serbest zamanda algılanan özgürlüğün spesifik psikolojik faydalarının olduğu bilinse de bu faydalar arasındaki ilişkileri kuramsal bir model olarak ortaya koyup derinlemesine inceleyen çalışmaların varlığı oldukça sınırlıdır. Bu bağlamda araştırmanın amacı, psikolojik sağlamlık ve mutluluk arasındaki ilişkide serbest zamanda algılanan özgürlüğün düzenleyici rolünün araştırılmasıdır. İlişkisel tarama modelindeki araştırmanın çalışma grubunu kolayda örnekleme yöntemiyle seçilen 345 kadın ve 329 erkek olmak üzere toplam 674 (Ortyaş=21,50±1.86) üniversite öğrencisi oluşturmaktadır. Çalışmada veri toplamak amacıyla ''Serbest Zamanda Algılanan Özgürlük Ölçeği (SZAÖ)'', ''Kısa Psikolojik Sağlamlık Ölçeği (KPSÖ)'' ve ''Oxford Mutluluk Ölçeği – Kısa Formu (OMÖ-K) kullanılmıştır. Parametrik testlerin temel varsayımlarının test edilmesinden sonra, Pearson korelasyon analizi ve ölçümlerin güvenilirliği ve geçerliliği için SPSS AMOS 24 ile doğrulayıcı faktör analizi yapılmış ve ölçüm modeli uyum istatistiklerinin kabul edilebilir sınırlar içinde olduğu tespit edilmiştir ($\chi2$ = 1530,55, df = 319, $\chi2$/df = 4,79; GFI = 90, NFI = 90; CFI = 91 ve RMSEA = 0.075). Çalışma kapsamında oluşturulan hipotezleri test etmek amacıyla yapısal eşitlik modeli oluşturulmuş ve SPSS Process Makro uzantısında (Model 1) kullanılarak analizler gerçekleştirilmiştir. Psikolojik sağlamlığın, mutluluk düzeyi üzerindeki etkisinde serbest zamanda algılanan özgürlüğün düzenleyici rolünün anlamlı olduğu saptanmıştır (β = 0,13, p < 0,01, t = 2,25, [CI = 0,01, 0,25]). Serbest zamanda algılanan özgürlüğün yüksek olması durumunda, psikolojik sağlamlığın mutluluk düzeyine etkisi daha fazla olmaktadır (β = 0,45, p < 0,01, t = 8,85, [CI = 0,35, 0,55]). Serbest zamanda algılanan özgürlüğün yüksek düzeyde olması psikolojik sağlamlığın mutluluk düzeyine etkisinin daha fazla olacağını ortaya koymuştur. Gençlerde serbest zamanda algılanan özgürlük düzeylerini artırmak, psikolojik sağlıklarına önemli katkılar yapabileceği fikrini doğurmuştur.

Anahtar Kelimeler: Serbest Zamanda Algılanan Özgürlük, Psikolojik Sağlamlık, Mutluluk, Düzenleyici Rol, Psikolojik Sağlık

INTRODUCTION

The mental health of young people around the world has been deteriorating. In particular, 39% of young people between the ages of 18 and 24 are known to experience severe depression, stress and anxiety. Also, emotional well-being is deteriorating (32). Furthermore, the World Happiness Report (51) indicated that young people are becoming increasingly unhappy due to the conditions brought about by living conditions. From this perspective, leisure activities assume a significant value in overcoming increasing psychological health problems and negative emotions (44). Indeed, leisure activities play a pivotal role in the maintenance of psychological health (4,43).

Leisure is the individual's orientation of preferences in freedom without physical environment and cultural constraints. In this way, individuals create a personally and intuitively valuable belief base (19). Perceived freedom has an important place in creating this foundation (7,27). The concept of perceived freedom, which is widely acknowledged as a crucial element influencing the leisure experience, has been defined as the perceived state that emerges because of one's own choice (34). In this context, individuals who experience perceived freedom in leisure activities exhibit disparate behavioral patterns (1). Those who experience high levels of perceived freedom in leisure activities tend to view themselves as competent and in control during participation in leisure activities. In contrast, those with lower levels of perceived freedom tend to feel a sense of helplessness and rely on others for opportunities in leisure participation (15, 16). From these perspectives, it is suggested that perceived freedom in leisure has an important effect on the development of resilience (2) as well as positive emotional gains (6, 41, 40).

One of the major areas of positive psychology is resilience, which has been addressed from different perspectives in the literature (17). In general, resilience is the ability of individuals to recover from distressing situations and to adapt and react to stressful situations (31). From the perspective of positive psychology, it has been observed that individuals with high resilience have greater capacity to experience positive emotions, maintain an optimistic outlook, and receive social support (24). Furthermore, it has been suggested that

individuals with high resilience can view the activities they engage in as positive experiences, developing a strong and constructive identity, establishing close relationships with others, and developing social skills (38). Upon review of the literature, it has been observed that leisure activities have a significant impact on the achievement of these positive emotional gains and the development of individuals' resilience (9). In this context, the study conducted by Avcı Taşkıran and Gürbüz (2) on university staff revealed that increased perceived freedom in leisure increased resilience. This information is consistent with previous studies that have demonstrated a significant relationship between resilience and leisure (10, 45). It can be argued that to gain a more comprehensive understanding of this relationship, it is necessary to consider the concept of happiness, which is a fundamental component of resilience (29, 39).

The concept of happiness is examined in two basic components, hedonic and eudaimonic. While hedonic happiness is the acquisition of pleasure and avoidance of pain, eudaimonic happiness deals with feelings of meaning, purpose, and self-actualization from a deeper philosophy (37). Currently, the concept of happiness has been defined as a person's emotional and cognitive evaluations within the life they are living. A review of the literature reveals that happiness is related to many concepts (11, 12). Among these concepts, leisure is certainly one of the most essential. The relationship between leisure and happiness has a long history and is increasingly being studied (33, 48). Many studies have found that perceived freedom in leisure increases happiness levels and provides many psychological benefits to individuals (6, 47). In the study conducted by Serdar and Harmandar Demirel (40), a significant relationship was found between perceived freedom in leisure and happiness, and it was found that as perceived freedom in leisure increased, so did happiness levels. One of the other significant areas that happiness has been linked to is resilience (36, 39). When reviewing the studies in the literature, there are studies that report that individuals with high resilience also have high levels of happiness (5, 30). In their study on fear of COVID-19, Peker and Cengiz (36) found that resilience and coping with perceived stress reduced the effect of fear of COVID-19 on happiness and stress.

A review of the literature revealed that there is a significant relationship between perceived freedom in leisure and resilience (2), perceived freedom in leisure and happiness (6, 40; 47), resilience and happiness (5, 30, 36). In exploring the relationship between these three concepts, we found that there is a limited number of studies investigating the moderating role of perceived freedom in leisure in the effect of resilience on happiness levels. In this context, we suggest that exploring the effects of perceived freedom in leisure on these two positive psychology concepts in terms of a low, moderate and high-level moderating role may positively contribute to the deteriorating mental health and happiness levels of young people, thus increasing the importance of the research and filling this gap in the literature. Considering this information, the aim of the study is to investigate the moderating role of perceived freedom in leisure on the relationship between resilience and happiness. In parallel with the purpose of the research, the following hypotheses are sought to be answered;

1. H1: Resilience has a positive effect on levels of happiness.
2. H2: Perceived freedom in leisure has a positive effect on happiness.
3. H3: Perceived freedom in leisure has a moderating role in the effect of resilience on happiness. In other words, when perceived freedom in leisure is high, the effect of resilience on the level of happiness will be higher.

METHOD

Research Model

This research is quantitative research based on numerical data to test the hypotheses (35). Within the scope of the research, the correlational survey method, which is frequently used in quantitative research methods, was preferred. Correlational surveys are studies that try to reveal the relationship between two or more variables (20). Furthermore, a research model was created within the scope of the study. Structural equation model was used to determine the cause-and-effect relationships of the model. The structural equation model is a multivariate statistical method that combines both regression and factor analysis (8, 23). The model includes x) resilience (independent variable) w) perceived freedom in leisure (moderator variable) y)

happiness (dependent variable) variables. According to this information, the theoretical structure of the research is presented in Figure 1.

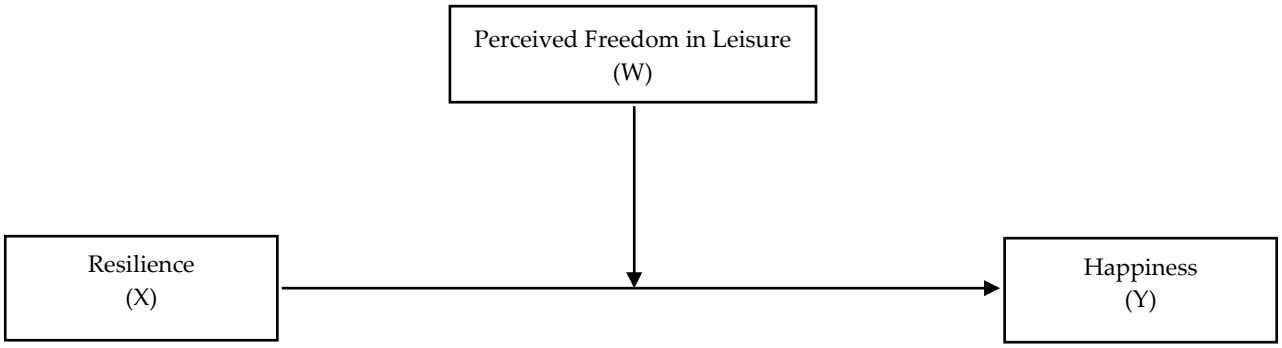

Figure 1. Research Model

Participants

The study group of this research consisted of a total of 674 university students, 345 females (51.2%) and 329 males (48.8%), selected using simple random sampling method (Meanage=21,50.06±1.86). Simple convenience sampling method refers to collecting data in the most convenient and accessible way until the sample size required for the research is reached (35). However, the income status of the participants was generally moderate (n=365, 54.2%). Most of the sample were active in their leisure (n=589, 87.4%), with the majority reporting occasional participation in physical activity (n=337, 50%).

Measures

Personal Information Form

The 'personal information form' designed by the researchers in line with the information obtained from the literature review consisted of independent variables such as age, gender, income status, participation in physical activity and preference for participation in leisure activities.

Perceived Freedom in Leisure Scale (PFLS)

To measure the perceived freedom in leisure of individuals participating in the study, the Perceived Freedom in Leisure Scale (PFLS) was used. The scale was developed by Witt and Ellis (50) and adapted into Turkish by Yerlisu Lapa and Kaas (26). The scale consists of 25 items and one factor. The items in the scale are ranked as (1) "Strongly Disagree" and (5) "Strongly Agree". The Cronbach's Alpha internal consistency coefficient calculated on the data collected within the scope of this research was found to be 0.95.

Brief Resilience Scale (BRS)

The Brief Resilience Scale (BRS), which was developed to measure the resilience levels of the individuals participating in the study, was developed by Smith et al. (42) and a Turkish validity and reliability study was conducted by Doğan (14). The scale consists of 6 items and one factor. The scale consists of 5-point Likert type, ranging from (1) "Not at all appropriate" to (5) "Completely appropriate". Cronbach's Alpha internal consistency coefficient calculated on the data collected within the scope of this research was determined as 0.70.

Oxford Happiness Questionnaire – Short Form (OHQ-SF)

The Oxford Happiness Scale - Short Form (OHQ-SF) developed by Hills and Argyle (25) to determine the happiness levels of individuals was validated in Turkish by Doğan and Akıncı Çötok (13). The scale consists of 7 items and one factor. The scale is scored as (1) "Strongly Disagree" and (5) "Strongly Agree". The Cronbach's Alpha internal consistency coefficient calculated on the data collected within the scope of this study was 0.72.

Ethical Approval and Institutional Permission

Prior to the collection of data within the framework of the study, the Ethics Committee of Kütahya Dumlupınar University (Decision numbered: 29/02/2024-275534) granted its approval. The necessary permissions for the use of the measurement tools used in the study were obtained by contacting the corresponding author. Volunteerism was considered as the basis for the individuals participating in the study.

Common Method Bias

As far as self-reported measures are concerned, we used Harman's one-factor test to check whether common method bias is a problem in our study by using SPSS factor analysis to determine the first eigenvalue from the data matrix. If the first eigenvalue explains most of the variance, then common method bias is a problem. The results show that the first eigenvalue explains 28.95% of the total variance (Critical threshold: 50%). Based on these results, it provides evidence that common method bias is unlikely to bias the results (22).

Data Analysis

The data collected within the scope of the research were analyzed using SPSS 23 software. In the analyses, firstly, skewness and kurtosis values were examined regarding the normality distribution of the data, and the range of +3 and -3 was taken as reference (28). After testing the basic assumptions of parametric tests, Pearson correlation analysis method was performed to determine the relationship between 'PFLS', 'BRS' and 'OHQ-SF' of the participants (35). In addition, confirmatory factor analysis was performed with SPSS AMOS 24 for the reliability and validity of the measurements, and it was determined that the measurement model fit statistics were within acceptable limits ($\chi 2$ = 1530,55, df = 319, $\chi 2$/df = 4,79; GFI = 90, NFI = 90; CFI = 91 and RMSEA = 0.075) (49). Furthermore, Cronbach's alphas internal consistency coefficients of the measurement tools used in the study were determined and found to vary between 0.72 and 0.95. These values are above acceptable levels (21). After all conditions regarding our research model were met, SPSS Process macro (Model 1) was used to test the moderating role of perceived freedom in leisure in the effect of resilience on happiness level. 5000 Bootstrap samples and confidence interval (CI) 95% were determined. As a result of the bootstrap analysis, the lower and upper confidence interval (CI) values do not include the value of 0 (zero), indicating that the moderating effect is significant. While operationalizing low, moderate and high levels of change seeking, 16th, 50th and 84th percentiles of the distribution were used (23).

FINDINGS

Table 1. Distribution of the Scale Scores (N=674)

Scale	Item	N	Min.	Max.	*M*	*SD*	Skewness	Kurtosis	α
PFLS	25	674	1	5	3,81	0,63	-0,72	1,58	0,95
BRS	6	674	1	5	3,67	0,62	-0,62	1,76	0,70
OHQ-SF	7	674	1	5	3,49	0,71	-0,29	-0,19	0,72

Note: Perceived Freedom in Leisure Scale (PFLS), Brief Resilience Scale (BRS), Oxford Happiness Questionnaire – Short Form (OHQ-SF).

When the data in Table 1 were examined, it was determined that the mean scores of the scales showed a normal distribution in the range of ±3 (28). However, the mean score obtained from PFLS (mean =3,81), the mean score obtained from BRS (mean =3,67) and finally, the mean of the total scores obtained from OHQ-SF (mean = 3,49) were determined.

Table 2. Findings Related to Correlation Analysis

Scale	PFLS	BRS	OHQ-SF
PFLS	1		
BRS	0,142**	1	
OHQ-SF	0,260**	0,365**	1

Note: *= p<0,05; **= p<0,01 Perceived Freedom in Leisure Scale (PFLS), Brief Resilience Scale (BRS), Oxford Happiness Questionnaire – Short Form (OHQ-SF).

Pearson correlation analysis results are presented in Table 3. According to the results of the analyses, a statistically significant relationship was found between PFLS, BRS and OHS-S (p<0.01). Firstly, PFLS and BRS had a significant positive relationship (r=0,142, p<0,01). Secondly, there was a significant positive correlation

between PFLS and OHQ-SF (r=0,260, p<0,01). Finally, there was a significant positive correlation between BRS and OHQ-SF (r=0,365, p<0,01).

Table 3. Regression Analysis Results Demonstrating the Moderating Effect

Variable	*β*	SE	*t*	C.I.	*p*
Constant	3.483	.025	138.8	[3.434, 3.532]	0.00
BRS (X)	.3644	.047	8.964	[.2846, .4442]	0.00
PFLS (W)	.2565	.040	6.341	[.1771, .3359]	0.00
X.W	.1388	.061	2.258	[.0181, .2595]	0.02

R=.42	R^2=.18
F(3, 670)= 50.25	*p*=0,000

Note: Perceived Freedom in Leisure Scale (PFLS), Brief Resilience Scale (BRS)), Standard Error (SE), Confidence Interval (CI)

According to the data in Table 3, it was observed that all predictor variables included in the regression analysis explained approximately 18% (R^2=.18) of the change in happiness level. It was found that resilience (β = 0,36, p < 0,01, t = 8,96, [CI = 0,28, 0,44]) and perceived freedom in leisure (β = 0,25, p < 0,01, t = 6,34, [CI = 0,17, 0,33]) had positive and significant effects on happiness level. Furthermore, the moderating role of perceived freedom in leisure in the effect of resilience on happiness level was found to be significant (β = 0,13, p < 0,01, t = 2,25, [CI = 0,01, 0,25]).

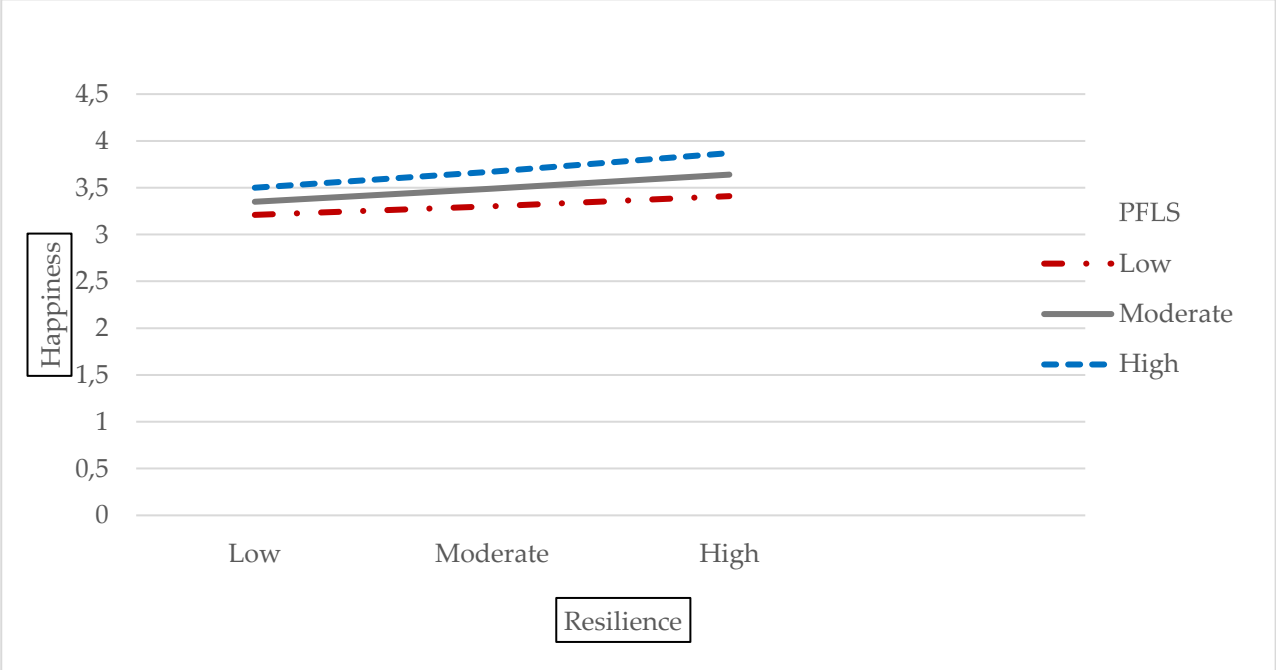

Figure 2. The Graphical Illustration of the Moderating Effect of Perceived Freedom in Leisure

Note: *Perceived Freedom in Leisure Scale (PFLS)*

As a result of the slope analysis, the effects of the moderating variable were graphically presented in Figure 3. When the details of the moderating effect are examined, it was observed that the effect of resilience on happiness level increased when the perceived freedom in leisure was low (β = 0,29, p < 0,01, t = 5,39, [CI = 0,18, 0,40]), moderate (β = 0,36, p < 0,01, t = 9,09, [CI = 0,28, 0,44]) and high (β = 0,45, p < 0,01, t = 8,85, [CI = 0,35, 0,55]). When the graph was examined, it was observed that this relationship was even stronger when the perceived freedom in leisure was high. More specifically, when the perceived freedom in leisure was higher, the effect of resilience on the level of happiness was higher, which means that the relationship between resilience and happiness is moderated by the perceived freedom in leisure.

DISCUSSION AND CONCLUSION

The aim of the study is to investigate the moderating role of perceived freedom in leisure on the relationship between resilience and happiness. In line with expectations, resilience and perceived freedom in leisure were found to have a positive and significant effect on happiness. Moreover, perceived freedom in leisure was identified as a significant moderator in the relationship between resilience and happiness. Accordingly, when perceived freedom in leisure is high, the effect of psychological resilience on happiness becomes even stronger. In light of this, the results obtained from the research findings supported all of the hypotheses developed within the scope of the study.

Firstly, resilience had a positive effect on happiness level (H1). Previous studies regarding the effect of resilience on happiness level revealed that the relationship between these concepts has a positive effect in general (5, 18, 36). Strengthening resilience, as well as many positive contributions in terms of health, has an important effect on the acquisition of positive emotions and positive increase in well-being (46). In a study conducted by Bajaj et al. (3) on undergraduate students in India, it was found that resilience had a positive relationship with happiness and a negative relationship with stress. Furthermore, the mediating role of resilience in the relationship between mindfulness and happiness was emphasized and it was reported to have a significant effect on the level of happiness. In another study, Gao et al. (18) found that resilience had significant effects on overall well-being and mental health and found that overall well-being mediated the relationship between resilience and mental health. In this context, the importance of the decisive role of leisure in the acquisition of positive emotions such as happiness that arise with the formation of resilience has been frequently emphasized (10).

Secondly, perceived freedom in leisure had a positive effect on happiness (H2). In previous studies in the literature, it was observed that there is a positive relationship between perceived freedom in leisure and happiness, which supports our findings (6, 40). Tükel and Temel (47) reported that perceived freedom in leisure is related to life satisfaction and happiness in university students. In this context, this positive effect of leisure provides individuals with benefits such as relaxation, reenergization, and renewal, as well as very significant contributions to the personal development of individuals through opportunities for success and social interaction (52).

Finally, the effect of resilience on happiness level was found to differ depending on whether the individual perceived low, moderate or high level of perceived freedom in leisure. In other words, the higher the perceived freedom in leisure, the higher the effect of resilience on the level of happiness (H3). Therefore, perceived freedom in leisure is very crucial for the development of resilience (2). The point to be noted here is that, unlike previous studies that examined the effect of resilience on happiness (5, 18, 36) and the relationship between perceived freedom in leisure and happiness (6, 40, 47), perceived freedom in leisure not only supports our view that perceived freedom in leisure is an influential predictor of resilience and happiness, but also confirms the research model.

Considering the deterioration in the mental health of young people and the positive effects of effective use of leisure on mental health, the value of the study increases. The findings of the study indicated that perceived freedom in leisure plays a moderating role in the relationship between resilience and happiness. Therefore, a high level of perceived freedom in leisure revealed that the effect of resilience on the level of happiness would be higher. As a result, increasing the level of perceived freedom in leisure among young people has led to the idea that it can make significant contributions to their psychological health. Mixed-method studies can be supported by qualitative studies to develop an in-depth understanding by determining the mediating effects on the concepts related to future research.

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Investigation of the Effect of Swimming Exercises on Body Fat Percentage and Anthropometric Characteristics in Sedentary Women

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Abstract

The aim of this study is to examine the effects of regular swimming exercises on certain physical parameters, anthropometric characteristics, and body fat percentage in sedentary women. Twenty sedentary women (31.05 ± 5.04 years; 163 ± 5 cm; 66.15 ± 11.68 kg) who had not previously engaged in regular physical activity participated in the study. Participants underwent a swimming exercise program three days a week for six weeks, with each session lasting 60 minutes. To evaluate the effects of the exercise program, anthropometric circumference measurements, subcutaneous fat thickness measurements, and body mass index (BMI) calculations were conducted at the beginning and end of the study. The swimming sessions were held at the Ankara Eryaman Swimming Pool, and the physical measurements were carried out in a performance measurement laboratory. Data were analyzed using SPSS 22 for Windows. According to the results, there was no statistically significant difference in shoulder, chest, thigh, and forearm circumference measurements ($p>0.05$), while statistically significant differences were found in waist, abdominal, hip, leg, and arm circumference measurements ($p<0.05$). In terms of subcutaneous fat thickness, significant reductions were observed in the biceps, triceps, suprailiac, and quadriceps regions ($p<0.05$), whereas no significant differences were found in the pectoral, subscapular, abdominal, and calf regions ($p>0.05$). Additionally, participants' body weight, body mass index, and body fat percentage showed statistically significant decreases ($p<0.05$). In conclusion, swimming exercises were found to positively affect certain components of body composition in sedentary women. The findings of this study are supported by similar results in the existing literature. Accordingly, swimming can be considered an effective form of exercise for individuals aiming to lose weight and achieve a healthier anthropometric profile. Future studies are recommended to examine different age groups, genders, and variations in exercise duration and frequency for a more comprehensive understanding of swimming's effects.

Keywords: Swimming, Body Fat Ratio, Anthropometry.

Özet

Sedanter Kadınlarda Yüzme Egzersizlerinin Vücut Yağ Yüzdesi ve Antropometrik Özellikler Üzerine Etkisinin İncelenmesi

Bu çalışmanın amacı, düzenli yüzme egzersizlerinin sedanter kadınların bazı fiziksel parametreleri, antropometrik özellikleri ve vücut yağ yüzdesi üzerindeki etkilerini incelemektir. Araştırmaya, daha önce düzenli spor yapmamış 20 sedanter kadın (31,05 ± 5,04 yaş; 163 ± 5 cm; 66,15 ± 11,68 kg) katılmıştır. Katılımcılara haftada 3 gün, 6 hafta süresince her biri 60 dakika süren yüzme egzersizleri uygulanmıştır. Egzersiz programının etkilerini değerlendirmek amacıyla çalışmanın başında ve sonunda antropometrik çevre ölçümleri, cilt altı yağ kalınlığı ölçümleri ve beden kitle indeksi hesaplamaları yapılmıştır. Egzersizler Ankara Eryaman Yüzme Havuzu'nda gerçekleştirilmiş, ölçümler ise performans ölçüm laboratuvarında yapılmıştır. Elde edilen veriler SPSS 22 for Windows programı ile analiz edilmiştir. Analiz sonuçlarına göre; omuz, göğüs, uyluk ve ön kol çevresi ölçümlerinde anlamlı bir fark görülmezken ($p>0,05$), bel, karın, kalça, bacak ve kol çevresi ölçümlerinde istatistiksel olarak anlamlı fark tespit edilmiştir ($p<0,05$). Cilt altı yağ kalınlığı ölçümlerinde ise biseps, triseps, suprailiak ve kuadriseps bölgelerinde anlamlı azalma görülmüş ($p<0,05$), pektoralis, subskapularis, abdominal ve baldır bölgelerinde anlamlı bir fark saptanmamıştır ($p>0,05$). Ayrıca, katılımcıların vücut ağırlığı, beden kitle indeksi ve vücut yağ yüzdesi değerlerinde istatistiksel olarak anlamlı düşüşler belirlenmiştir ($p<0,05$). Sonuç olarak, yüzme egzersizlerinin sedanter kadınların vücut kompozisyonunun bazı bileşenleri üzerinde olumlu etkiler yarattığı belirlenmiştir. Elde edilen bulgular, literatürdeki benzer çalışmalarla örtüşmektedir. Bu doğrultuda, yüzme egzersizlerinin kilo vermek ve uygun bir antropometrik yapıya sahip olmak isteyen bireyler için etkili bir egzersiz türü olduğu söylenebilir. Gelecekte farklı yaş grupları, cinsiyetler ya da egzersiz süre ve sıklıklarının karşılaştırıldığı çalışmalarla bu etkilerin daha ayrıntılı incelenmesi önerilmektedir.

Anahtar Kelimeler: Yüzme, Vücut Yağ Oranı, Antropometre.

INTRODUCTION

Today, technological advancements that facilitate nearly every aspect of life have increasingly led individuals toward a sedentary lifestyle (2). Individuals who adopt this lifestyle from childhood are at a higher risk of developing health problems due to physical inactivity over time (22). Consequently, sedentary individuals face a significantly elevated risk of hypokinetic diseases such as coronary heart disease, hypertension, hypercholesterolemia, cancer, obesity, and musculoskeletal disorders (21).

Swimming is defined as a series of purposeful movements that enable an individual to move through water over a certain distance. Compared to many other sports, swimming carries a lower risk of injury and contributes significantly to the development of motor skills (11). One of the most distinguishing features of swimming is the high energy expenditure required to perform horizontal movements by simultaneously or alternately using the arms and legs. Furthermore, swimmers must overcome water resistance, which hinders movement, and deal with the hydrostatic pressure of water, which makes breathing more difficult. Therefore, it is stated that "the energy required to swim a given distance is approximately four times that required to run the same distance" (18).

Due to its positive effects on developmental processes, swimming has become a mandatory sport for children in many countries. It is a widely preferred physical activity across all age groups, providing excellent cardiovascular conditioning without the weight-bearing impact on the musculoskeletal system. As such, it is considered an ideal form of exercise for obese children. Additionally, the high temperature and humidity of the swimming environment make it a beneficial option for individuals with asthma. However, achieving the intensity required for fitness gains and calorie burning in swimming requires a certain level of technical proficiency (7).

Among the major physiological consequences of a sedentary lifestyle are obesity and being overweight. Swimming, which is based on aerobic principles, is effective in addressing these issues. The aerobic energy system involves the oxidation of nutrients in the mitochondria to produce energy. In this process, carbohydrates and fats are broken down into water and carbon dioxide in the presence of oxygen, allowing fat to be used as a primary energy source (17).

Swimming is one of the few sports performed in water that optimally supports physical development. The sport, which nearly eliminates the effect of gravity, ensures the harmonious activation of all muscle groups. Performed against the resistance of water, it enhances endurance without exerting a detrimental impact on the body. Moreover, it is utilized in physical therapy due to its role in promoting the symmetrical and balanced development of muscle structures (6).

Empirical studies have demonstrated that swimming improves physical appearance, aids in weight management by increasing energy expenditure capacity, and constitutes an important means of combating physical inactivity (7). Swimming is one of the few sports performed in an aquatic environment that optimally supports physical development. The water's buoyancy nearly eliminates the effect of gravity, enabling all muscle groups to work in harmony. Performing movements against water resistance improves endurance without placing harmful stress on the body. Moreover, swimming is widely used in physical therapy due to its role in promoting symmetrical and balanced muscular development (6).

Empirical studies have demonstrated that swimming improves physical appearance, aids in weight management by increasing energy expenditure capacity, and constitutes an effective means of combating physical inactivity (7). In this context, the aim of this study is to investigate the effects of swimming exercises on certain physical parameters, anthropometric characteristics, and body fat percentage in sedentary women.

METHOD

Participants

The study included 20 middle-aged women residing in Ankara who had no prior experience with regular swimming training or participation in any other regular physical activity. All swimming sessions were conducted at the Eryaman Swimming Pool in Ankara. The study was approved by the local ethics committee (Protocol number 120, 11.11.2024, Ethics Committee of Selçuk University, Faculty of Sports Science, Konya, Turkey). Before the assessment, every participant received the same detailed information about the testing procedure. Every participant signed the informed consent.

Data Collection Tools: Height and Weight Measurements

Participants' height and weight were measured in a performance testing laboratory. Height was measured using a stadiometer, and body weight was measured using a digital scale.

Anthropometric Circumference Measurements

Anthropometric measurements were performed using a measuring tape, and the values were recorded in centimeters. The measurement sites and procedures were as follows:

- Shoulder: Measured from the maximum protrusion of the deltoid muscle to the junction of the sternum and the second rib.
- Biceps: Measured at the midpoint between the acromion of the scapula and the olecranon of the ulna while the arm was extended.
- Abdomen: Measured approximately 5 cm below the navel with the subject standing upright, heels together, and arms at the sides.
- Waist: Measured at the narrowest point of the waist during normal respiration.
- Hip: Measured horizontally over the maximum protrusion of the gluteal muscles.
- Chest: Measured horizontally at the level of the fourth rib at the junction with the sternum, while the participant stood with feet shoulder-width apart. Measurements were taken after a normal exhalation.
- Thigh: Measured at the point of maximum circumference just below the gluteal fold.
- Calf: Measured at the point of maximum circumference of the calf muscles.

Skinfold Thickness Measurements

Skinfold thickness was measured using a Holtain brand skinfold caliper, with values recorded in millimeters. All measurements were performed by the same trained specialist to ensure consistency and reduce inter-rater variability. The caliper used has been widely validated in anthropometric research and is known for its high reliability and accuracy. The measurement points and procedures were as follows.

- Triceps Skinfold: Measured vertically at the midpoint between the acromion and olecranon on the posterior aspect of the right upper arm, with the participant standing and arms relaxed at the sides.
- Biceps Skinfold: Measured vertically over the midpoint of the biceps muscle on the right upper arm with arms relaxed at the sides.
- Subscapular Skinfold: Measured diagonally at a 45° angle below the inferior angle of the scapula.
- Suprailiac Skinfold: Measured diagonally at a 45° angle above the iliac crest along the midaxillary line.
- Abdominal Skinfold: Measured vertically at a 90° angle along the midline of the abdomen.
- Quadriceps Skinfold: Measured vertically at the point of maximum circumference of the right thigh with the participant seated and knees flexed at 90°.
- Calf Skinfold: Measured vertically at a 90° angle at the midpoint of the calf muscle while the participant was standing (3).

Body Fat Percentage

Body fat percentage was calculated using the Lange formula

% Body Fat = (bi + tr + sc + si + chest + thigh) × 0.097 + 3.64

BMI Calculation

Body Mass Index (BMI) was calculated using the formula:

BMI = Body Weight (kg) / Height² (m^2)

Procedure

Before the initiation of the study, the topic was determined, literature was reviewed, and a hypothesis was formulated. The experimental group was then identified. Pre-test measurements were taken from the 20 selected participants. After a 6-week swimming training program, post-test measurements were conducted and compared with the pre-test values using statistical analysis. The findings obtained at the end of the study were interpreted in light of the relevant literature.

Training Model

The swimming sessions, conducted three times per week, included the following components:

- 10 minutes of general stretching exercises targeting major muscle groups before entering the pool,
- 5 minutes of free swimming as warm-up in the pool,
- 3 sets of 50-meter freestyle swimming,
- 15 minutes of resistance exercises for the arms, trunk, and legs performed in water,
- 2 sets of 50-meter backstroke swimming,
- 10 minutes of swimming in the participant's preferred style.

Statistical Analysis

Parametric data in the study were analyzed using the SPSS 22 software. Initially, the Shapiro-Wilk normality test was conducted to assess whether the data met the assumptions required for parametric tests. This test was utilized to determine if the data were normally distributed. A p-value greater than 0.05 indicated that the data satisfied the normality assumption, thus allowing the application of parametric tests.

After confirming the normality assumption, the Paired Sample T-Test was employed to evaluate whether there were statistically significant differences between the pre-test (before exercise) and post-test (after exercise) values. The significance level was set at $p < 0.05$. The analysis results reported the statistical significance of changes observed in the measured parameters.

FINDINGS

Table 1. Mean Age and Height Values of the Sedentary Participants in the Study

Variables	N	Min	max	Mean	S.d
Age (years)	20	25,00	40,00	31,05	5,04
Height (meters)	20	1,52	1,74	1,63	0,05

Table 2. Comparison of Pre- and Post-Test Circumferential Measurements of Sedentary Participants

Parameters	Time	N	X	Ss	t	P
Shoulder circumference (cm)	Pre test	20	103,50	9,15	1,422	,171
	Post test	20	103,01	9,35		
Chest circumference (cm)	Pre test	20	94,00	10,19	1,270	,219
	Post test	20	93,41	10,54		
Waist circumference (cm)	Pre test	20	80,80	10,58	2,378	*,028
	Post test	20	79,95	10,23		
Abdomen circumference (cm)	Pre test	20	90,70	11,75	2,861	*,010
	Post test	20	89,00	12,13		
Hip circumference (cm)	Pre test	20	103,95	9,71	4,030	*,001
	Post test	20	102,00	9,73		
Thigh circumference (cm)	Pre test	20	54,40	6,10	1,962	,065
	Post test	20	53,63	5,29		
Leg circumference (cm)	Pre test	20	36,35	3,56	2,162	*,044
	Post test	20	35,60	3,19		
Arm circumference (cm)	Pre test	20	28,35	3,83	2,210	*,040
	Post test	20	27,60	3,59		
Forearm circumference (cm)	Pre test	20	23,30	2,05	2,015	,058
	Post test	20	22,40	4,60		

* Significant differences (P<0.05).

The pre-test and post-test mean shoulder circumference measurements of the sedentary participants were found to be 103.50 ± 9.15 cm and 103.01 ± 9.35 cm, respectively. The participants' mean chest circumference was 94.00 ± 10.19 cm in the pre-test and 93.41 ± 10.54 cm in the post-test. The mean waist circumference decreased from 80.80 ± 10.58 cm to 79.95 ± 10.23 cm ($p<0.05$), and abdominal circumference decreased from 90.70 ± 11.75 cm to 89.00 ± 12.13 cm ($p<0.05$). The hip circumference also declined from 103.95 ± 9.71 cm to 102.00 ± 9.73 cm ($p<0.05$).Additionally, the participants' mean thigh circumference changed from 54.40 ± 6.10 cm to 53.63 ± 5.29 cm, while calf circumference decreased from 36.35 ± 3.56 cm to 35.60 ± 3.19 cm ($p<0.05$), arm circumference from 28.35 ± 3.83 cm to 27.60 ± 3.59 cm ($p<0.05$), and forearm circumference from 23.30 ± 2.05 cm to 22.40 ± 4.60 cm. Statistical analysis revealed no significant differences between the pre-test and post-test measurements of shoulder, chest, thigh, and forearm circumferences ($p > 0.05$). However, significant differences were observed in waist, abdominal, hip, calf, and arm circumferences ($p < 0.05$).

Table 3. Comparison of Pre- and Post-Test Subcutaneous Fat Measurements of Sedentary Participants in the Study

Parameters	Time	N	X	Ss	t	P
Biceps subcutaneous fat (mm)	Pre test	20	11,40	7,30	2,165	*,043
	Post test	20	10,55	6,41		
Triceps subcutaneous fat (mm)	Pre test	20	17,95	5,22	2,320	*,032
	Post test	20	17,15	4,52		
Pectoral subcutaneous fat (mm)	Pre test	20	9,55	5,23	1,022	,320
	Post test	20	9,20	5,01		
Subscapularis subcutaneous fat (mm)	Pre test	20	15,80	6,46	1,140	,269
	Post test	20	15,40	5,88		
Abdominal subcutaneous fat (mm)	Pre test	20	18,00	6,58	1,610	,124
	Post test	20	17,40	5,58		
Suprailiac subcutaneous fat (mm)	Pre test	20	14,10	3,92	2,156	*,044
	Post test	20	13,45	3,72		
Quadriceps subcutaneous fat (mm)	Pre test	20	17,00	6,14	5,205	*,000
	Post test	20	15,85	6,23		
Calf subcutaneous fat (mm)	Pre test	20	14,11	5,90	,360	,723
	Post test	20	13,86	5,51		

* Significant differences (P<0.05).

Statistical analysis revealed significant reductions in subcutaneous fat thickness at specific sites following the six-week swimming exercise program. The biceps skinfold thickness decreased from 11.40 ± 7.30 mm to 10.55 ± 6.41 mm ($p<0.05$), the triceps from 17.95 ± 5.22 mm to 17.15 ± 4.52 mm ($p<0.05$), the suprailiac from 14.10 ± 3.92 mm to 13.45 ± 3.72 mm ($p<0.05$), and the quadriceps from 17.00 ± 6.14 mm to 15.85 ± 6.23 mm ($p<0.05$). No statistically significant changes were observed in the pectoral (9.55 ± 5.23 mm to 9.20 ± 5.01 mm), subscapularis (15.80 ± 6.46 mm to 15.40 ± 5.88 mm), abdominal (18.00 ± 6.58 mm to 17.40 ± 5.58 mm), and calf (14.11 ± 5.90 mm to 13.86 ± 5.51 mm) skinfold thicknesses.

Table 4. Comparison of Pre- and Post-Test Body Weight, Body Mass Index, and Body Fat Percentage Measurements of Sedentary Participants in the Study

Parameters	Time	N	X	Ss	t	P
Body Weight (kg)	Pre test	20	66,15	11,68	3,022	*,007
	Post test	20	63,05	11,08		
Body Mass Index (kg/m²)	Pre test	20	25,02	4,70	3,041	*,007
	Post test	20	23,86	456		
Body Fat Percentage (%)	Pre test	20	23,93	4,65	2,735	*,013
	Post test	20	23,22	4,06		

* Significant differences (P<0.05).

The mean body weight of the participants was 66.15 ± 11.68 kg before the intervention and 63.05 ± 11.08 kg after the intervention ($p<0.05$). The Body Mass Index (BMI) decreased from 25.02 ± 4.70 kg/m² to 23.86 ± 4.56 kg/m² ($p<0.05$). Additionally, the mean body fat percentage declined from 23.93 ± 4.65% to 23.22 ± 4.06% ($p<0.05$).

DISCUSSION

Anthropometric circumference measurements taken before and after the swimming exercise program in sedentary women were compared. No statistically significant differences were found in the shoulder, chest, thigh, and forearm circumferences between pre- and post-test values. However, significant reductions were observed in waist, abdomen, hip, leg, and arm circumferences. A partially supporting study examined the effects of Pilates, an aerobic exercise method, and reported significant reductions in the 40–50 age group for

biceps (1.2 cm), chest (1.65 cm), abdomen (1.72 cm), hip (2.43 cm), upper leg (0.83 cm), calf (0.78 cm), and waist (0.9 cm) circumferences. In contrast, the same study found that in the 18–25 age group, only abdominal circumference showed a significant decrease (1.2 cm), while changes in other regions were not statistically significant (3).

There is a well-established relationship between reductions in body circumference measurements and decreases in both body fat percentage and overall weight. Previous studies have demonstrated a significant association between circumference measurements and body fat levels (26). In our study, statistically significant reductions were observed in the biceps, triceps, suprailiac, and quadriceps skinfold measurements. However, no significant changes were found in the pectoral, subscapularis, abdominal, and calf regions. The absence of reduction in certain sites may be attributed to the lack of region-specific exercises in our program, which did not target localized fat loss.

A comparable study involving aerobic exercise in individuals aged 18–25 reported a significant decrease of 1.6 mm in the suprailiac region, while reductions in the triceps, subscapular, thigh, and abdominal areas were not statistically significant (1). In contrast, among participants aged 40–50, the same study found significant decreases in the triceps (9.1 mm), subscapularis (2.61 mm), suprailiac (1.36 mm), abdomen (1.43 mm), and thigh (2.3 mm) skinfolds (3). These findings are largely consistent with the outcomes of our study.

Participants' body fat percentages and Body Mass Index (BMI) values were measured at the beginning and end of the study. The results revealed statistically significant decreases in both parameters following the swimming exercise intervention. Similarly, a previous study on swimmers reported that regular swimming led to a significant reduction in body fat percentage (13).

Swimming predominantly relies on the aerobic energy system (Tamer, 1995), and aerobic exercises have been shown to reduce body fat when applied consistently across different age groups (14). In a study conducted on 45 sedentary middle-aged women, a moderate-intensity exercise program was performed three times per week for one hour per session. By the end of the program, participants experienced a 9.06% reduction in body weight and a 21.4% decrease in body fat percentage (15). Another study involving middle-aged men and women also reported significant improvements. Tortop et al. (24) demonstrated that a 12-week aerobic exercise regimen resulted in marked decreases in both body weight and body fat percentage. These findings are consistent with the outcomes observed in our study. A similar study supporting our findings involved a group of middle-aged women who participated in a 12-week running–walking program, performed three times per week for 30 minutes. A significant reduction in body fat was observed between the pre- and post-test measurements (8). While many studies have reported that aerobic exercises significantly reduce body fat percentage, some have found non-significant changes. For instance, in a study involving middle-aged and older women who engaged in aerobic resistance exercises, reductions in body fat percentage were not statistically significant (3). This discrepancy may be due to the low intensity or short duration of the training sessions. Therefore, to achieve meaningful reductions in body fat through swimming, the exercise intensity must be sufficient to stimulate fat metabolism. This is particularly important, as the physiological adaptations gained through exercise can quickly regress once physical activity ceases (4). In a related study by Çolakoğlu and Karacan (9), aerobic resistance training led to a statistically significant reduction in BMI, from 35.87 ± 6.86 kg/m² to 32.75 ± 5.60 kg/m², further supporting the effectiveness of appropriately structured aerobic exercise programs.

Okyar (19) also reported that aerobic exercise led to a significant decrease in BMI. In contrast, another study involving middle-aged women who participated in an 8-week step aerobics program found a slight reduction in BMI—from 27.18 ± 4.20 kg/m² to 26.91 ± 4.29 kg/m²—which was not statistically significant (16). In a separate study, 31 healthy women took part in a 6-month combined resistance and aerobic training program, performed five days a week. By the end of the intervention, BMI had decreased by 2.2% (20). Similarly, a study on 41 middle-aged women who engaged in 45–60-minute aerobic exercise sessions three times per week for eight weeks reported significant reductions in BMI (25). Numerous studies in the literature have similarly reported that aerobic exercise programs, including swimming, lead to significant reductions in body fat percentage (5, 10, 12). Taken together, these findings indicate that the results of our study are consistent with the existing literature. However, one limitation of the present study is the small sample size, which may affect the generalizability of the findings.

CONCLUSION

In conclusion, this study demonstrated that swimming, as a form of aerobic exercise, resulted in reductions in subcutaneous fat and several anthropometric circumference measurements. Statistically significant decreases were also observed in participants' body fat percentages and Body Mass Index (BMI) values following the six-week swimming program. These results are consistent with findings from similar studies in the literature. Based on the evidence obtained, it can be concluded that swimming positively contributes to improvements in body composition. Furthermore, swimming appears to offer favorable physiological effects not only on body structure and fat metabolism but also potentially on motor skills and cardiovascular health. Therefore, swimming-based training can be considered an effective exercise method for enhancing both physical fitness and overall well-being in sedentary individuals.

Recommendations

1. Future studies could investigate the extent to which accompanying nutritional programs support reductions in body fat percentage when combined with swimming.

2. The effects of training duration and intensity on body composition in swimming programs could also be examined.

3. Future studies may compare the changes in body composition observed after swimming programs based on age and gender differences.

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A Research on Sports Science Students' Concern About Finding a Job and Career Planning

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Abstract

The aim of this study is to examine the attitudes of individuals studying at the faculty of sport sciences towards job finding anxiety and career planning. The research group consisted of 69 female and 148 male. In the research, the job finding anxiety scale of sport sciences students and the career planning scale of students studying in sport sciences were used. In the research findings, while significant differences were found in the factors of gender, age and licensed athlete, no statistically significant difference was found in the factor of the department of study. In addition, it was determined that there was a low level negative relationship between anxiety about finding a job and professional awareness sub-dimension. As a result, anxiety is an emotional state that can occur in all areas of life and can deeply affect people. Especially the fact that women are more fragile will affect them even more negatively in business life. For this reason, it is very important for people to have skills such as problem solving skills and psychological resilience while climbing the career ladder. These skills will prevent the deterioration of the individual's well-being against potential threats that may occur.

Keywords: Career Planning, Concern About Finding a Job, Sport

Özet

Spor Bilimleri Fakültesi Öğrencilerinin İş Bulma Kaygısı ve Kariyer Planlamalarına Yönelik Bir Çalışma

Bu araştırmanın amacı spor bilimleri fakültesinde öğrenim gören bireylerin iş bulma kaygısı ve kariyer planlamalarına yönelik tutumlarını incelemektir. Araştırma grubu 69 kadın 148 erkek katılımcıdan oluşmaktadır. Araştırmada Spor bilimleri öğrencilerinin iş bulma kaygısı ölçeği ve spor bilimlerinde öğrenim gören öğrencilerin kariyer planlama ölçeği kullanılmıştır. Araştırma bulgularında cinsiyet, yaş ve lisansı sporculuk faktöründe anlamlı düzeyde farklılıklar tespit edilirken; öğrenim görülen bölüm faktöründe istatistiksel olarak anlamlı düzeyde bir farklılık tespit edilmemiştir. Ayrıca iş bulma kaygısıyla mesleki farkındalık alt boyutu arasında düşük düzeyde negatif yönlü bir ilişkinin olduğu tespit edilmiştir. Sonuç olarak kaygı yaşamın her alanında ortaya çıkabilecek insanları derinden etkileyebilecek bir duygu durumudur. Özellikle kadınların daha kırılgan yapıda olması onları iş hayatında daha da olumsuz etkileyecektir. Bu nedenle kariyer basamaklarını çıkarken aynı zamanda insanların problem çözme becerisi ve psikolojik dayanıklılık gibi becerilere sahip olması oldukça önemlidir. Bu beceriler oluşabilecek potansiyel tehditlere karşı bireyin iyi oluş halinin bozulmasını engelleyecektir

Anahtar Kelimeler: Kariyer Planlama, İş Bulma Kaygısı, Spor.

INTRODUCTION

Throughout their lifetimes, individuals have confronted numerous challenges and have endeavored to counter these difficulties by cultivating diverse methodologies. While physical remedies exist, psychological resistance mechanisms are often required. The development of problem-solving skills has enabled individuals

to identify solutions to the challenges they encounter with greater ease. However, the absence of a resolution to these issues or the occurrence of a deadlock resulted in the manifestation of adverse emotional states. A variety of negative emotional states, including anxiety, stress, learned helplessness, and depression, are possible consequences of encountering a problem (11).

The term "anxiety" is derived from the ancient Greek word "anxsietas," which denotes negative emotional states such as worry, fear, and curiosity in humans. (10, 14). Anxiety can also be conceptualized as a defensive mechanism that emerges in response to perceived threats. This multifaceted emotional state encompasses subjective feelings and may also manifest physiological symptoms (19). Such negative states are an appropriate state of the human psyche in order to combat possible dangers by being affected by internal or external factors (18).

Conditions such as anxiety, stress, and depression, which have been demonstrated to exert a detrimental influence on human life, have also been shown to give rise to certain complications in the quotidian flow of life (12). Furthermore, individuals may encounter the repercussions of their environment, which can result in a gradual decline of protective factors (16). Situations occurring within the family unit have been demonstrated to exert a direct influence on the social and professional lives of individuals. This is particularly salient in the context of career planning, a process that demands both organizational and individual responsibility. Individuals in the midst of ascending the career ladder may encounter challenges in achieving their future goals due to the adverse circumstances they may face during this period. Such circumstances represent critical factors that can directly impact individuals' career planning (3).

The term "career" is defined as "the path that an individual follows in his/her working life, the field he/she works in, the job or position he/she starts and continues until the end of his/her working life" (5). Furthermore, the concept of career has been translated into Turkish from the English word "career" (8). The notion of career planning is influenced by a variety of factors. The term's usage can vary, encompassing both the individual and professional development senses (13). Nonetheless, the notion of career planning is a comprehensive one, encompassing elements such as career management, career development, job satisfaction, and career commitment (1).

The notion of career planning encompasses a series of interconnected elements, with the primary objective being the identification of future aspirations. This process entails the integration of an individual's knowledge, skills, and abilities, the acknowledgment of potential risks encountered during the pursuit of these objectives, the cultivation of self-motivation, and the capacity to surmount challenges encountered during the achievement process. The establishment of specific, attainable objectives is identified as a pivotal component of career planning, serving as a catalyst for the realization of future goals. However, in addition to these factors, individuals should be held accountable for capitalizing on these opportunities and developing personal work programs, adhering to these programs (15).

Indeed, the degree to which one's professional endeavors are successful can be seen as a reflection of the fundamental principles that govern one's social life. However, it is important to acknowledge that individuals may encounter various challenges along the path to success. The inability to effectively manage anxiety can hinder the implementation of these principles and the development of career plans. In this case, anxiety can be regarded as one of the factors influencing career success. However, it is imperative to acknowledge that when individuals adhere to fundamental principles and possess the capacity to execute them, their aspirations can evolve into concrete plans, and these plans can, in turn, materialize into tangible realities. Therefore, the objective of this study is to examine the attitudes of students enrolled in the Faculty of Sport Sciences towards job anxiety and career planning.

METHOD

Data Design

This study employed a comparative method, a quantitative research method, and employed the "Sports Sciences Students' Job Anxiety Scale and the Sports Sciences Students' Career Planning Scale." Participants were asked questions regarding gender, age, licensed athletics, and departmental factors.

Research Group

The research population consisted of students studying at the Faculty of Sports Sciences, while the sample group consisted of a total of 217 individuals (69 female and 148 male) studying at the Faculty of Sports Sciences at Selçuk University, who were selected through convenience sampling and volunteered to participate in the study.

Demographic Information Form:

The demographic information form was developed by the researchers to collect data on the gender, age, department, licensed athlete, and branch factors of the participants.

Job Finding Anxiety Scale of Sport Sciences Students:

In the present study, the "Sport Sciences Students' Job Finding Anxiety Scale," whose validity and reliability were previously examined by Aslan and Uğraş (4), was utilized. The 5-point Likert-type scale is comprised of a single dimension and eight questions. The items are classified as follows: "always true" (5), "usually true" (4), "sometimes true" (3), "rarely true" (2), and "never true" (1). As the score on the scale increases, so does the level of anxiety experienced by the individual.

Career Planning Scale of Students Studying in Sport Sciences:

The scale, the validity and reliability of which was conducted by Yavuz Eroğlu and Eroğlu (23), consists of 5 sub-dimensions and 23 items. The sub-dimensions of the scale are as follows: career awareness (1, 4, 5, 7, 8, 9, 10, 11, 15); professional awareness (12, 13, 14, 17); belief in career (20, 21, 22, 23); correctness of choice (2, 3, 6); and adequacy of education (16, 18, 19). It is important to note that the scale does not include reverse-scored items.

Analysis of Data

The "Statistical Package for Social Sciences" (SPSS) Version 22.0 statistical program was utilized to analyze the research data sample. In order to ascertain the normality of the data distribution, the kurtosis and skewness values were examined, and normality tests were applied, given that the distribution of the data was within the range of ±2. The independent t-test was used to compare independent groups, and the one-way ANOVA test was used to compare multiple groups. Pearson correlation analysis was employed to assess the relationship between the variables of interest.

Ethical Approval and Institutional Permission

This research was approved by the ethics committee report of Selçuk University Faculty of Sports Sciences dated 30.12.2024 and numbered 144.

FINDINGS

Table 1. JFAS and CPS Analysis Results Regarding Gender Factor

	Gender	N	x	Sd	t	p
Job Finding Anxiety	Female	69	31,48	7,58	-,020	,984
	Male	148	31,50	7,25		
Career Awareness	Female	69	38,16	4,90	2,258	,025*
	Male	148	36,28	6,06		
Professional Awareness	Female	69	16,75	2,51	1,106	,270
	Male	148	16,30	2,91		
Career Oriented Belief	Female	69	17,04	2,68	2,655	,009*
	Male	148	15,88	3,15		
Accuracy of Choice	Female	69	12,03	2,17	1,958	,052
	Male	148	11,36	2,43		
Adequacy of Training	Female	69	10,17	2,99	,320	,749
	Male	148	10,04	2,80		

Table 1 shows the results of the analysis of the participants' anxiety about finding a job and career planning related to the gender factor. In the results obtained, no significant difference was found in the participants' anxiety about finding a job. In the career awareness and career belief sub-dimensions of the career planning scale, it is seen that the average scores of female participants are significantly higher than male participants. It is seen that there is no significant difference in the sub-dimensions of vocational awareness, accuracy of choice and adequacy of education.

Table 2. JFAS and CPS Analysis Results Regarding Age Factor

	Age	N	x	Sd	F	p	Tukey
Job Finding Anxiety	21	66	31,77	7,52	,278	,842	
	22	72	31,61	7,77			
	23	51	31,61	7,01			
	24	28	30,32	6,57			
Career Awareness	21	66	37,33	6,23	1,089	,355	
	22	72	36,43	6,35			
	23	51	37,65	4,47			
	24	28	35,54	5,10			
Professional Awareness	21	66	16,76	2,72	,650	,584	
	22	72	16,32	2,98			
	23	51	16,51	2,56			
	24	28	15,93	2,91			
Career Oriented Belief	21	66	17,30	2,94	3,975	,009	A>B
	22	72	15,76	3,06			
	23	51	15,90	2,93			
	24	28	15,64	3,05			
Accuracy of Choice	21	66	11,83	2,26	,654	,581	
	22	72	11,42	2,40			
	23	51	11,67	2,31			
	24	28	11,18	2,67			
Adequacy of Training	21	66	10,12	3,06	,261	,853	
	22	72	10,24	2,94			
	23	51	9,78	2,82			
	24	28	10,14	2,19			

According to Table 2, which presents the results of the analysis of the participants' anxiety levels related to the age factor and career planning, while there was no significant difference in the level of anxiety about finding a job, it was found that individuals aged 21 years showed a significant difference in the sub-dimension of belief in career compared to individuals aged 22 years. There was no statistically significant difference in the sub-dimensions of career awareness, vocational awareness, accuracy of choice and adequacy of education.

Table 3. JFAS and CPS Analysis Results Regarding Licensed Athlete Factor

	Licensed athlete	N	x	Sd	t	p
Job Finding Anxiety	Yes	97	31,28	7,76	-,387	,699
	No	120	31,67	7,00		
Career Awareness	Yes	97	37,43	5,84	1,281	,202
	No	120	36,43	5,70		
Professional Awareness	Yes	97	16,87	2,71	2,003	,046*
	No	120	16,11	2,82		
Career Oriented Belief	Yes	97	16,88	2,96	2,764	,006*
	No	120	15,74	3,04		
Accuracy of Choice	Yes	97	11,94	2,34	2,068	,040*
	No	120	11,28	2,36		
Adequacy of Training	Yes	97	10,56	2,82	2,220	,027*
	No	120	9,70	2,83		

Table 3, which examines the participants' anxiety about finding a job and career planning according to the factor of being a licensed athlete, shows that there is no significant difference in anxiety scores. When the sub-

dimensions for career planning were examined, it was determined that there was no significant difference in the sub-dimension of career awareness, while there was a statistically significant difference in the sub-dimensions of vocational awareness, belief in career, correctness of choice and adequacy of education.

Table 4. JFAS and CPS Analysis Results Regarding the Department Factor

Department of Education		N	x	Sd	F	p
Job Finding Anxiety	Physical Education and Sports Teaching	43	29,91	9,82	,893	,446
	Coaching Education	71	31,75	6,12		
	Sports Management	63	32,19	6,73		
	Recreation	40	31,65	7,17		
Career Awareness	Physical Education and Sports Teaching	43	37,49	7,24	,628	,598
	Coaching Education	71	36,61	5,50		
	Sports Management	63	36,30	5,05		
	Recreation	40	37,60	5,63		
Professional Awareness	Physical Education and Sports Teaching	43	16,58	3,19	,927	,428
	Coaching Education	71	16,59	2,72		
	Sports Management	63	15,97	2,50		
	Recreation	40	16,80	2,90		
Career Oriented Belief	Physical Education and Sports Teaching	43	16,70	3,83	1,053	,370
	Coaching Education	71	16,52	2,61		
	Sports Management	63	15,95	2,85		
	Recreation	40	15,75	3,14		
Accuracy of Choice	Physical Education and Sports Teaching	43	11,91	2,33	,568	,637
	Coaching Education	71	11,41	2,49		
	Sports Management	63	11,41	2,06		
	Recreation	40	11,75	2,66		
Adequacy of Training	Physical Education and Sports Teaching	43	10,65	3,21	2,565	,056
	Coaching Education	71	9,83	2,67		
	Sports Management	63	9,51	2,79		
	Recreation	40	10,83	2,70		

The results of the analysis related to the department of study of the participants are given in Table 4. When the findings obtained were examined, it was determined that there was no significant difference at this level in the participants' anxiety about finding a job and career planning scale sub-dimension scores.

Table 5. Job Finding Anxiety and Career Planning Scale Correlation Analysis

		1	2	3	4	5	6
Job Finding Anxiety	r	1					
	p						
Career Awareness	r	-,109	1				
	p	,109					
Professional Awareness	r	-,133*	,719**	1			
	p	,049	,000				
Career Oriented Belief	r	-,130	,646**	,723**	1		
	p	,055	,000	,000			
Accuracy of Choice	r	-,109	,702**	,535**	,495**	1	
	p	,111	,000	,000	,000		
Adequacy of Training	r	-,128	,514**	,598**	,476**	,601**	1
	p	,060	,000	,000	,000	,000	

Table 5 shows the results of the correlation analysis between the job finding anxiety scale and the career planning scale. According to the findings;

there is a low level negative relationship between the total results of job finding anxiety and the sub-dimension of professional awareness; accordingly, it can be said that increasing the level of professional awareness will lead to a decrease in anxiety levels.

There is a high level positive relationship between the sub-dimension of career awareness and the sub-dimension of vocational awareness and the accuracy of the choice,

there is a medium level positive relationship between the sub-dimension of career awareness and the sub-dimension of belief in career and the adequacy of education,

there is a high level positive relationship between the sub-dimension of vocational awareness and the sub-dimension of belief in career,

There is a moderate positive relationship between the sub-dimension of vocational awareness and the sub-dimension of accuracy of choice and adequacy of education,

there is a moderate positive relationship between the sub-dimension of career belief and the sub-dimension of accuracy of choice and adequacy of education,

there is a moderate positive relationship between the sub-dimension of accuracy of choice and the sub-dimension of adequacy of education.

According to the positive relationship between the sub-dimensions of the career planning scale, any increase in the sub-dimensions will lead to an increase in other sub-dimensions or any decrease in the sub-dimensions will lead to a decrease in other sub-dimensions.

DISCUSSION AND CONCLUSION

A study was conducted to examine the job-finding anxiety of students from the Faculty of Sport Sciences and their attitudes toward career planning. The study's results yielded insights into various factors, including gender, age, department of study, status as a licensed athlete, and branch. The gender analysis yielded no statistically significant differences in the participants' anxiety levels concerning their employment prospects. A significant discrepancy was identified in the career planning scores, indicating a notable difference between male and female participants in the career awareness and career belief sub-dimensions.

Erail et al. (7) conducted a study on the career planning and job-finding anxiety of students at the Faculty of Sport Sciences. The researchers determined that the level of job-finding anxiety experienced by women was significantly higher than that experienced by men. A subsequent analysis revealed no statistically significant differences in career planning scores among the participants.

The study on the job-finding anxiety and career planning of recreation department students revealed no significant gender disparity in job-finding anxiety scores. However, a notable distinction emerged in the sub-dimensions of career belief and career planning for career planning, where female participants exhibited significantly different patterns compared to their male counterparts (2).

In their study, Turhan and Arslanboğa (20) did not find a significant difference in the participants' job-finding anxiety scores according to gender. This finding was reported in their study on the examination of job-finding anxiety and perceived stress levels. Deniz and Beltekin (6) examined the effect of the quality of education in higher education institutions on career planning and found no statistically significant difference in the career planning scores of the participants regarding the gender factor. Tutar and Öner (21) examined the relationship between university students' career awareness and anxiety about finding a job. The results of the analysis revealed that there was no statistically significant difference with respect to gender.

As demonstrated in the study conducted by Yılmaz and Caz (24), male participants exhibited significantly greater disparities than female participants in the sub-dimension of adequacy of education in the analysis results related to the gender factor. Additionally, female participants demonstrated significantly greater disparities than male participants in the total results of anxiety about finding a job. An investigation was conducted by Şengül (17) into the anxiety levels experienced by students enrolled in the Sports Sciences faculty with regard to securing employment. The results obtained from the study indicated that female participants exhibited higher anxiety scores compared to their male counterparts, thereby supporting the gender factor hypothesis.

The findings obtained from this study are consistent with those of previous studies, though the results obtained from these studies vary. The underlying reasons for this phenomenon may be attributable to the attitudes of university students' families and the prevailing societal attitudes. Furthermore, the elevated anxiety levels exhibited by female participants in the studies cited may suggest that men possess a more expansive range of job options, while women demonstrate a heightened level of job selection criteria.

Upon analysis of the research findings, significant differences were identified with respect to the age factor. In the sub-dimension of career-oriented belief, it was determined that the average scores of individuals aged 21 were higher than those of individuals aged 22.

The results of the analysis related to the age factor of the participants in the research on recreation students' anxiety about finding a job and career planning indicated that individuals aged 22-23 had higher anxiety scores than individuals aged 18-19 and 20-21. Furthermore, it was determined that individuals aged 24 and over exhibited higher anxiety scores compared to those aged 18-19. However, an examination of the mean scores of the participants in the career planning sub-dimensions reveals that individuals in the 18-19 age range exhibit lower mean scores in career awareness, choice accuracy, and planning compared to other age groups. (2).

In a study that examined the influence of age on career awareness and anxiety about finding employment, it was determined that there was no significant difference in the anxiety levels of the participants according to their age (21). A study was conducted on the job-finding anxiety and career planning of students enrolled in the Faculty of Sports Sciences. The study revealed that there was no significant difference in the participants' job-finding anxiety and career planning scores related to the age factor (7).

A comprehensive review of the extant literature on the age factor reveals significant disparities in the findings of several studies. However, a paucity of studies has identified significant differences. The narrow age range of the sample group can be attributed to the absence of significant differences. The emergence of a significant discrepancy between age groups can be attributed to the fact that, in a developing society, even young individuals possess the capacity to formulate future plans and to live within the confines of these plans, enabled by their awareness of life.

The present study's findings, derived from an in-depth analysis of job-finding anxiety and career planning scores, illuminate the correlation with the concept of licensed athlete. The findings obtained revealed that, while no significant difference was found in the total scores of the participants' anxiety about finding a job, a statistically significant difference was determined in the sub-dimensions of professional awareness, belief in career, correctness of choice, and adequacy of education. In their study, Turhan and Arslanboğa (20) examined the scores of the participants with respect to their sportsmanship level. The findings of the study revealed no statistically significant differences in the total results of job finding anxiety. A subsequent examination of the extant literature on the participants' sports participation yielded insufficient findings. It is hypothesized that the factor of licensed sportsmanship will contribute to the literature.

The results of the analysis related to the factor of the department where the students study are given in Table 4. The findings of the study indicated that there was no statistically significant difference in the scores of students enrolled in the departments of the Faculty of Sports Sciences with respect to job-finding anxiety and career planning.

In his study, Şengül (17) examined the participants' anxiety about finding a job according to the department factor. The results of the analysis revealed no statistically significant differences.

In their study, Tutar and Öner (21) examined the average scores of the participants regarding the department factor. They investigated the relationship between career awareness and anxiety about finding a job. The findings indicated an absence of statistically significant variation with respect to the department factor.

A study was conducted to examine the relationship between career planning and job-finding anxiety among students in the Faculty of Sport Sciences. The study revealed significant differences based on the department. In the sub-dimension of professional awareness, the mean scores of individuals in the department of coaching education were higher than those in the department of religious education and sports education,

and the mean scores of individuals in the department of physical education and sports education were higher than those in the department of sports management (24).

Turhan and Arslanboğa (20) discovered a modest positive correlation between anxiety regarding employment and perceived stress levels, while a modest negative correlation was identified between anxiety about securing employment and perceived stress discomfort.

Tutar and Öner (21) conducted a correlation analysis between vocational career awareness and anxiety about finding a job. The findings of the analysis indicate a modest negative correlation between vocational career awareness and anxiety regarding employment.

A review of the extant literature on anxiety regarding employment outcomes reveals a modest positive correlation between self-efficacy and anxiety (22).

A recent study examined the relationship between career anxiety and career awareness among participants in the labor force. The study revealed a modest positive correlation between career anxiety and career awareness, as well as vocational awareness and career planning total scores.

In their study, Yılmaz and Caz (24) examined students' career planning and anxiety about finding a job. However, their findings did not reveal a significant correlation between anxiety about finding a job and career planning sub-dimensions.

Consequently, a wide array of emotional responses, including anxiety, stress, psychological vulnerability, mobbing, and depression, are plausible components of the typical course of life. The hypothesis that women possess a more fragile psychological structure may serve to exacerbate feelings of anxiety in both familial and professional contexts. Consequently, individuals with such dispositions may encounter challenges in advancing within their chosen professional trajectory, particularly within the context of business. In order to prevent the occurrence of negative situations, such as anxiety, various methods can be employed, including the development of problem-solving skills. However, individuals who adhere to a more disciplined and planned lifestyle may be regarded as a more effective means of preventing potential crises. A meticulous organization of one's affairs is predicated on a set of principles, including, but not limited to, regular sleep, effective work habits, the attainment of tangible results, and the systematic planning of subsequent tasks. It can also be posited that these individuals possess a high degree of self-esteem and self-value. Individuals who demonstrate an ability to uphold these principles consistently throughout their professional journeys tend to advance within their careers with assurance and poise. However, the judicious implementation of these goals and the meticulous planning that precedes it can facilitate the continuity of daily life and the advancement of individuals without compromising the quality of life. This approach is predicated on the premise that it can prevent the onset of debilitating emotions such as anxiety, stress, and depression.

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Examination of Mental Toughness, Anxiety, and Generalized Anxiety Disorder-7 (GAD-7) Levels of Elite and Amateur Cyclists

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Abstract

Nowadays, it is an accepted fact that in order to achieve high performance in sports environment, the athlete's psychological competence is as important as his/her physical competence. Cycling is an activity performed by large masses all over the world for recreational, health, and performance purposes. This study aims to examine some psychological variables (mental toughness, anxiety and worry, and Generalized Anxiety Disorder levels) of amateur and elite cyclists. The sample of the study consisted of 124 amateur and 95 elite volunteer cyclists between the ages of 15-41 (N=219) who cycle throughout Turkey. Personal information form, Mental Toughness Scale, Worry and Anxiety Scale, and Generalized Anxiety Scale-7 prepared considering the DSM-IV SCID-I clinical interview guide were used as data collection tools in the study. Independent t-test and ANOVA statistical analyses were used in the analysis of the study. As a result of the analyses, (1) men's mental toughness levels were found to be higher than women's, but there was no significant difference between them ($p>0.05$). (2) It was found that women's levels of worry and anxiety and generalized anxiety disorder were higher than men's ($p<0.001$). (3) Elite cyclists' mental toughness levels were found to be higher than amateurs ($p<0.05$). (4) Amateur cyclists' worry and anxiety levels were higher than elite cyclists' ($p<0.005$). (5) Cyclists' mental toughness levels were high, while worry and anxiety, and generalized anxiety disorder levels were moderate. As a result, this study shows that the levels of mental toughness, anxiety and generalized anxiety disorder of cyclists may vary depending on gender, age and sport level (amateur/elite).

Keywords: Bicycle, athlete, mental endurance, worry, anxiety.

Özet

Elit ve Amatör Bisikletçilerin Zihinsel Dayanıklılık, Anksiyete ve Yaygın Anksiyete Bozukluğu-7 (YAB-7) Düzeylerinin İncelenmesi

Günümüzde spor ortamında yüksek performans elde etmek için sporcunun fiziksel yeterliğinin yanı sıra psikolojik yeterliğinin de önemli olduğu kabul edilmiş bir gerçektir. Bisiklet sürme, rekreasyonel, sağlık ve performans amaçlı tüm dünyada geniş kitlelerce yapılan bir aktivitedir. Bu çalışma amatör ve elit bisikletçilerin bazı psikolojik değişkenlerini (zihinsel dayanıklılık, endişe ve kaygı ile Yaygın Kaygı Bozukluğu düzeyleri) incelemeyi

amaçlamaktadır. Araştırmanın örneklemini Türkiye genelinde bisiklet kullanan 15-41 yaş aralığındaki 124 amatör ve 95 elit gönüllü bisikletçi (N=219) oluşturmuştur. Araştırmada veri toplama aracı olarak kişisel bilgi formu, Zihinsel Dayanıklılık Ölçeği, Endişe ve Anksiyete Ölçeği ile DSM-IV SCID-I klinik görüşme kılavuzu göz önüne alınarak hazırlanan, Yaygın Anksiyete Ölçeği-7 kullanılmıştır. Araştırmanın analizinde bağımsız t test ve ANOVA istatistiksel analizleri kullanılmıştır. Analizler sonucunda (1) erkeklerin zihinsel dayanıklılık düzeylerinin kadınlara göre daha yüksek bulunmuş ancak aralarında anlamlı fark çıkmamıştır (p>0,05). (2) Kadınların endişe ve kaygı ile yaygın kaygı bozukluğu düzeylerinin erkeklere göre daha yüksek olduğu tespit edilmiştir (p<,001). (3) Elit bisikletçilerin zihinsel dayanıklılık düzeylerinin amatörlere göre daha yüksek olduğu tespit edilmiştir (p<0,05). (4) Amatör bisikletçilerin endişe ve kaygı düzeyleri elit bisikletçilere göre daha yüksektir (p<,005). (5) Bisikletçilerin zihinsel dayanıklılık düzeyleri yüksek düzeydeyken endişe ve kaygı ile yaygın kaygı bozukluğu düzeyleri orta düzeydedir. Sonuç olarak bu araştırma bisiklet sporcularının zihinsel dayanıklılık, endişe ve kaygı ile yaygın kaygı bozukluğu seviyelerinin cinsiyet, yaş ve spor düzeyi (amatör/elit) değişkenlerine bağlı olarak değişebileceğini göstermektedir.

Anahtar Kelimeler: Bisiklet, sporcu, zihinsel dayanıklılık, endişe, anksiyete.

INTRODUCTION

While cycling offers physiological and psychological benefits in daily life, its role as a competitive sport also emphasizes the pursuit of high performance. It is an accepted fact that both psychological and physical competence are necessary to achieve high performance (14). Among these psychological factors, mental toughness stands out as one of the most critical components. One of the most basic elements of these psychological competencies is mental toughness. Mental resilience, defined as the power to recover after difficult life experiences or the ability to overcome changes and difficulties that may occur, is a process of achieving success or adaptation that reduces the negative effects of stress and encourages adaptation. On the other hand, scholars define mental toughness as the ability to cope with pressure and challenges in a way that minimizes the impact on performance (19). In any sport where all competitors are equal, using technical skills consistently and being a champion athlete requires mental toughness (34). Mental toughness is a condition considered to be associated with high performance in sports competitions. The mentally strong athlete is likely to overcome some challenges and be successful in a competition. The importance of mental endurance, especially in competitive sports, has been mentioned in the literature (21). Several studies, many methods and approaches to increase mental resilience are stated. Additionally, other studies suggest that the determination of mental toughness may be affected by genetics, education, experience, and environmental factors (25). For example, in a study, it was stated that individuals with more sports history and experience had higher mental endurance levels and better performance than individuals with less sports experience (3).

On the other hand, one of the most basic elements of psychological competencies is worry and anxiety. Most coaches or athletes believe that there should be "zero" anxiety to achieve the highest level of performance. While an optimal level of sports-related performance anxiety is considered healthy, excessive anxiety negatively affects athlete performance. Various factors can lead to the development, severity, and persistence of performance anxiety in sports (8). Fear of failure in sports, performance anxiety, increased perception of stress, higher risk of burnout, and higher levels of anxiety have been associated with sports anxiety (29). In contrast, mental training, motivation, concentration, and psychological skills such as focus, goal setting, and self-confidence are very important factors in reducing anxiety to a moderate level and achieving high performance in sports events. Additionally, positive thinking and emotional control are important components of this process (12).

Mentally strong athletes have a range of responses that can maintain mood, composure, and strength. The relationship between mental toughness and performance has been consistently demonstrated in studies involving cognitive and motor skills. Elite athletes have higher levels of mental toughness than lower-level performers. Studies have used a variety of psychological variables, such as emotions, affects, pain perceptions, or other factors, as potential ways to maintain mental toughness in sports (36).

The development of anxiety and the effect of exercise on the brain is affected by psychological mechanisms. Exercise-specific determinants of anxiety and worry focused on anxiety while explaining the metacognitive system of 'Generalized Anxiety Disorder (GAD)'. In recent years, anxiety in sports has become one of the most

talked about elements (34). It is known that anxiety, emotional, and personality factors are of great importance in sports competitions, but individuals' anxiety states include different emotional reactions. These include being tense, anxious, and nervous, negative thoughts (worries), and physiological changes (stomach problems, muscle cramps, and headaches). Therefore, stress and anxiety management are very important for individuals. "Autogenic work is needed in sports to eliminate stress" (10; as cited in 35). The variety of negative thoughts created by anxiety creates a situation in which individuals cannot understand their environment. This situation is seen with an increase in individuals' tension and restlessness (24; as cited in 34). Trait and state anxiety theory provides a general framework for examining the main variables that involved in stress and anxiety situations and includes the investigation of possible relationships between these variables (43). According to Wells, excessive and difficult-to-manage anxiety is the hallmark of the disorder (GAD). Anxiety is diagnosed not only based on symptoms but also serves as an effective assessment and coping tool that examines a person's thoughts and beliefs (46). As with most psychiatric disorders, the root cause of GAD is not fully understood. The adaptive nature of anxiety makes it difficult to distinguish between normal and pathological levels of stress disorder, as well as to distinguish between psychosocial and biological factors. Psychosocial and biological factors are likely interdependent (40). GAD is most commonly associated with depression and personality disorders, as well as other mental illnesses (39). In general, the main features that distinguish anxiety in GAD from other anxiety are; its prevalence, its chronic and harmful effects on functionality. Although it is important in all sports branches, mental endurance becomes even more important, especially in branches where the cyclist must compete with his opponent and the environment. This research will contribute significantly to the literature, as there is very limited research on mental toughness, anxiety, worry, and Generalized Anxiety Disorder in sports. For this reason, the discussion regarding the results of the research will be done indirectly.

METHOD

In this research, the relational survey model was used to determine the relationships between two or more dependent variables without intervention. These model studies are generally studies in which the relationship between two or more dependent variables is determined and examined without interfering with these variables (20). In this study, the mental toughness, worry, anxiety levels, and generalized anxiety disorder 7 levels of elite and amateur cyclists were examined.

Research Model

This research used a quantitative research method, the relational screening model. This model is generally used in research where the relationship between two or more dependent variables is determined and examined without intervening in these variables. In this research, the mental toughness, worry, and anxiety levels and generalized anxiety disorder-7 levels of elite and amateur cyclists were examined. Amateur cyclists participating in this study must be using a normal bicycle, not have a license, and not have participated in competitions. Elite cyclists must be using a bicycle used in different competitions, have a license for at least one year, and have participated in competitions.

Participants

The research group consists of volunteer cyclists across Türkiye in 2023. A total of 219 participants between the ages of 15-41 were included in the study. In this study, the dependent variables of elite and amateur cyclists are mental toughness, worry, and anxiety level (EAS), and generalized anxiety disorder-7 (GAD-7) levels; Gender, age, and group (amateur-professional) status constitute the independent variables. The required qualification numbers have been determined within the scope of the literature. It is stated in the literature that this potential can be sufficient for the relevant analyses of 5 to 10 times the item (Brown, 2015; Kline, 2023). The powers that the dimensions used are much higher than this criterion due to the development of the dimensions used from 11 items.

Relationships between Demographic Variables were examined with ANOVA analysis and the results are presented in Table 1.

Table 1. Descriptive statistical information regarding the study group

Variables		n	%
Gender	Female	70	32,0
	Male	149	68,0
Age	15-17	34	15,5
	18-25	67	30,6
	26-33	47	21,5
	34-41	71	32,4
Group	Amateur	124	56,6
	Elite	95	43,4
	Total	219	100,0

When Table 1 is examined, it is seen that 32.0% of the participants are women and 68.0% are men. 15.5% of the participants are 15-17 years old, 30.6% are 18-25 years old, 21.5% are 26-33 years old, and 32.4% are 34-41 years old It is seen that 56.6% of the participants are amateurs and 43.4% are elite athletes.

Data Collection Tools

Mental Toughness Scale (MTS):

Mental Toughness Scale was developed by Madrigal et al., (26), and Turkish validity and reliability were tested by Erdoğan (9). The scale is a five-point Likert-type scale, ranging from strongly disagree to completely agree (strongly disagree 1, disagree 2, undecided 3, agree 4, and completely agree 5). The lowest score that can be obtained in the scale scoring is 11 and the highest score is 55. High scores indicate high mental toughness and low scores indicate low mental toughness. In this study, the Cronbach alpha value of the Mental Toughness Scale was determined to be 0.888.

Worry and Anxiety Scale (WAS)

The Turkish validity and reliability of the Worry and Anxiety Scale (WSS) developed by Dugas et al., (7) was adapted to Turkish by Akyay (1). WAS is a Likert-type scale with, 11 items and nine points (0-8). The score that can be obtained in EAS is between 0-80. In this study, the Cronbach alpha value of the Worry and Anxiety Scale was determined as 0.898.

Generalized Anxiety Disorder-7 Scale (GAD-7)

Generalized Anxiety Disorder-7 Scale (GAD-7) was developed by Spitzer et al. (35). The validity and reliability study of the scale in Turkish was conducted by Konkan (23). According to DSM IV-TR criteria, the GAD-7 scale is a scale that measures generalized anxiety disorder and is a self-assessment type. It is a Likert-type scale [four points between 0-3, (0) never, (1) many days, (2) more than half of the days, (3) almost every day. The obtained score can be between 0-21 on the scale. Scale scores; between 0-4 points were considered as mild, 5-9 points as moderate, 10-14 points as high, and 15-21 points as severe anxiety. Eight was determined as the threshold value for the diagnosis of GAD-7. In this study, GAD-7 Cronbach's alpha value was determined as 0.833.

Analysis of Data

The data obtained from the research were evaluated using the SPSS Windows 29.00 program. Skewness-kurtosis values were examined to determine the suitability of the data for normal distribution. One-way ANOVA was used to compare age scale scores since the data conformed to normal distribution; Independent groups t-test analyses were used to compare gender, group structure (amateur, professional), and scale scores. The statistical significance level was taken as 0.05.

Ethical approval and institutional permission

This study was conducted in accordance with the Declaration of Helsinki. The study was approved by the Pamukkale University Non-Interventional Clinical Research Ethics Committee on Number: E-60116787-020-503218. Written consent forms were obtained from all participants.

FINDINGS

Gender relationships between the variables were examined with T-test analysis and the results are presented in Table 2.

Table 2. Comparison of the mental toughness, worry and anxiety, and generalized anxiety disorder-7 statistical analysis results of the cyclists participating in the study according to gender variable

The dependent variable	Gender	n	$\bar{x}$	Sd	t	*p*
Mental Toughness	Female	70	45,28	6,951	-1,233	0,219
	Male	149	46,60	7,566		
Worry and Anxiety	Female	70	32,61	19,521	3,856	0,000**
	Male	149	22,51	17,373		
Generalized Anxiety Disorder-7	Female	70	7,48	4,817	3,435	0,001**
	Male	149	5,26	4,275		

** p<0,05; *p<0,001*

As a result of the independent sample t-test statistical analysis, no significant difference was found in the mental toughness level total scores of male and female cyclists (p>.05; Table 2). However, when the total mean scores of worry and anxiety were examined, a significant difference was detected between male and female cyclists (p<.000). Table 2 shows that the total mean scores of female cyclists for worry and anxiety are higher than the mean scores of male cyclists. Finally, when the generalized anxiety disorder-7 total mean scores were compared between genders, a significant difference was detected against women (p<.001). Accordingly, the generalized anxiety disorder-7 total average scores of female cyclists are higher than male cyclists.

Age relationships between the variables were examined with Anova test analysis and the results are presented in Table 3.

Table 3. Comparison of the statistical analysis results of mental toughness, anxiety, and generalized anxiety disorder-7 of the cyclists participating in the study according to their age variable.

The dependent variable	Age	n	$\bar{x}$	Sd	F	*p*	Difference
Mental Toughness	15-17¹	34	48,14	6,742	1,274	0,284	
	18-25²	67	45,35	6,498			
	26-33³	47	46,702	6,527			
	34-41⁴	71	45,67	8,811			
	Total	219	46,18	7,385			
Worry and Anxiety	15-17¹	34	30,05	17,677	18,766	0,000**	4<1 3<2 4<2 4<2
	18-25²	67	35,91	20,146			
	26-33³	47	24,21	16,859			
	34-41⁴	71	15,08	11,901			
	Total	219	25,73	18,650			
Generalized Anxiety Disorder-7	15-17¹	34	6,64	4,650	6,808	0,000**	3<2 4<2
	18-25²	67	7,70	5,314			
	26-33³	47	5,27	3,943			
	34-41⁴	71	4,49	3,492			
	Total	219	5,97	4,563			

p<0,05; **p<0,001*

When Table 3 is examined, no significant difference was detected in the total mental toughness level scores of the participants according to the age variable (p>.05). The results of the total mean scores of Worry and Anxiety showed a statistically significant difference according to the age variable (p<.000). Tukey HSD post hoc analysis was performed to determine which groups the differences occurred. As a result of the analysis, it was determined that there were significant differences between the 15-17 age group and the 34-41 age group, the 18-25 age group and the 26-33 age group, and the 34-41 age group and the 34-41 and 26-33 age groups (Table 3). When the generalized anxiety disorder-7 total score averages were compared, a statistically significant difference was found between the age groups (p<.000). As a result of the Tukey HSD post-hoc

analysis performed to determine in which groups the difference occurred, a significant difference was found between the 18-25 age groups, 26-33 age groups, and 34-41 age groups (Table 3).

Amateur and elite cyclists' relationships between the variables were examined with T-test analysis and the results are presented in Table 4.

Table 4. Comparison of the mental toughness, worry and anxiety, and generalized anxiety disorder-7 statistical analysis results of the research participants according to amateur and elite cyclists

The dependent variable	Group	N	$\bar{x}$	Sd	t	*p*
Mental Toughness	Amateur	124	45,32	6,444	-1,982	0,049*
	Elite	95	47,30	8,360		
Worry and Anxiety	Amateur	124	28,12	18,530	2,185	0,030*
	Elite	95	22,62	18,439		
Generalized Anxiety Disorder-7	Amateur	124	6,02	4,277	0,174	0,862
	Elite	95	5,91	4,935		

p<0,05*

As a result of the independent sample t-test statistical analysis, a statistically significant difference was found in the total mental toughness level scores of amateur and elite cyclists (p<.05). Accordingly, on the one hand, it was determined that the mental endurance mean scores of elite cyclists were higher than amateur cyclists, and on the other hand, the total mean scores of anxiety and anxiety state of amateur cyclists were found to be higher than the mean scores of elite cyclists (p <.05). Finally, there was no significant difference between the generalized anxiety disorder-7 total mean scores of amateur cyclists and the mean scores of elite cyclists (p>.05) (Table 4).

DISCUSSION AND CONCLUSION

In this study, no statistically significant difference was found in the mental endurance mean scores between male cyclists and female cyclists. While some studies in the literature support this result, some studies do not. For example, it has been reported that men's mental toughness levels are higher than women's and that there is a significant difference in favor of men at the total score level of mental toughness sub-dimensions (22). In another study, a significant difference was found in the total scores of mental toughness levels of male athletes compared to female athletes. The results of these studies were conducted. It was found to be contrary to the results of our research. Other studies support our research. For example, there was no significant difference between male and female athletes in terms of mental toughness. In another example, it has been reported that there is no difference in the mental toughness levels of tennis players in terms of the gender variable (17). The reason for these differences in the studies may be due to the difference in the subject group of our study and the different scales used.

The research result shows male cyclists' total worry and anxiety scale scores were lower than female cyclists. This result is different from some previous studies. For example, no statistically significant difference was found in any parameter of cycling athletes according to gender (16; 28; 11). In another study, no difference was found in anxiety levels according to gender (24). The reason these studies differ from the results of our study can be explained by using different scales and different subject groups and sports branches. In light of the answers given by female cyclists, the reason why they feel more anxiety and anxiety is that it may be due to situations such as financial issues, future anxiety, health, traffic accidents, and technical malfunction.

In our study, female cyclists' GAD-7 total mean scores were higher than male cyclists. While this result is supported by some previous studies, it is not supported by most studies. For example, in his thesis research, Kankurtay (18) found that women's generalized anxiety disorder (GAD-7) scores were higher than men's. On the other hand, in different studies conducted on this subject, it has been seen that there are many studies indicating that GAD-7 does not differ according to gender. In other studies, conducted; It has been reported that women's trait anxiety levels are higher (2). As a result, studies in the literature reveal contradictory results. This may be due to the different sample groups and individual and demographic characteristics of the participants in the studies.

In our research, no significant difference was detected in the total mental toughness level scores of the participants according to the age variable. While this result is similar to some studies in the literature, it differs from some other studies. For example, a study stated that there was no relationship between teachers' mental toughness levels and age (33). Another study found that there was no difference in the mental toughness levels of the participants according to age (39). The results of these studies are similar to the results of our study. On the other hand, a study found that there is a difference in the level of mental toughness depending on the age variable, that it is in favor of athletes between the ages of 24-29 and 30-35 compared to athletes between the ages of 18-23, and that as the age of the athletes increases, their mental toughness levels also increase (38). In another study, it was found that mental toughness increases in direct proportion to age (28). In a different study, the psychological skills, mental toughness, and anxiety of 174 elite handball players were examined in terms of age and it was determined that there was no difference in terms of the age variable (24). This discrepancy may be due to: The reason for this difference in our study may be that only individual athletes are examined; in related studies, however, both individual and team athletes are included. Also, it is conducted with different sports branches and different subject groups.

In our research, the results of the total mean scores of the participants on the Worry and Anxiety Scale (WAS) are respectively; 18-25, 15-17, and 26-33-year-old cyclists' EAS scores were moderately high compared to 34-41-year-old cyclists according to the age variable. EAS scores of 34-41-year-olds were at low levels. In another study, there was no difference between the anxiety profiles of elite athletes and non-athletes; It has been determined that young athletes have higher anxiety according to the age variable (30). The result of this research supports the result of the research conducted.

In this study, according to GAD-7 total scores, it was observed that the GAD-7 mean scores of 18-25-year-old cyclists were medium-high, while the GAD-7 mean scores of 26-33 and 34-41-year-old cyclists were low. As a result of the research, we can say that GAD-7 levels decrease with increasing age in cyclists. In this research, we think that factors such as experience, being determined, being more consistent, and psychological superiority in coping with stress may be among the main reasons for the difference according to the age variable. However, studies on generalized anxiety disorder-7 (GAD-7) have obtained different results. For example, in the study on "Development, validation, and feasibility of a general yoga-based intervention for Generalized Anxiety Disorder (GAD)", 8 out of 20 patients between the ages of 18-50 were included in the study, and as a result, patients experienced a subjective change in anxiety scores and severity after the intervention (27). In a thesis study conducted by Demir (6), a weak relationship was found between the age variable and trait anxiety. In his thesis study, Beksaçi determined that trait anxiety varies according to age and that anxiety levels are higher at younger ages. When other studies were examined, it was seen that there were studies supporting that GAD was not related to age. In his study, Kankurtay determined that there was no significant difference in GAD-7 scores according to the age variable. However, another study also stated that generalized anxiety may decrease or may not change with age (33). These contradictory findings across different studies suggest that age may interact with other variables.

In our research, it was determined that the mental toughness level total scores of elite cyclists were higher than amateur cyclists (10). This result is similar to the results of studies in the literature. For example, it has been determined that national athletes have a higher level of mental endurance than non-national athletes and that being a national athlete is an element that increases the level of mental endurance (40). In our research, the total mean scores of amateur cyclists on anxiety and anxiety state (AAS) were higher than the mean scores of elite cyclists. In other words, it means that elite cyclists experience less worry and anxiety. This result is similar to studies conducted in the literature. For example, a study conducted on 97 elite and 114 non-elite competitive swimmers found that elite athletes interpreted anxiety states as facilitating performance more than amateur athletes. However, they stated that the anxiety intensity levels in amateur athletes were higher than in elite athletes (15).

In this study, no significant difference was found between the generalized anxiety disorder-7 total mean scores of amateur cyclists and the mean scores of elite cyclists. Although there is no direct research on generalized anxiety disorder-7 in athletes in the literature, the findings of our study are thought to support studies conducted in different fields in the literature (15; 4; 13; 5). For example, Jones et al. (15) reported that

there was no difference in the intensity of cognitive and somatic anxiety symptoms between amateur and professional athletes.

In this study, the mental toughness levels, anxiety and worry states, and generalized anxiety disorder-7 total average scores of cyclists were examined according to gender, age, and amateur and elite status. As a result; no significant difference was found between the mental toughness levels of female and male cyclists. Therefore, we can say that cycling does not affect mental toughness. In our study, the anxiety and worry states (WAS) and generalized anxiety disorder (GAD-7) of female cyclists were found to be higher than male cyclists. The fact that women feel more anxiety and worry and generalized anxiety while cycling may be the result of reasons such as health, traffic accidents, technical malfunctions, financial issues, and future anxiety. There was no difference between the mental toughness levels of cyclists according to the age variable. However, we can say that anxiety and worry states decrease with increasing age. The mental toughness levels of elite cyclists were higher than those of amateur cyclists. This is a result of elite cyclists' performance elements, such as competition, struggle, and endurance. The anxiety and worry levels (WAS) of amateur cyclists were higher than elite cyclists. The anxiety and worry levels of amateur cyclists were higher than elite cyclists. It can be said that the low generalized anxiety (GAD-7) scores of elite cyclists are the result of elite cyclists feeling similar situations to amateur cyclists (traffic accidents, health, technical malfunction, financial issues, and future anxiety).

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Investigation of the Factors Motivating Veteran Tennis Players to Start Recreational Tennis According to Some Variables

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Abstract

The aim of this study is to examine the factors that motivate veteran tennis players to start recreational tennis. A total of 292 veteran tennis players, 163 male and 129 female, between the ages of 30-72 (mean age 43.4±9.9), who actively participate in tournaments, participated in the study. In order to obtain demographic information about the participants, a personal information form and the Factors Motivating Individuals to Start Recreational Tennis Scale (BRTBMFÖ) were used. The Kolmogorov-Smirnov test and the Skewness and Kurtosis tests were applied to confirm that the research data did not show a normal distribution. Non-parametric tests were preferred in the analysis of data that did not conform to a normal distribution. In the comparison between numerical measurements, the Mann-Whitney U test was used for paired groups, and the Kruskall Wallis test was preferred in multiple group comparisons. The Games-Howell test was used to measure differences between multiple groups. As a result of the research, the first three factors that motivate veteran tennis players to start recreational tennis were ranked according to their weights as "physical health", "mental health" and "renewal-development". A significant difference was found between the competition sub-dimension and gender and occupational status variables; between the recognition/social status and trying a new sport sub-dimensions and gender variable; between the renewal/development and career expectation sub-dimensions and gender, marital status, educational status, occupational status and perceived income level variables; between the mental health and being an example sub-dimensions and marital status; between the considering suggestions sub-dimension and marital status, educational status, occupational status variables; between the distancing sub-dimension and perceived income level variable; between the liking tennis sub-dimension and gender, educational status and occupational status variables ($p<0.05$). As a result, it can be said that the factors that motivate veteran tennis players to start recreational tennis are affected by some demographic factors.

Keywords: Tennis; Veteran; Motivation.

Veteran Tenis Oyuncularını Rekreasyonel Tenise Başlamaya Motive Eden Faktörlerin Bazı Değişkenlere Göre İncelenmesi

Özet

Bu araştırmanın amacı, veteran tenisçileri rekreasyonel tenise başlamaya motive eden faktörlerin incelenmesidir. Araştırmaya aktif olarak turnuvalara katılan, 30-72 yaş aralığında (yaş ortalaması 43,4±9,9), 163 erkek ve 129 kadın olmak üzere toplam 292 veteran tenisçi katılmıştır. Araştırmada katılımcıların demografik

bilgilerini elde etmek amacıyla kişisel bilgi formu ve Bireyi Rekreasyonel Tenise Başlamaya Motive Eden Faktörler Ölçeği (BRTBMFÖ) kullanılmıştır. Kolmogorov-Smirnov testi ile Skewness ve Kurtosis testi uygulanarak, araştırma verilerinin normal dağılım göstermediği doğrulanmıştır. Normal dağılıma uymayan verilerin analizinde non-parametrik testler tercih edilmiştir. Sayısal ölçümler arasındaki karşılaştırmada, Mann-Whitney U testi ikili gruplar için kullanılmış, çoklu grup karşılaştırmalarında ise Kruskall Wallis testi tercih edilmiştir. Çoklu gruplar arasındaki farklılıkların ölçümü için Games-Howell testinden yararlanılmıştır. Araştırma sonucunda, veteran tenisçileri rekreasyonel tenise başlamaya motive eden faktörlerin ağırlıklarına göre sıralamasında ilk üç sırayı "fiziksel sağlık", "mental sağlık" ve "yenilenmek-gelişim" faktörleri almıştır. Rekabet alt boyutu ile cinsiyet ve meslek durumu değişkenleri arasında; tanınma/sosyal statü ve yeni bir spor branşını deneme alt boyutları ile cinsiyet değişkeni arasında; yenilenmek/gelişim ve kariyer beklentisi alt boyutları ile cinsiyet, medeni durum, eğitim durumu, meslek durumu ve algılanan gelir düzeyi değişkenleri arasında; mental sağlık ve örnek olma alt boyutları ile medeni durum arasında; önerileri dikkate alma alt boyutu ile medeni durum, eğitim durumu, meslek durumu değişkenleri arasında; uzaklaşma alt boyutu ile algılanan gelir düzeyi değişkeni arasında; tenisi sevme alt boyutu ile cinsiyet, eğitim durumu ve meslek durumu değişkenleri arasında anlamlı düzeyde farklılık tespit edilmiştir ($p<0,05$). Sonuç olarak, veteran tenisçileri rekreasyonel tenise başlamaya motive eden unsurların bazı demografik faktörlerden etkilendiği söylenebilir.

Anahtar Kelimeler: Tenis; Veteran; Motivasyon.

INTRODUCTION

From the beginning of human existence to the present day, sports have gained an important place in their lives for many reasons. When the lifestyles of people in the past are considered, it is seen that sports have an important place in terms of social and physical activity. Countries have also taken this situation into consideration and have considered the quality of life of people and the physical health of societies and have organized and supported various sports organizations. At the beginning of these organizations, tennis, which people of all age groups can participate with various motivation factors, has recently gained an important place (23). Today, tennis has become a recreational activity that attracts spectators and players from all ages and all segments of society in addition to sports performance. With the fact that tennis can be played at all ages and has spread to society, it has also attracted attention as a recreational activity (21). Today, tennis is one of the most important sports branches that people prefer to compete in addition to parameters such as physical health, recognition and social status, renewal, development and mental health. Tennis is preferred by different age groups because it offers the opportunity to be competitive in every age group (1,23). One of these age categories is senior tennis, which has an important place in tennis. Senior tennis can meet the needs of veteran groups such as competing and being a competitor. Today, organizations are organized in which national and international veteran groups can participate. In these organizations, athletes have the opportunity to represent their teams, cities and countries (26).

Motivation in sports is a very important concept that shapes athlete performance and therefore directly affects success. In fact, it is stated in the literature that high performance in sports depends not only on talent but also on motivation; talent alone is not enough to achieve success if there is no motivation. However, motivation in sports is considered as a desire to succeed rather than a concept related to the level of arousal, which is slightly different from the way psychology treats motivation (3). The behaviors that people exhibit in order to meet their needs and desires and reach their goals can be defined as intrinsic motivation. The determination and perseverance that enable individuals to reach their goals during the participation in sports and recreational activities and the necessary motivation to reach these goals in these activities are expressed as intrinsic motivation (11,14,22). The thought that they will receive a reward or punishment as a result of their behaviors and their motivation are expressed as extrinsic motivation. Material and spiritual elements that are not directly related to them but can have negative or positive effects and also increase or decrease the desired behaviors are expressed as extrinsic motivation (11). In this context, the aim of the research is to examine the factors that motivate veteran tennis players to start recreational tennis.

METHOD

A total of 292 veteran tennis players (163 male and 129 female) aged 30-72 (mean age 43.4±9.9) living in Konya, Antalya, and Istanbul, actively participating in tournaments, participated in the study voluntarily. The study was conducted in accordance with the principles of the Declaration of Helsinki and was obtained from

the report of the Non-Interventional Clinical Research Ethics Committee of the Faculty of Sports Sciences of Selçuk University.

Data Collection Tools

In this study, a personal information form and the Factors Motivating Individuals to Start Recreational Tennis Scale (BRTBMFÖ) were used to obtain demographic information about the participants. The scale consists of the following sub-dimensions: physical health, competition, recognition and social status, renewal-development, mental health, career expectations, considering suggestions, being an example, distancing, liking tennis, socializing and trying a new sport. The total Cronbach's alpha value of BRTBMFÖ is 0.938 (1).

Data Analysis

Data analyzed consistently in a computer-based environment were checked and corrected in accordance with the survey formula. The reporting analysis performed using the IBM SPSS 22 package program included numerical processing of categorical measurements. The Kolmogorov-Smirnov test and the Skewness and Kurtosis tests were applied to verify that the research data did not show a normal distribution. Non-parametric tests were preferred in the analysis of data that did not conform to a normal distribution. In the comparison between numerical measurements, the Mann-Whitney U test was used for binary groups, and the Kruskall Wallis test was preferred in multiple group comparisons. The Games-Howell test was used to measure differences between multiple groups.

FINDINGS

Descriptive characteristics of the study participants are presented in Table 1 below.

Table 1. Distribution of participants according to demographic characteristics.

Demographic Characteristics	Frequency (f)	Percentage (%)
Gender		
Male	163	55,8
Female	129	44,2
Marital Status		
Married	180	61,6
Single	112	38,4
Educational Status		
High School	69	23,6
Undergraduate	174	59,6
Postgraduate	49	16,8
Occupation		
Public	58	19,9
Private Sector	113	38,7
Self-Employed	70	24,0
Housewife	28	9,6
Retired	23	7,9
Perceived Income Level		
Low	20	6,8
Medium	241	82,5
High	31	10,6
Total	**292**	**100,0**

Table 2. Mean (◎) and standard deviation (SD) values of BRTBMFÖ item statistics.

Factors	N	$\bar{X}$	SS
Because I want to protect and improve my physical health	292	4,56	0,60
Because I want to do physical activity	292	4,61	0,54
Because I want to have a healthy body	292	4,60	0,67
Because I want to be more energetic and fit	292	4,66	0,52
Because it is an activity that can be done at any age	292	4,73	0,44
PHYSICAL HEALTH	**292**	**4,63**	**0,55**
Because I like competitive activities	292	4,14	0,76
Because I think it develops the spirit of struggle	292	4,18	0,76
To compete with others	292	3,75	0,98
Because I desire success	292	3,79	0,97
Because I believe in self-actualization	292	4,17	0,74
Because I think I can compete with myself	292	4,21	0,84
COMPETITION	**292**	**4,04**	**0,84**
Because the image of the place where tennis is played is high	292	3,01	1,07
Because I think playing tennis provides status to the individual	292	3,01	1,14
Because playing tennis will allow me to be accepted in other social groups	292	2,84	1,24
Because I believe tennis is a prestigious activity	292	3,73	1,10
Because I think I will gain social power when I become a good tennis player	292	2,80	1,17
Because I want to be remembered as a good tennis player	292	3,32	1,15
RECOGNITION AND SOCIAL STATUS	**292**	**3,12**	**1,15**
Because I want to acquire new skills and use them	292	4,18	0,68
Because it will give me the opportunity to use the skills I have	292	4,29	0,63
Because I think I will renew and improve myself	292	4,29	0,65
Because I want to add a new dimension to my life	292	4,32	0,73
RENEWAL / DEVELOPMENT	**292**	**4,27**	**0,67**
Because I think it will relax and increase my work/life efficiency	292	4,57	0,67
Because I want to slow down and calm my mind	292	4,52	0,68
Because I think I will feel renewed and refreshed when I play tennis	292	4,59	0,59
Because I think I will protect and improve my mental health	292	4,65	0,569
Because I think I will feel happier	292	4,72	0,47
MENTAL HEALTH	**292**	**4,61**	**0,60**
To make a professional career in tennis	292	2,10	1,15
Because I think I can make money from tennis in the future	292	2,08	1,16
Because I think I will make new business connections	292	2,25	1,17
CAREER EXPECTATION	**292**	**2,14**	**1,16**
The impact of social media	290	3,11	1,21
The impact of audiovisual media such as newspapers / television	292	3,05	1,19
The impact of my friends from the social world	292	3,32	1,17
My doctor's advice	292	3,41	1,24
The impact of family members	292	3,78	1,11
CONSIDERING SUGGESTIONS	**292**	**3,33**	**1,18**
Because I think I will be an example for the individuals around me	292	3,95	1,07
Because I think I will be an example for the individuals in society	292	3,96	0,97
Because I think I will be an example for the family members	292	3,96	0,93
BEING AN EXAMPLE	**292**	**3,96**	**0,99**
Because I want to get away from the crowd and routine	292	4,02	1,03
Because I want to get away from work/school for a while	292	3,94	1,05
Because I want to get away from the routine of daily life	292	4,14	0,86
Because I want to get away from the people around me	292	3,32	1,36
GO AWAY	**292**	**3,86**	**1,08**
Because I watch tennis matches with interest	292	4,24	0,65
Because I love tennis as a sport	292	4,38	0,55
Because I think my talents and skills are suitable for playing tennis	292	3,93	0,85

Because I find playing tennis aesthetic and attractive	292	4,32	0,67
LOVING TENNIS	**292**	**4,22**	**0,68**
To be able to do the same things and be together with my friends	292	4,03	0,71
To be able to do the same things and be together with my family	292	4,00	0,94
To be with others who enjoy doing the same things	292	4,19	0,69
SOCIALIZE	**292**	**4,07**	**0,78**
Because I think I am suitable for individual sports	292	3,73	0,90
Because I think I will be successful in racket sports	292	3,80	0,88
Because I can reach tennis facilities more easily	292	3,91	1,05
TRYING A NEW SPORT	**292**	**3,81**	**0,94**

The item codes and explanations of the factors that motivate individuals to start recreational tennis are given in Table 2. According to the table; In the first place is "physical health" (4.63±0.55), in the second place is "mental health" (4.61±0.60), in the third place is "renewal-development" (4.27±0.67), in the fourth place is "liking tennis" (4.22±0.68), in the fifth place is "socialization" (4.07±0.78), in the sixth place is "competition" (4.04±0.84), in the seventh place is "setting a good example" (3.96±0.99), in the eighth place is "distancing" (3.86±1.08), in the ninth place is "trying a new sport" (3.81±0.94), in the tenth place is "taking into consideration suggestions" (3.33±1.18), in the eleventh place is "recognition and social status" (3.12±1.15) and in the last place is "career expectations" (2.14±1.16).

Table 3. Difference analysis between the sub-dimensions of BRTBMFÖ and the gender variable.

Sub-Dimensions		Gender	N	Rank Average	Rank Total	Significance Test	Difference
Physical Health	A	Male	163	154,37	25161,50	Z=-1,903	
	B	Female	129	136,56	17616,50	p= 0,057	
Competition	A	Male	163	156,09	25443,00	Z=-2,221	A>B
	B	Female	129	134,38	17335,00	**p= 0,026***	
Recognition and Social Status	A	Male	163	136,93	22319,00	Z=-2,182	B>A
	B	Female	129	158,60	20459,00	**p= 0,029***	
Renewal / Development	A	Male	163	157,59	25686,50	Z=-2,689	A>B
	B	Female	129	132,49	17091,50	**p= 0,007***	
Mental Health	A	Male	163	148,82	24258,00	Z=-0,559	
	B	Female	129	143,57	18520,00	p= 0,576	
Career Expectations	A	Male	163	158,04	25760,50	Z=-2,687	A>B
	B	Female	129	131,92	17017,50	**p= 0,007***	
Considering Suggestions	A	Male	163	143,39	23372,50	Z=-0,717	
	B	Female	129	150,43	19405,50	p= 0,473	
Setting an Example	A	Male	163	148,66	24232,00	Z=-0,526	
	B	Female	129	143,77	18546,00	p= 0,599	
Staying Away	A	Male	163	148,95	24278,50	Z=-0,563	
	B	Female	129	143,41	18499,50	p= 0,574	
Loving Tennis	A	Male	163	157,26	25634,00	Z=-2,512	A>B
	B	Female	129	132,90	17144,00	**p= 0,012***	
Socializing	A	Male	163	146,16	23823,50	Z=-0,084	
	B	Female	129	146,93	18954,50	p= 0,933	
Trying a New Sport	A	Male	163	157,44	25662,50	Z=-2,530	A>B
	B	Female	129	132,68	17115,50	**p= 0,011***	

*p<0.05; Z= Mann-Whitney U Test; A=Male; B=Female

Table 3 shows the Mann-Whitney U Test results comparing the mean scores of veteran tennis players on the sub-dimensions of the BRTBMFÖ according to the gender variable. These results showed that the mean scores of the sub-dimensions of competition, recognition/social status, renewal/development, career expectations, liking tennis and trying a new sport branch differed significantly (P<0.05). Of these sub-dimensions, only recognition/social status showed a difference in favor of women, while differences were observed in favor of men in the other sub-dimensions.

Table 4. Difference analysis between the BRTBMFÖ sub-dimensions and the marital status variable.

Sub-Dimensions		Marital Status	N	Rank Average	Rank Total	Significance Test	Difference
Physical Health	A	Married	180	139,54	25118,00	Z=-1,898	
	B	Single	112	157,68	17660,00	p= 0,058	
Competition	A	Married	180	145,73	26232,00	Z=-0,200	
	B	Single	112	147,73	16546,00	p= 0,841	
Recognition and Social Status	A	Married	180	146,51	26371,00	Z=-0,001	
	B	Single	112	146,49	16407,00	p= 0,999	
Renewal / Development	A	Married	180	137,16	24689,00	Z=-2,555	B>A
	B	Single	112	161,51	18089,00	**p= 0,011***	
Mental Health	A	Married	180	155,98	28077,00	Z=-2,576	B>A
	B	Single	112	131,26	14701,00	**p= 0,010***	
Career Expectations	A	Married	180	135,36	24364,50	Z=-2,926	B>A
	B	Single	112	164,41	18413,50	**p= 0,003***	
Considering Suggestions	A	Married	180	155,76	28037,50	Z=-2,409	A>B
	B	Single	112	131,61	14740,50	**p= 0,016***	
Setting an Example	A	Married	180	156,19	28115,00	Z=-2,662	A>B
	B	Single	112	130,92	14663,00	**p= 0,008***	
Staying Away	A	Married	180	146,32	26337,00	Z=-0,048	
	B	Single	112	146,79	16441,00	p= 0,962	
Loving Tennis	A	Married	180	140,27	25248,50	Z=-1,640	
	B	Single	112	156,51	17529,50	p= 0,101	
Socializing	A	Married	180	152,92	27526,00	Z=-1,772	
	B	Single	112	136,18	15252,00	p= 0,076	
Trying a New Sport	A	Married	180	142,19	25595,00	Z=-1,123	
	B	Single	112	153,42	17183,00	p= 0,261	

*p<0,05; Z= Mann-Whitney U Test; A=Married; B=Single

Table 4 shows the Mann-Whitney U Test results comparing the mean scores of veteran tennis players on the sub-dimensions of the BRTBMFÖ according to the marital status variable. These results show that the mean scores of the sub-dimensions of renewal/development, mental health and career expectations differed significantly in favor of single tennis players, while the mean scores of the sub-dimensions of considering suggestions and being an example differed significantly in favor of married tennis players (P<0.05).

Table 5. Difference analysis between the sub-dimensions of the BRTBMFÖ and the education status variable.

Sub-Dimensions		Education Status	N	Rank Average	Significance Test	Games-Howell Difference Test
Physical Health	A	High School	69	133,05	X^2 =2,9 p= 0,235	
	B	Undergraduate	174	152,21		
	C	Postgraduate	49	145,15		
Competition	A	High School	69	135,45	X^2=1,6 p= 0,449	
	B	Undergraduate	174	149,83		
	C	Postgraduate	49	150,22		
Recognition and Social Status	A	High School	69	161,91	X^2=3,5 p= 0,171	
	B	Undergraduate	174	139,59		
	C	Postgraduate	49	149,33		
Renewal / Development	A	High School	69	124,46	X^2=11,07 **p= 0,004***	C>A C>B
	B	Undergraduate	174	147,65		
	C	Postgraduate	49	173,47		
Mental Health	A	High School	69	138,41	X^2=1,65 p= 0,438	
	B	Undergraduate	174	146,60		
	C	Postgraduate	49	157,55		

Career Expectations	A	High School	69	136,17	X^2=6,24 **p= 0,044***	B>A
	B	Undergraduate	174	156,14		
	C	Postgraduate	49	126,83		
Considering Suggestions	A	High School	69	176,20	X^2=12,55 **p= 0,002***	A>B A>C
	B	Undergraduate	174	140,37		
	C	Postgraduate	49	126,46		
Setting an Example	A	High School	69	144,46	X^2=0,65 p= 0,723	
	B	Undergraduate	174	144,98		
	C	Postgraduate	49	154,78		
Staying Away	A	High School	69	143,59	X^2=4,89 p= 0,087	
	B	Undergraduate	174	153,89		
	C	Postgraduate	49	124,34		
Loving Tennis	A	High School	69	110,24	X^2=17,89 **p= 0,000***	C>A C>B
	B	Undergraduate	174	155,98		
	C	Postgraduate	49	163,89		
Socializing	A	High School	69	144,07	X^2=4,53 p= 0,104	
	B	Undergraduate	174	141,37		
	C	Postgraduate	49	168,13		
Trying a New Sport	A	High School	69	138,99	X^2=2,88 p= 0,237	
	B	Undergraduate	174	144,51		
	C	Postgraduate	49	164,15		

*p<0,05; X^2: Kruskal Wallis-H test; A=High School; B=Undergraduate; C=Postgraduate

Table 5 shows the Kruskal Wallis-H test results showing the comparison of the mean scores of veteran tennis players on the sub-dimensions of BRTBMFÖ according to the educational status variable. These results showed that the mean scores of the sub-dimensions of renewal/development, career expectation, considering suggestions and liking tennis differed significantly (P<0.05). The mean scores of the tennis players with postgraduate education on the sub-dimensions of renewal/development and liking tennis were significantly higher than those of tennis players with high school and undergraduate education; the mean scores of the tennis players with undergraduate education on the sub-dimension of career expectation were significantly higher than those of tennis players with high school education; and the mean scores of the tennis players with undergraduate education on the sub-dimension of considering suggestions were significantly higher than those of tennis players with undergraduate and graduate education (p<0.05).

Table 6. Difference analysis between the BRTBMFÖ sub-dimensions and the occupational status variable.

Sub-Dimensions		Occupational Status	N	Rank Average	Significance Test	Games-Howell Difference Test
Physical Health	A	Public	58	141,43	X^2=7,47 p= 0,113	
	B	Private sector	113	160,11		
	C	Freelance	70	143,76		
	D	Housewife	28	119,64		
	E	Retired	23	133,46		
Competition	A	Public	58	148,66	X^2=15,79 **p= 0,003***	D<B D<C
	B	Private sector	113	151,75		
	C	Freelance	70	164,99		
	D	Housewife	28	101,43		
	E	Retired	23	113,87		
Recognition and Social Status	A	Public	58	157,12	X^2=6,13 p= 0,190	
	B	Private sector	113	155,68		
	C	Freelance	70	130,44		
	D	Housewife	28	144,04		
	E	Retired	23	126,48		
Renewal / Development	A	Public	58	149,86	X^2=13,45 **p= 0,009***	B>D
	B	Private sector	113	146,12		
	C	Freelance	70	166,15		

	D	Housewife	28	103,32		
	E	Retired	23	132,67		
Mental Health	A	Public	58	151,31	X^2=1,13 p= 0,890	
	B	Private sector	113	149,52		
	C	Freelance	70	141,01		
	D	Housewife	28	136,82		
	E	Retired	23	148,00		
Career Expectations	A	Public	58	122,78	X^2=11,87 **p= 0,018***	B>A B>C
	B	Private sector	113	165,12		
	C	Freelance	70	138,88		
	D	Housewife	28	134,54		
	E	Retired	23	152,61		
Considering Suggestions	A	Public	58	141,48	X^2=18,35 **p= 0,001***	D>A D>B D>C D>E
	B	Private sector	113	159,52		
	C	Freelance	70	122,24		
	D	Housewife	28	187,82		
	E	Retired	23	118,72		
Setting an Example	A	Public	58	161,26	X^2=3,38 p= 0,496	
	B	Private sector	113	138,14		
	C	Freelance	70	147,17		
	D	Housewife	28	150,07		
	E	Retired	23	143,96		
Staying Away	A	Public	58	149,55	X^2=4,75 p= 0,314	
	B	Private sector	113	151,72		
	C	Freelance	70	147,55		
	D	Housewife	28	145,89		
	E	Retired	23	110,70		
Loving Tennis	A	Public	58	140,81	X^2=12,39 **p= 0,015***	D<B D>C
	B	Private sector	113	158,51		
	C	Freelance	70	154,97		
	D	Housewife	28	102,50		
	E	Retired	23	129,63		
Socializing	A	Public	58	138,09	X^2=3,51 p= 0,477	
	B	Private sector	113	145,00		
	C	Freelance	70	157,70		
	D	Housewife	28	132,57		
	E	Retired	23	157,98		
Trying a New Sport	A	Public	58	149,71	X^2=6,73 p= 0,151	
	B	Private sector	113	146,86		
	C	Freelance	70	150,80		
	D	Housewife	28	111,07		

*p<0,05; X^2: Kruskal Wallis-H test; A=Public; B=Private sector, C=Self-employed; D=Housewife; E=Retired

Table 6 shows the Kruskal Wallis-H test results showing the comparison of the mean scores of veteran tennis players on the sub-dimensions of BRTBMFÖ according to the occupational status variable. These results show that the mean scores of the sub-dimensions of competition, renewal/development, career expectation, considering suggestions and liking tennis differ significantly (P<0.05). It was determined that the mean scores of the sub-dimensions of competition and liking tennis were lower in housewife tennis players than in the private sector and self-employed/own-employed tennis players; the mean scores of the renewal/development sub-dimension were higher in private sector tennis players than in housewife tennis players; the mean scores of the career expectation sub-dimension were higher in private sector tennis players than in the public and self-employed tennis players; and the mean scores of the sub-dimension of considering suggestions were higher in housewife tennis players than in other occupational groups (p<0.05).

Table 7. Difference analysis between the BRTBMFÖ sub-dimensions and the perceived income level variable.

Sub-Dimensions		Perceived Income Level	N	Rank Average	Significance Test	Games-Howell Difference Test
Physical Health	A	Low	20	168,60	X^2=5,13 p= 0,077	
	B	Medium	241	141,66		
	C	High	31	169,85		
Competition	A	Low	20	113,60	X^2=3,398 p= 0,183	
	B	Medium	241	148,65		
	C	High	31	151,00		
Recognition and Social Status	A	Low	20	154,50	X^2=2,93 p= 0,231	
	B	Medium	241	148,94		
	C	High	31	122,35		
Renewal / Development	A	Low	20	109,25	X^2=6,55 **p= 0,038***	B>A
	B	Medium	241	146,93		
	C	High	31	167,19		
Mental Health	A	Low	20	164,50	X^2=1,19 p= 0,552	
	B	Medium	241	144,64		
	C	High	31	149,35		
Career Expectations	A	Low	20	82,80	X^2=14,20 **p= 0,001***	B>A
	B	Medium	241	153,30		
	C	High	31	134,69		
Considering Suggestions	A	Low	20	159,15	X^2=5,02 p= 0,081	
	B	Medium	241	149,42		
	C	High	31	115,63		
Setting an Example	A	Low	20	179,05	X^2=3,83 p= 0,147	
	B	Medium	241	144,83		
	C	High	31	138,45		
Staying Away	A	Low	20	150,35	X^2=9,02 **p= 0,011***	B>C
	B	Medium	241	151,66		
	C	High	31	103,89		
Loving Tennis	A	Low	20	135,50	X^2=0,57 p= 0,753	
	B	Medium	241	146,54		
	C	High	31	153,27		
Socializing	A	Low	20	111,90	X^2=5,04 p= 0,081	
	B	Medium	241	147,45		
	C	High	31	161,40		
Trying a New Sport	A	Low	20	128,20	X^2=3,78 p= 0,151	
	B	Medium	241	150,84		
	C	High	31	124,60		

*p<0,05; X^2: Kruskal Wallis-H test; A=Low; B=Medium; C=High

Table 7 shows the Kruskal Wallis-H test results showing the comparison of the mean scores of veteran tennis players on the sub-dimensions of the BRTBMFÖ according to the perceived income level variable. These results showed that the mean scores of the sub-dimensions of renewal/development, career expectation and moving away differed significantly (P<0.05). It was determined that the mean scores of the sub-dimensions of renewal/development and career expectation were higher in middle-income tennis players than in low-income tennis players; and the mean scores of the moving away sub-dimension were higher in middle-income tennis players than in high-income tennis players (p<0.05).

DISCUSSION AND CONCLUSION

This study aimed to determine the factors that motivate veteran tennis players to start recreational tennis. As a result of the study, a significant difference was found between the competition sub-dimension and the variables of gender and occupational status; between the recognition/social status and trying a new sport sub-

dimensions and the gender variable; between the renewal/development and career expectation sub-dimensions and the variables of gender, marital status, educational status, occupational status and income level; between the mental health and being an example sub-dimensions and marital status; between the considering suggestions sub-dimension and the variables of marital status, educational status and occupational status; between the distancing sub-dimension and the variables of income level; between the liking tennis sub-dimension and the variables of gender, educational status and occupational status.

In Turkey, it is seen that family is the most important encouraging factor in athletes who do performance tennis starting sports, and also that loving tennis, being a national team athlete, being a well-known athlete and wanting to study at university level are important factors in doing tennis. However, it has been revealed that physical education teachers do not have much of an effect on athletes who do tennis (32). The most important reasons for turning to tennis are; family encouragement at the student level, the effect of mass media, the effect of the group of friends, sports activities in the environment and interest in tennis in the environment, the need to move and health. Expectations from tennis are listed as having a good physical appearance, relieving stress, relaxing, free time activity, playing games, having fun, increasing performance, gaining a new environment and gaining status (17). Among the athletes participating in inter-university tennis competitions, the most important reasons for turning to tennis are family (31.9%), followed by the desire to be a world-famous athlete (27.2%) and to play in the national team (26.5%). On the other hand, when the reasons for athletes to engage in tennis professionally are examined, it is seen that loving tennis (44.4%), enjoying success (35.8%), being healthy by doing sports (33.8%) and finding happiness in this sport (33.8%) come to the fore. The opinions of the athletes regarding their expectations from tennis are, in order of importance, being healthy and maintaining health (42.4%), having a good physical appearance (33.1%) and receiving education scholarships from universities abroad thanks to tennis (31.6%) (23). It has been determined that the physical education teacher, friends and peer group and the environment in which university students start playing tennis are effective, respectively. It has been found that students play tennis for the purposes of being healthy by doing sports, making good use of their free time, liking tennis and being aware of the positive contributions of sports (30). In the research examining the frequency values of the motivation factors that play a role in young people's choosing tennis, the first three places were taken as wanting to improve skills (88.7%), liking fun (73%) and wanting to be with friends (70%) (9). It was determined that the main reasons for licensed tennis athletes to choose tennis were 28.5% because of their families, 17.3% because they liked a famous tennis player, 16.3% because of their physical education teacher, 15.2% because of a coach they knew in their close circle, 13.1% because of the press and media, 5.6% because of their circle of friends, 4% because of the environment they lived in and 0.1% because of other reasons (19). In the ranking of the factors that motivate an individual to start recreational tennis, physical health ranked first, mental health ranked second, and liking tennis ranked third (2). In the current study, the first three places in the ranking of the factors that motivate veteran tennis players to start recreational tennis were physical health, mental health, and renewal-development factors. The majority of the study results obtained as a result of the literature review are similar to the findings of the current study.

As a result of comparing the factors that motivate individuals to start playing tennis according to gender, it was found that there was a significant difference in favor of women in the sub-dimensions of physical health, renewal-development, mental health and career expectations (1). A significant difference was found in favor of men between the answers given to the questions of enjoying success and acting in a team spirit with friends among the reasons for professionally engaging in boxing and the gender variable (18). As a result of investigating whether the reasons for athletes with an athletics license to engage in athletics differed according to gender, significant differences were found in favor of women athletes in the sub-dimensions of loving athletics and being recognized, loved and respected by friends as an athlete, and in favor of men athletes in the dimension of acting in a team spirit with friends (28). When the reasons for athletes who actively do rafting and canoeing to start sports are examined, it is seen that the effect of being healthy by doing sports is greater in male athletes than in female athletes. Among the expectations of athletes from sports, having a good physical appearance is more important for male athletes than for female athletes (10). Significant differences were found in the dimensions of increasing financial income, loving volleyball and being healthy by playing volleyball among the reasons for playing volleyball according to the gender variable (6). Görgüt (16), who examined the sub-dimensions of participation in sports according to the gender of handball players, stated

that both women and men had the highest scores in the entertainment sub-dimension. Similarly, Scanlan et al. (27) stated that the most important factor in participation in sports was entertainment. In a study involving primary school students, it was seen that women started sports for the purpose of being healthy and male athletes for the purpose of hobby and entertainment (20). It was found that there were statistically significant differences in terms of the entertainment sub-dimension and competition sub-dimension of badminton athletes according to their gender. No statistically significant difference was found in terms of the other sub-dimensions (31). In a different study, the factors affecting the motivation of badminton athletes to participate in sports were found to be statistically significant according to the gender variable in the sub-dimensions of success/status, physical fitness, friendship, fun and skill development (12). Unlike the findings of this research, no statistically significant difference was found between the gender variable and the reasons and expectations for starting sports in performance swimmers (8), athletes interested in racket sports (19,29) and students studying at physical education and sports schools (in the sub-dimensions of encouragement to sports, involvement in sports, expectation from sports) (7). In the current study, a significant difference was found between the mean scores of the sub-dimensions of competition, recognition/social status, renewal/development, career expectations, liking tennis and trying a new branch of sports and the gender variable. The desire of women to be recognized by others and to gain social status compared to men; It has been observed that the sense of competition, the individual's desire to renew and improve himself, career expectations, liking tennis and the individual's desire to try a new branch of sport are higher in men than in women.

In a study examining the factors that motivate individuals to start recreational tennis according to marital status, a significant difference was found in the career expectations and role model sub-dimensions. It was reported that singles had higher career expectations than marrieds, and that marrieds wanted to be role models for people around them than singles (1). A significant difference was found between the physical fitness sub-dimension and marital status among sports participation motivations in European underwater hockey athletes. The physical fitness score averages of single athletes were found to be higher than those of married athletes (3). Unlike the results of this study, when the changes in the levels of sports participation motivation in underwater hockey athletes were examined according to marital status, it was observed that there was no difference in the skill development, team spirit, entertainment, success, physical fitness, competition, movement and friendship sub-dimensions (5). In the current study, a significant difference was found between the score averages of the sub-dimensions of renewal/development, mental health, career expectations, considering suggestions and role model and marital status. It has been determined that the individual's desire to renew and improve himself, the individual's feeling of well-being mentally and the individual's career expectations are higher in single tennis players compared to married tennis players; the individual's taking into consideration the suggestions made and the individual's desire to be an example to the people around him are higher in married tennis players compared to single tennis players.

The increase in the level of education can be considered among the factors that positively affect the demand for sports (13). Similarly, the desire and desire of people with a higher level of education to actively participate in sports is higher than those with a lower level of education (25). In a study examining the reasons for cricket players to start playing cricket, it is stated that factors such as turning to cricket and being involved in it are the reasons for preference as the level of education increases. A statistically significant difference was found in the reasons for cricket players to start playing sports at the level of education. This difference was seen between the reasons for university graduates to start playing sports and high school graduates and primary school graduates (15). It was observed that the most important factors in the motivations for participation in sports according to the education levels of ice hockey players in Turkey were “success/status, physical fitness/energy expenditure, team membership/spirit, competition and movement/being active” (4). As a result of comparing the factors that motivate individuals to start recreational tennis according to their level of education, a significant difference was found in the career expectation sub-dimensions, and it was stated that this difference was in favor of those with a high school equivalent or below education level (1). Contrary to the results of this study, no significant relationship was found between the reasons for engaging in the relevant branch and the level of education in triathlon athletes (24), boxers (18) and badminton players (31). In the current study, it was found that the mean scores of the sub-dimensions of renewal/development, career expectation, considering suggestions and liking tennis differed significantly according to the

educational status variable. The levels of desire to renewal and development and liking of tennis of tennis players with postgraduate education were higher compared to tennis players with high school and undergraduate education; The career expectations of tennis players with undergraduate education were higher compared to tennis players with high school education; It was found that tennis players with undergraduate education were significantly more likely to take the recommendations into consideration than tennis players with undergraduate and graduate education.

As a result of comparing the factors that motivate individuals to start recreational tennis according to professions, significant differences were found in the sub-dimensions of career expectations, considering suggestions, trying a new sport branch and moving away (1). According to the professions that handball players want to choose, a significant difference was found only in the entertainment sub-dimension of sports participation (16). In a different study, significant differences were found between the entertainment sub-dimension and physical fitness sub-dimension of the athletes' career choice in their later lives and the motivation for sports participation scale, while no significant difference was found in terms of the other sub-dimensions (31). In the current study, a significant difference was found between the mean scores of the sub-dimensions of competition, renewal/development, career expectations, considering suggestions and liking tennis and their occupational status. The sense of competition and the levels of liking tennis of housewife tennis players were lower compared to tennis players in the private sector and self-employed groups; The desire of tennis players working in the private sector to renewal and development was higher compared to housewife tennis players; It has been found that the career expectations of tennis players working in the private sector are higher than those of tennis players in the public and freelance professions; and that housewife tennis players are more likely to take suggestions into consideration than tennis players in all other professions.

In a study, it was concluded that there was a significant difference between the economic levels of students' families and their preference for tennis. It was observed that children who preferred tennis preferred tennis to children of families with good and very good economic conditions (33). When the sports participation motivation levels of athletes interested in racket sports were examined according to their income levels, a significant difference was found in the skill, friendship, movement and physical fitness sub-dimensions (29). A significant difference was observed between the monthly personal income of individuals and the career expectation sub-dimension, which is one of the factors that motivate them to start recreational tennis (1). A significant difference was found only between the monthly income variable of underwater hockey athletes and the skill development sub-dimension, which is one of the factors that motivate them to participate in sports (3,5). A significant relationship was found when the average of the reasons for starting running sports was compared in terms of monthly total income level (25). In some studies, it has been determined that there is no significant difference between the motivation to turn to the relevant sports branch and the income levels of the athletes (19,31). In the current study, a significant difference was found between the mean scores of the sub-dimensions of renewal/development, career expectation and moving away and the perceived income level. It was observed that the desire to renew and develop oneself and career expectations of middle-income tennis players were higher than those of low-income tennis players; and the desire to get away from the routine of daily life of middle-income tennis players was higher than those of high-income tennis players.

The study has some limitations. It is thought that it would be useful to examine different sociodemographic characteristics in addition to the existing demographic variables with a larger sample group in future studies on this subject.

As a result of the study, the first three places in the ranking of the factors that motivate veteran tennis players to start recreational tennis were physical health, mental health and renewal-development factors. In addition, it can be said that the factors that motivate veteran tennis players to start recreational tennis are affected by some demographic factors.

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Architectural Discourse and Spatial Reality: A Critical Approach to Stadium Architecture

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Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.

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Abstract

This study aims to examine the relationship between the discourse articulated by architects and the resulting physical products in stadium buildings constructed in the 21st century. A total of ten stadiums—eight from Turkey and two from abroad—are evaluated based on six main criteria: urban integration, symbolic value, multi-functionality, environmental impact, sustainability, and transportation. Through a "critical" perspective, the analysis compares the architect's discourse, the stated objectives of the project, and the actual outcomes of the built structures. The findings indicate that many stadiums built in Turkey over the past two decades have been primarily assessed in terms of technical adequacy and increased capacity. However, concepts such as sustainability, multifunctionality, and urban integration often remain superficial. In contrast, international examples demonstrate a more apparent implementation of conceptual coherence, energy efficiency, and user-oriented design principles. The study concludes that the conceptual goals expressed by architects do not always align with the functional and spatial outcomes of the buildings. It emphasizes that the consistency between discourse and practice should be addressed more carefully, especially in projects funded by public resources. In this context, the importance of designing future stadiums as integrated, sustainable, multifunctional, and vibrant public spaces is reasserted.

Keywords: Stadium Architecture, Discourse-Practice Consistency, Critique

Özet

Mimarlık Söylemi ve Mekansal Gerçeklik: Stadyum Mimarisine Eleştirel Bir Yaklaşım

Bu çalışma, 21. yüzyılda inşa edilen stadyum yapılarında mimarların dile getirdiği söylemler ile ortaya çıkan fiziksel ürün arasındaki ilişkiyi irdelemeyi amaçlamaktadır. Türkiye'den sekiz ve yurt dışından iki olmak üzere toplam on stadyum, kente entegrasyon, simgesel değer, çok amaçlı kullanım, çevresel etki, sürdürülebilirlik ve ulaşım gibi altı temel kriter çerçevesinde değerlendirilmiştir. "Eleştiren" bir bakış açısıyla yürütülen analizlerde, mimarın söylemi, projedeki hedefler ve ortaya çıkan yapının gerçek çıktıları karşılaştırmalı olarak incelenmiştir. Elde edilen bulgular, Türkiye'de son yirmi yılda inşa edilen birçok stadyumun yalnızca teknik yeterlilik ve kapasite artışı üzerinden değerlendirildiğini, ancak sürdürülebilirlik, çok yönlü işlevsellik ve kentsel entegrasyon gibi kavramların çoğunlukla yüzeysel kaldığını göstermektedir. Uluslararası örneklerde ise kavramsal bütünlük, enerji etkinliği ve kullanıcı odaklı tasarım ilkelerinin daha belirgin biçimde hayata geçirildiği gözlemlenmiştir. Çalışma sonucunda, mimarların ifade ettikleri kavramsal hedeflerin yapıların işlevsel ve mekânsal çıktılarıyla tam olarak örtüşmediği; söylem-eylem tutarlılığının, özellikle kamu kaynaklarıyla inşa edilen yapılarda daha dikkatli ele alınması gerektiği vurgulanmaktadır. Bu doğrultuda, gelecek stadyum tasarımlarında kentle bütünleşik, sürdürülebilir, çok amaçlı ve yaşayan kamusal mekânlar üretmenin önemi yeniden ortaya konmuştur.

Anahtar Kelimeler: Stadyum Mimarisi, Söylem-Eylem Tutarlılığı, Eleştiri

INTRODUCTION

Football, the most popular sport of the 21st century, appeals to wide audiences due to its ease of understanding and accessibility through mass media (16). With the rapid growth of the football industry, modern stadiums capable of serving large crowds have been constructed in recent years. As technology has advanced, stadiums with diverse architectural designs have begun to occupy significant space in urban plans, influencing numerous factors such as transportation and infrastructure (4). Major events like the 2010 South Africa, 2014 Brazil, 2018 Moscow, and 2022 Qatar World Cups have also contributed significantly to the infrastructure of host cities and countries (20).

In antiquity, the term stadium referred to a complex consisting of an open racecourse for athletic competitions—often held as sacred events—and the surrounding seating areas for spectators (12). The earliest examples of stadium architecture are found in Ancient Greek architecture, and similar structures are frequently observed in Roman urban plans (8). In modern terms, a stadium is defined as an open or semi-enclosed sports facility constructed in accordance with international regulations, comprising a football field surrounded by athletics tracks and spectator seating areas, along with the service spaces required for their operation (25). More broadly, it refers to a specially designed venue for hosting various sports events (28). The first examples of modern stadium architecture appeared in the late 1700s and throughout the 1800s in countries such as Spain, France, and Portugal (22). Compared to Greek and Roman stadiums, significant differences can be observed in construction technology and site placement, as well as in usage purposes—these earlier stadiums were primarily built for bullfighting. One of the earliest examples of a modern stadium is the Real Maestranza de Sevilla, constructed in 1761 in Seville, Spain, with a capacity of 12,500 spectators (33).

After 1900, with the development of industry and technology, stadium construction accelerated rapidly, particularly in Europe. The stadiums built during this period differed significantly from those of previous eras in terms of architectural characteristics. One of the most notable changes was the introduction of roof structures covering the spectator areas (33). In the 21st century, stadiums in Europe and other parts of the world have increasingly been designed solely for football. The stadiums built for the UEFA Euro 2000 championship are considered important pioneers of modern stadium design. One early example of a stadium with a retractable roof is the Amsterdam Arena, built in Amsterdam in 1996, with a capacity of 51,324 spectators. The stadium was designed exclusively for football. Another prominent example of modern stadium architecture that blends past architectural forms with contemporary technology is the Busan Asiad Main Stadium in South Korea. With a capacity of 55,982, this stadium has served as an example of innovative roof structures in stadium design (33).

By the 21st century, stadium architecture had undergone a significant transformation. Unlike the multipurpose stadiums typical of the mid-20th century, modern stadiums are increasingly designed as specialized venues. The global growth of football and the large investments in the sport have led to the construction of stadiums dedicated solely to football. From antiquity to the present day, stadiums have evolved from mere sports arenas into structures that reflect collective memory, architectural development, and technological advancement (23). Especially in the 21st century, with increasing urbanization and architectural diversity on a global scale, stadiums are no longer seen merely as sports facilities but also as public spaces, cultural centers, and urban landmarks (6).

In Turkey, the first example of a multipurpose stadium is the Atatürk Olympic Stadium, built in 2001. With a seating capacity of 82,576, it is the largest stadium in the country. The stadium is equipped with infrastructure that allows it to host a wide range of events—from amphitheater performances to educational activities (34).

The primary aim of this study is to examine the relationship between what architects "claim" and what is actually "delivered" to users and cities through the analysis of ten stadiums built over the last 20 years. The study focuses on a total of ten stadiums eight from Turkey (Beşiktaş, Konya, Gaziantep, Kayseri, Kocaeli, Sakarya, Sivas, and Mersin) and two international examples (Atlanta and Bordeaux). The selection was made to allow for a comparative evaluation within a global context.

From Turkey, eight stadiums constructed after 2005 were chosen, representing different geographical regions and featuring publicly available architectural discourses. These stadiums were selected due to their status as state-supported transformation projects and their influence on the development of sports architecture in Turkey. On the international scale, two stadiums—Atlanta and Bordeaux—were selected for their conceptual architectural approaches, their frequent citation in architectural literature, their award-winning status (35, 36), and their role as influential examples in contemporary stadium architecture. These structures are considered notable for their technological innovations, sustainability practices, and urban integration strategies, making them exemplary representations of 21st-century stadium design.

This selection enables a comparative analysis of local policies implemented in different Turkish cities alongside current global architectural trends, thus offering a platform for both internal and external evaluation.

The selected stadiums were analyzed in conjunction with public statements made by their architects and assessed based on architectural design, relationship with the city, functionality, energy efficiency, and accessibility.

Within this framework, the study seeks to answer the following questions:

- To what extent does 21st-century stadium architecture align with the conceptual, technical, and social goals articulated by architects?
- How successfully have the architects' stated discourses been realized, and which projects have effectively achieved coherence between discourse and practice?

Adopting a critical perspective, the study evaluates the selected stadiums based on six main criteria:

- Location in relation to the city
- Iconic/symbolic architectural qualities
- Alternative uses beyond sports events
- Shading and impact on the surrounding environment
- Use of contemporary materials and energy efficiency
- Ease of transportation and accessibility

As a result of these evaluations, the study demonstrates that stadium architecture should not be assessed solely in terms of form and aesthetics, but also in relation to its connection with the urban fabric, its social functionality, and its approach to sustainability.

METHOD

This study adopts a qualitative research method with the aim of examining the relationship between discourse and practice in architectural works. The central approach of the research is to evaluate the selected stadiums not only through their physical or technical attributes but also through a comparative analysis of the architects' statements and the actual spatial, functional, and social outcomes of the constructed buildings. Accordingly, a critical reading model was developed, and the analysis process was structured around a "critical" perspective.

In this context, the term "critical" refers to an approach that is free from bias or affiliation, one that questions through independent thinking and produces alternative viewpoints. The evaluation thus aims to consider not only the technical or formal data of the stadiums but also qualities such as urban context, social functionality, and sustainability.

The study sample was designed to examine the discourse-practice relationship in stadium architecture both on a national and international scale.

Evaluation Model:

Within the scope of the research, each stadium was analyzed on three fundamental levels:, Architect's Discourse: The architect's statements, conceptual approach, and stated objectives, Project: The planning, functional layout, and technical solutions of the design, Built Product: The final physical structure and the experiential outcomes delivered to users

These three levels were comparatively assessed using a matrix based on six key questions:

1. Urban Location: The spatial relationship between the stadium and the city, distance from the center, and its impact on the urban silhouette

2. Iconic/Symbolic Value: The alignment between the architect's conceptual intent and the building's symbolic presence in the urban memory

3. Alternative Uses Beyond Sports: The stadium's potential for multi-purpose use, continuity of activity, and public engagement

4. Impact on Surrounding Environment: The structure's scale and its shadowing or dominating effect on nearby buildings and public spaces

5. Contemporary Materials and Energy Efficiency: Material technologies used, sustainability practices, and certifications

6. Accessibility: Availability of public transportation, ease of access, and diversity of transit options

Through this matrix, a comparative analysis of the ten stadiums was conducted, and consistency between discourse and action was assessed. At the conclusion of the evaluation, the stadiums were ranked according to their strengths and weaknesses, resulting in a comprehensive overview.

FINDINGS

Contemporary stadium architecture stands out as a multi-layered building typology, both functionally and symbolically. Today, the success of a stadium is not measured solely by its capacity or architectural form, but also by its contribution to the city, sustainability, multi-functionality, and user experience. Architectural discourses are no longer limited to aesthetic or structural analyses; they must also address social, ecological, and technological parameters.

Annual competitions that rank the "most popular" or "best" stadiums are often based largely on visual surveys. A significant portion of the participants in these competitions are individuals without architectural education, and their evaluations are mostly based on the appearance of the stadium façades. However, stadiums constructed using contemporary building technologies and modern materials have multidimensional impacts that go far beyond aesthetics—such as integration with the urban fabric, environmental effects, and contributions to urban life. These dimensions have not been sufficiently addressed in the academic literature and remain underexplored from a scientific perspective. This highlights the need for a comprehensive architectural and urban analysis of stadium structures (4). At this point, the consistency between the discourses expressed by architects and the spatial and functional realities of the final product becomes critically important.

Stadium architecture should not be considered solely as a functional or structural design challenge; rather, it is a complex form of spatial production that must be examined within the contexts of representation, urban memory, power dynamics, and collective identity. This study questions the degree of alignment between the architectural "discourse" expressed during the design process and the "actions"—namely, the physical and functional outcomes—of the completed structures. This approach is closely related to critical theories in architecture that view the practice not merely as the production of form, but also as the production of meaning and value.

1. Location within the City: The Physical and Monumental Relationship with the Urban Context

The placement of stadiums within the urban fabric is significant not only in terms of accessibility, but also with regard to the historical, physical, and symbolic relationship the structure establishes with the city. This

criterion includes evaluations such as proximity to the city center, impact on the skyline, relationship with surrounding buildings, and distance to public spaces (7).

With the growing awareness of the importance of sustainable development by public institutions and stakeholders, the environmental impacts of stadiums that host large-scale sports events are being taken into greater consideration. Depending on their location, stadiums are generally categorized as either urban (inner-city) or suburban (peripheral) structures (6). Inner-city stadiums, particularly when designed with integrated recreational areas, can create new urban focal points that contribute to city branding and enhance tourism potential. Their strong relationship with the city also provides strategic advantages for hosting international events (7).

On the other hand, suburban stadiums are often preferred for their ability to minimize issues such as traffic congestion, noise pollution, and land costs. These structures are typically connected to city centers via rail systems. Before the 2000s, such locations were more commonly preferred, especially in light of compliance with UEFA and FIFA standards (46).

However, large-scale stadiums are not limited to hosting sports events; they often offer multi-purpose usage such as museums or social spaces, and thus exert significant physical and social influence on their surroundings (2). In this context, if environmental impact assessments are not conducted rigorously, such structures may lead to urban issues such as traffic congestion or irregular urban development.

The Beşiktaş Stadium was built on the site of the historic İnönü Stadium, directly across from the Dolmabahçe Palace, a prominent element of Istanbul's historical memory. As a structure that integrates harmoniously with the city's silhouette, it has established a strong connection with the urban context. The design carefully limited the building's height to avoid overshadowing neighboring historical buildings, which demonstrates a deliberate and sensitive urban-architectural relationship. It is considered the most positive example in this regard.

The Atlanta Stadium, located 1.5 km from the city center, has formed both a symbolic and functional center. Its location has been evaluated positively in terms of both accessibility and urban significance (37).

Most of the Anatolian stadiums—such as those in Sakarya, Sivas, Kocaeli, Mersin, and Gaziantep—are situated 3 to 9 km from their respective city centers. These structures were generally constructed in areas that are not integrated with the city and lack surrounding development. Consequently, they fail to become part of daily urban life, weakening their potential as public spaces (37).

Although the Kayseri and Konya stadiums are also located 7 to 9 km from the city center, they are considered advantageously positioned due to their accessibility via rail systems (37).

The Bordeaux Stadium is located on the northern edge of the city. Despite its distance from the city center, the strong relationship it establishes with the surrounding landscape balances this disadvantage. Architecturally, the stadium successfully connects with its natural environment (37).

Table.1. Location within the City (37)

Stadium	Photograph	Proximity to the City Center	Urban Integration
Beşiktaş		High	High
Atlanta		Medium- High	High
Bordeaux		Low	Integration with the landscape
Kayseri, Konya		Medium	Supported by transportation infrastructure
Sakarya, Gaziantep, Kocaeli, Sivas, Mersin		Low	Urban connection is weak

2. Iconic / Symbolic Architectural Quality: Conceptual Power and Urban Representation

Hasol (2010) defines the concept of the icon as sacred depictions used for both worship and religious instruction in Orthodox Christianity, emphasizing that icons were historically associated with sanctity (15). However, in contemporary discourse, the concept of the icon is more commonly used to mean "symbol," "visual sign," or "indicator," having moved away from its sacred context to acquire new functions across various disciplines.

With societal, political, and economic transformations, icons—once representations of authoritative power—have evolved into city icons shaped by capital. These structures gain significance not only through their physical attributes but also by contributing to the construction of the city's image and leaving a lasting impression on collective memory. Lynch (2016) argues that a city's memorability is shaped through the relationships among its components—such as buildings, squares, shops, and urban furniture—and describes "landmarks" as focal points that help orientation and create new centers in the urban fabric(19).

In the 21st century, as cities become increasingly globalized and homogenized due to advances in technology and transportation, many strive to secure a place in the global economy either through trend-setting iconic projects or by emphasizing historical urban layers. Jencks (2006) defines the transformative impact of Frank Gehry's Guggenheim Museum in Bilbao as the "Bilbao Effect," where a single building elevates a city's global profile—a model that many cities, large and small, have since sought to replicate(17). The Sydney Opera House, the Centre Pompidou in Paris, and Gehry's Guggenheim in Bilbao are often cited as such symbolic structures (1).

According to Jencks (2006), these buildings are typically located within walking distance of city centers and near bodies of water(17). They are shaped by a search for originality and innovation, often favoring visual impact over functionality. Although such designs may initially face public resistance (as in the case of Sydney), they frequently evolve into symbols of local pride and regional identity. In this context, cities' ambitions to

"put themselves on the map" through iconic architecture are directly tied to long-term tourism growth and sustained economic gain. Sklair (2005) notes that since the 1950s the driving force behind these iconic structures has shifted from the state or religious institutions to the global capitalist class, their transformative impact on urban identity remains potent(26).

In recent years, international stadium architecture has witnessed a shift away from purely functional approaches. New-generation stadiums reflect a broader trend toward creating iconic structures within the global competition among cities and institutions (32). These iconic stadiums stand out not only due to their architectural originality but also because of their potential to attract interest beyond their immediate regions.

Many sports venues have become new symbols of the cities in which they are located, increasing both their international recognition and prestige (24). A structure's symbolic value lies not just in its striking form but in its references to the city's cultural and historical context, offering an interpretation of the city through the architect's conceptual approach. In this context, the conceptual backgrounds of the stadiums discussed in this study, and their alignment with the architects' discourse, are evaluated under this heading.

The Atlanta Stadium draws inspiration from the Pantheon in its architecture, featuring a retractable roof system designed like a camera lens. Composed of octagonal ETFE panels, the dynamic and movable roof provides a kinetic expression. This technological concept renders the building not only functional but also an iconic and monumental structure, transforming it into a city-scale symbol. It possesses the highest symbolic potential among the examples.

The Bordeaux Stadium, with its thin columns inspired by the surrounding forested landscape, makes a reference to classical temples. Its emphasis on architectural purity and geometric clarity invites comparisons to traditional temple typologies. In this respect, the structure emerges as an elegant and poetic image that stands out in the architectural memory of the city.

The Gaziantep Stadium uses a design language on its facade that references the mosaics of Zeugma, thereby making a cultural connection to the city. However, this conceptual aspect remains limited to the facade and is not reflected in the interior space or functional organization.

The Konya Stadium offers visual dynamism through the use of dynamic lines and club colors emphasized on the membrane facade. Nevertheless, this movement lacks conceptual depth related to the city or its users. Still, in terms of architectural expression, it stands out among the Anatolian examples.

The Beşiktaş Stadium consciously refrains from claiming iconic status. Instead, it positions itself as a representative of "cultural continuity" by respecting the historical silhouette of Dolmabahçe and acknowledging the significance of its location. Designed with sensitivity to its context, it pulls back visually, which is evaluated as a deliberate and positive architectural stance.

The stadiums in Kayseri, Mersin, Sivas, Sakarya, and Kocaeli generally lack an aspiration to be iconic or fail to base such an ambition on architectural concepts. In the case of Kocaeli, a superficial reference to the local dessert "is seen as conceptually weak (41). The Mersin and Sivas examples fail to establish any connection with the local culture at all.

Table.2. Symbolic Architectural Quality

Stadium	Photograph	Conceptual Depth	Connection with Urban Identity
Atlanta(38)		High	High
Bordeaux(39,40)		High	Medium- High
Beşiktaş(41,42)		Medium	High
Gaziantep (41,43)		Superficial	High
Konya (41)		There is visual narration	Superficial
Kocaeli (41)		Superficial	Low
Sivas, Mersin, Sakarya, Kayseri(41,43)		No conceptual	Low

3. Alternative Uses Beyond Sports: Functionality, Continuity, and Public Life

Lu et al. (2019) argue that the design of a sports venue should incorporate human-centered approaches, enable multifunctional use, and remain valuable after the main event has concluded(18). Furthermore, various studies have demonstrated that collaboration between venues and communities in public-benefit activities—such as local cultural events, environmental campaigns, and sports education—can enhance the social service capacity of such spaces (31). Another expert opinion highlights that social sustainability involves not only ensuring social equity but also improving accessibility to venues, offering inclusive leisure opportunities for individuals from different social backgrounds, and protecting the rights of disadvantaged groups (11).

In this context, over the past two decades, stadiums are increasingly expected to host not only sporting events but also a wide range of activities such as concerts, exhibitions, museums, and social gatherings. The

stadiums examined in this study are therefore evaluated in terms of their "non-match-day use" potential. The primary objective is to determine whether the structure functions as a continuously active social center that serves the public throughout most of the day and year.

The Atlanta Stadium stands out as the most comprehensive example in this regard. It is supported by a 13-acre green area open for use as a playground, cultural event space, and venue for large concerts and festivals. Additionally, the stadium includes restaurants, cafés, and bars within its interior, making it a vibrant social hub operating 24/7 (38).

The Bordeaux Stadium was designed to accommodate not only rugby and football matches but also concerts, shows, and corporate events. It features restaurants, VIP bars, and showroom areas inside, catering to diverse user profiles. The architectural integration of the stadium into social life is strong and intentional (39).

The Beşiktaş Stadium goes beyond sports by including a museum, café, offices, retail spaces, and multipurpose halls, offering a socially rich program. The presence of permanent functions such as the Beşiktaş Museum helps keep the structure lively year-round (41, 42).

The Konya Stadium offers some opportunities for non-sporting use through supporting units like sports halls. However, these facilities remain focused solely on athletics. Proposed functions such as a swimming pool and athletic track were never realized. Recently, a functioning restaurant within the complex has become actively used by the public (41).

The Kocaeli and Sakarya Stadiums contain spaces such as restaurants, kiosks, and ticket offices, but all of these are only operational on match days. As a result, the stadiums fail to maintain a continuous public presence.

The Kayseri, Mersin, and Gaziantep Stadiums have limited social amenities. Their spaces open to public use outside of match days are minimal. In these stadiums, cafés and restaurants function only during match days, leaving the venues underutilized for the majority of the year (41,43).

The Sivas Stadium is used solely for national matches and is a single-function structure with no additional programs or multifunctional uses (41).

Table.3. Alternative Uses

Stadium	Non-match Use	Continuity / Social Function
Atlanta	Very high	24/7 use
Bordeaux	High	Variety of activities
Beşiktaş	High	Continuity with museum, cafe, shop
Konya	Medium	Restaurants/Gyms are available but limited
Kocaeli, Sakarya	Low	Match-oriented use
Gaziantep, Kayseri, Mersin	Low	Underutilized buildings
Sivas	None	Single function

4. Does the Stadium Cast a Shadow on Its Immediate Surroundings?

The visual impact of light and shadow in design goes beyond the limitations of visual perception and leads people to experience a different type of psychological response. Therefore, creating a reasonable balance of light and shadow can vividly enhance the architectural and landscape theme (31). However, due to their large scale and wide-span structures, stadiums often create significant physical effects on their surroundings. One such effect is the shading they cast on nearby buildings and open spaces. In particular, the prolonged overshadowing of residential or public spaces can raise concerns about the negative physical relationship between the stadium and its urban context.

Since 2018, all newly built or renovated official FIFA World Cup stadiums have been required to obtain green building certification (10). Within this framework, stadiums are expected to play a more environmentally conscious role. In this regard, shading effects are a significant parameter in assessing how stadiums engage with their environmental context (18).

The Beşiktaş Stadium is situated in a valley basin, 3.5 meters below sea level, and its roof height was lowered to avoid overshadowing historic buildings. This approach preserves the silhouette of Istanbul and prevents any permanent shadowing on surrounding structures. Its respectful attitude toward the cityscape serves as a model from an architectural perspective.

The Atlanta and Bordeaux Stadiums are surrounded by large open spaces, so they do not cast shadows on any nearby buildings. In particular, the Bordeaux stadium's integration with the landscape minimizes this risk even further (38, 39).

The Sakarya, Kocaeli, Mersin, Konya, and Gaziantep Stadiums are also located in sparsely built areas, often on vacant land, and thus do not cast permanent shadows on nearby structures. However, since these surroundings lack rich public or social spaces, the absence of shading cannot be considered a substantial advantage (41).

The Kayseri Stadium casts permanent shadows over adjacent residential areas. This is regarded as a negative physical intervention on an urban scale (43).

Similarly, the Sivas Stadium casts shadows on residential blocks located on its western façade. This indicates that environmental impacts were not sufficiently considered during the stadium's placement and design process (41).

Table 4. Impact of Stadium Design on Surrounding Shadowing Effects

Stadium	Photograph	Shadowing Effect in the Environment	Comment
Beşiktaş		None	Design respectful of silhouette
Atlanta		None	Extensive landscaping
Bordeaux		None	Planning integrated with nature
Konya, Sakarya, Kocaeli, Mersin, Gaziantep		None	The social environment is also weak
Sivas		Exist	Affects residences on the western side
Kayseri		Exist	Residential areas remain in the shadow

5. Contemporary Building Materials and Energy Efficiency: Technological Adequacy and Sustainability Reality

In the context of ecological sustainability, it is widely acknowledged that the construction and renovation of sports venues lead to high levels of energy and resource consumption, which directly impact environmental sustainability (10). In this regard, changing production and consumption habits and the use of recycled materials are emerging as critical methods to achieve sustainability (22). Sustainability has increasingly become a decisive factor in urban development and architectural design processes, particularly in large-scale public buildings, such as stadiums, which have high energy consumption and significant operation and maintenance costs (44). This situation has a considerable impact not only on similar structures but also on the sustainable planning and construction of entire urban areas (31). Some sports organizations, like FIFA, require stadiums to obtain mandatory green building certification to promote environmentally sustainable venues (3). Several studies have detailed the requirements for energy, water, and materials in sustainable buildings for large stadiums aimed at improving venue sustainability (44).

Stadium structures should be evaluated not only in terms of visual or structural aspects but also in terms of environmental sustainability, energy efficiency, and technological innovation (10). This section explores whether contemporary building materials (such as steel, membrane systems, ETFE, etc.) are being used in stadiums, whether passive and active climate control systems are implemented, and, most importantly, whether these applications are supported by concrete data.

The Atlanta Stadium stands out in this field. It is the first professional stadium in North America to have received a LEED Platinum Certification. It generates its own energy with 4,000 solar panels, and its ETFE panels on the roof provide passive cooling. The movable roof system is technologically superior to global standards (38).

The Sivas Stadium incorporates many energy-efficient features, such as rainwater harvesting, greywater use, and solar panels. However, these systems have not been certified with any green building certifications (LEED, BREEAM). Therefore, the architect's claim that it "generates its own energy" remains at the theoretical level, and the practical impact has not been fully validated (41).

The Konya Stadium has used membrane materials with varying permeability for façade solutions and contemporary building technologies such as steel structural systems and underfloor heating for the pitch. However, there are no certifications or measurable energy-saving data available (41).

The Gaziantep and Kayseri stadiums incorporate modern roof systems, steel structures, and sunshades, but these applications do not form a proven systemic integrity in terms of sustainability (41). Although awards have been received, these awards are primarily given for aesthetic or commercial value.

The Beşiktaş Stadium hosts technological elements like hybrid grass systems, smart security, and digital infrastructure, but it lacks concrete sustainability data regarding energy efficiency (41,42).

The Kocaeli, Sakarya, Mersin, and Bordeaux stadiums have minimal use of contemporary materials. Although some projects feature membrane or steel systems, these applications remain mainly structural solutions and do not provide measurable gains in energy performance (39).

Table 5. Contemporary Building Materials and Energy Efficiency

Stadium	Photograph	Materials and Technology	Sustainability Certificate
Atlanta		The most advanced (ETFE, roof, PV panel)	LEED Platinum, 88 points
Sivas		Passive systems + PV panels	No certificate
Konya		Steel + membrane systems	No certificate
Gaziantep, Kayseri		There are modern systems	No measurable data
Bordeaux		No emphasis on sustainability	No information provided
Kocaeli, Sakarya, Mersin, Beşiktaş		Basic building systems	No certificate

6. Is Stadium Access Easy, Accessibility, Transport Network, and User Comfort

Sports facilities are strongly connected to the planning and development of urban areas. When properly located and effectively managed, these structures can play an important role in the transformation processes of cities (5). Economically, sports venues create employment and support regional economic vitality by attracting new businesses and commercial activities (23). As part of the infrastructure, these buildings can also enhance societal and environmental resilience, serving as temporary shelters, election centers, or hospitals during emergencies (21). However, the location of sports facilities is crucial. The increasing demand for transporting athletes and spectators and for logistics further raises energy consumption and emissions (45).

While the impact of stadiums on urban structures is often limited economically (13), they can lead to significant consequences at the local level, particularly in terms of traffic. The increased number of visitors accompanying the construction of a new stadium can lead to transportation-related issues such as heavy traffic, parking problems, and pressure on public transportation. This situation often causes discomfort among local residents around the stadium and increases resistance to the projects. Traffic congestion and other transportation problems, combined with architectural preferences of modern stadiums, have become one of the main reasons for negative attitudes among local residents (1).

Transportation, as a core part of the user experience in a stadium, not only determines the comfort of access but also whether the building becomes an active focal point within the city. Public transportation options, parking capacity, railway system connections, and pedestrian access are considered essential criteria in this context.

Beşiktaş Stadium, located in the city center, is easily accessible by foot, public transport, and private vehicles. This location integrates the stadium into the city life, keeping it active at all times of the day (41, 42).

Atlanta Stadium has made access easier with a 3 km railway line and an advanced public transport system. The integrated planning of the transportation network helps minimize congestion on match days (38).

Bordeaux Stadium is connected to the city center via public transport systems such as buses and trams. However, its distance of 7 km results in a relatively longer travel time (39).

Kayseri Stadium is strategically located at a point between the city center and the bus terminal, with a rail system in place, making it advantageous in terms of transportation (41).

Konya Stadium is a positive example due to its proximity to the bus terminal and tram line. Public transport and private vehicle options are available (41).

Kocaeli, Sivas, and Sakarya Stadiums are located near the city center and are supported by parking and public transport systems. Detailed parking planning is particularly noticeable in Sakarya and Kocaeli (41).

Mersin and Gaziantep Stadiums are located far from the city center. In Mersin, public transport stops were added later, but they are insufficient. In the case of Gaziantep, the lack of proper transportation planning and vacant spaces around the structure weakens accessibility (41,43).

Table 6. Accessibility

Stadium	Public Transport	Private Vehicle / Parking Lot	Connection with the City
Beşiktaş	Very easy	Centrally located	High
Atlanta	Advanced system	Rail connection	High
Konya, Kayseri	Rail system + parking lot	The transportation network is strong	Medium -positive
Bordeaux	Tram/bus	The distance is long	Medium
Sivas, Kocaeli, Sakarya	Close location + parking	Public transportation is medium level	Medium
Gaziantep, Mersin	Access is poor	Far from the center	Negative

DISCUSSION AND CONCLUSION

This study analyzed 8 different stadiums built in Turkey over the last 20 years and 2 stadiums built abroad, evaluating whether they align with the architects' statements based on six key criteria: location in relation to the city, iconic status, multifunctional use, environmental shading impact, contemporary building technologies/sustainability, and transportation options. Comparisons made under each criterion examined the strengths and weaknesses of both domestic and international examples.

- Atlanta Stadium stands out as the most successful example of the study, both technically and conceptually. With its LEED Platinum Certification, innovative roof technology, sustainability practices, and multifunctional social spaces, it has become a reference point for 21st-century stadium architecture.

- Bordeaux Stadium features architectural purity, a poetic relationship with the landscape, and a potential for multifunctional use, representing contemporary European architectural language. However, its limited information on energy efficiency and sustainability has caused it to lag behind in the evaluation.

- Beşiktaş Stadium is notable for its strong connection to the city's memory, architectural simplicity, and focus on cultural continuity rather than an emphasis on sustainability. It has avoided the claim of being iconic and has instead shown respect for its surroundings, integrating seamlessly with the city.

- Konya and Gaziantep Stadiums stand out among the examples in Anatolia for adopting contemporary building technologies and striving for architectural differentiation. However, the lack of documented sustainability practices and weak conceptual depth has hindered their full success.

- Kayseri, Kocaeli, and Sakarya Stadiums incorporate modern building systems but fall short in terms of multifunctionality and sustainability. These structures remain largely unused outside of match days and

have not been integrated into social life.

- Sivas and Mersin Stadiums feature distinct characteristics compared to the other stadiums. While Sivas Stadium claims to have energy-efficient systems, it fails to support this assertion with any documentation; Mersin Stadium, on the other hand, is inadequate in terms of capacity, usage, and context.

21st-century architecture is being redefined not only by formal innovations but also by concepts such as social interaction, environmental sustainability, and multifunctionality. In this context, stadium structures must go beyond sports and become active parts of urban life. However, the 10 different stadium examples examined in this study have shown significant differences between the architects' expressed intentions and the resulting products. The relationship established with the urban context has proven to be a determining factor in the identity of the structures.

When examining stadium structures in Turkey, contemporary building materials are used in new stadium projects, but sustainability often remains uncertified. While technical criteria such as modern building technologies and compliance with UEFA/FIFA standards are generally met, concepts like multifunctional use and energy efficiency are often either neglected or remain at the level of rhetoric. Furthermore, a large portion of the stadiums built in Turkey are single-purpose and idle outside of match days.

Foreign examples, especially Atlanta and Bordeaux stadiums, are noteworthy not only for technological innovations but also for their architectural conceptual depth and urban integration. One of the positive examples in Turkey, Beşiktaş Stadium, presents a unique stance with its design that respects the city's memory. However, most of the stadiums built in Anatolia become idle structures outside of match days and fail to fulfill their social function.

- Urban and Socio-Cultural Context Should Be Considered in the Design Process: Stadiums should establish a connection with the historical, cultural, and natural values specific to their city. These structures should be approached with city-specific solutions, not just as "standard" sports buildings.

- Multifunctional Use Should Be Made Mandatory: Stadiums should be supported with different functions such as concerts, theaters, exhibitions, museums, libraries, and gyms, transforming them into 24/7 living structures.

- Sustainability Certifications Should Be Encouraged: Energy-efficient systems and green building applications should not remain as rhetoric but should be substantiated with certifications like LEED and BREEAM.

- Stadiums Should Be Located Close to City Centers and Be Accessible: Stadiums that are not integrated into transportation networks may be physically accessible but remain socially distant. Therefore, site selections should be made with great care.

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The Effect of Eccentric Based Post Activation Performance Enhancement Intervention Applied at Different Angular Velocities on Jump Performance (Preliminary Findings)

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Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.

** This study was presented as an verbal presentation at the 20th Turkish Sports Medicine Congress with International Participation held in Izmir between 8-11 May 2025.*

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Abstract

The aim of this study was to investigate the acute effects of eccentric contraction performed at different angular velocities (60°/s and 150°/s) on jump performance and to comparatively evaluate the contribution of eccentric loading at different velocities to the post activation performance enhancement (PAPE) effect. The study was completed in three sessions with 8 male participants. In the first session, anthropometric measurements, dominant leg determination, vertical jump test performance for the control condition and Familirization for eccentric contraction were performed. The next sessions were randomized at 48-hour intervals. In the second session, participants performed a single set of 5 repetitions (rep) maximal eccentric contractions at an angular velocity of 60°/s and after a 7-minute transition phase, vertical jump tests were performed. In the third session, participants performed a single set of 5 rep. maximal eccentric contractions at an angular velocity of 150°/s and after a 7-minute transition phase, vertical jump tests were performed. The results showed that two different angular velocities had no statistically significant effect on jumping performance ($p>0.05$). However, when compared with the control condition, 150°/s (+2.24 cm) has a higher delta value than 60°/s (+0.71 cm). As a result, especially eccentric contractions applied at higher angular velocity showed an increase in jump performance, indicating that angular velocity may be an important factor in the emergence of the PAPE effect (Cohen *d*: 0.56).

Keywords: Eccentric contraction, Angular velocity, Post-activation Performance Enhancement, Jumping.

Farklı Açısal Hızlarda Uygulanan Eksantrik Temelli Aktivasyon Sonrası Performans Arttırma Girişiminin Sıçrama Performansı Üzerine Etkisi (Ön bulgular)

Özet

Bu çalışmanın amacı, farklı açısal hızlarda (60°/s ve 150°/s) gerçekleştirilen eksantrik kasılmaların sıçrama performansı üzerine akut etkilerini araştırmak ve farklı hızlardaki eksantrik yüklenmenin aktivasyon sonrası performans arttırma (ASPA) etkisine katkısını karşılaştırmalı olarak değerlendirmektir. Çalışma 8 erkek

katılımcı ile üç seansta tamamlanmıştır. İlk seansta antropometrik ölçümler, dominant bacak belirleme, kontrol koşulu için dikey sıçrama test performansı ve eksantrik kasılma için familirizasyon gerçekleştirilmiştir. Sonraki oturumlar 48 saat aralıklarla rastgele şekilde gerçekleştirilmiştir. İkinci seansta katılımcılar 60°/s açısal hızda tek set 5 tekrar maksimal eksantrik kasılma gerçekleştirmiş ve 7 dakikalık bir geçiş fazının ardından dikey sıçrama testleri yapılmıştır. Üçüncü seansta, katılımcılar 150°/s açısal hızda tek set 5 tekrarlı maksimal eksantrik kasılma gerçekleştirmiş ve 7 dakikalık bir geçiş aşamasından sonra dikey sıçrama testleri yapılmıştır. Bulgular, iki farklı açısal hızın sıçrama performansı üzerinde istatistiksel olarak anlamlı bir etkisi olmadığını göstermiştir (p>0.05). Bununla birlikte, kontrol koşuluyla karşılaştırıldığında, 150°/s (+2,24 cm) 60°/s'den (+0,71 cm) daha yüksek bir delta değerine sahiptir. Sonuç olarak, özellikle daha yüksek açısal hızda uygulanan eksantrik temelli kasılmaların sıçrama performansında artış göstermesi, açısal hızın ASPA etkisinin ortaya çıkmasında önemli bir faktör olabileceğini göstermektedir (Cohen d: 0,56).

Anahtar Kelimeler: Eksantrik Kasılma, Açısal Hız, Aktivasyon Sonrası Performans Arttırma Sıçrama

INTRODUCTION

Jump performance, as one of the main parameters of explosive power production, is a critical component that directly affects success in many sports branches (1). Therefore, acute interventions to improve jumping have an important place in improving performance (2, 3). Short-term activation protocols applied before training are becoming prominent among strategies that aim to temporarily improve performance, especially in high intensity motor tasks (4) such as jumping (5). One of these strategies, post activation performance enhancement (PAPE), is characterized by short-term performance enhancement following heavy muscle activity (6).

The preferred muscle activation methods play a significant role in the occurrence of the PAPE effect. Generally, high intensity loading based on 1RM % (7) and plyometric exercises (8) are used for this purpose. However, in recent years, the potential of eccentric contractions (ECC) in particular has come to the forefront due to their high force production and neuromuscular stimulation capacity (9). ECC contractions involve the active extension of muscle tissue against an external force or load (10). Furthermore, several features and acute physiological responses specific to ECC contractions contribute to the generation of specific adaptive signals (e.g. fast-twitch muscle fiber hypertrophy, increased type IIx fiber composition) in the neuromuscular system (11). These adaptations are generally thought to reflect a transition to a faster and more explosive muscle phenotype (12).

ECC loading can be applied using different angular velocities, which directly affect the magnitude and nature of the physiological response. Lower angular velocities are often associated with higher torque production, whereas higher angular velocities are thought to promote increased neuromuscular recruitment, muscle-tendon stiffness, and rapid force development (11). Such applications are particularly relevant in sports where explosive activities like sprinting, jumping, and changing direction are frequent, including track and field, basketball, and football (13). Moreover, eccentric contractions are implemented in a variety of exercise modalities such as squats or eccentric leg press training (14, 15).

However, the magnitude of this effect produced by ECC can change depending on the angular velocity applied (16). In fact, loading at different angular velocities can have different physiological effects on performance output. Therefore, the aim of this study was to examine the acute effects of ECC performed at different angular velocities (60°/s and 150°/s) on jump performance and to comparatively evaluate the contribution of eccentric loading at different angular velocities to the PAPE effect.

METHOD

Experimental Approach to the Problem

In this study, subjects participated randomized in three experimental sessions. All interventions were conducted at the same time of the day (10:00-12:00). In the first session, anthropometric measurements, dominant leg determination, vertical jump test performance for the control condition and familirization for eccentric contraction were performed. The next sessions were randomized at 48-hour intervals. In the second session, participants performed a single set of 5 repetitions (rep) maximal eccentric contractions at an angular velocity of 60°/s and after a 7-minute transition phase, vertical jump tests were performed. In the third session, participants performed a single set of 5 rep. maximal eccentric contractions at an angular velocity of 150°/s and after a 7-minute transition phase, vertical jump tests were performed (Figure 1).

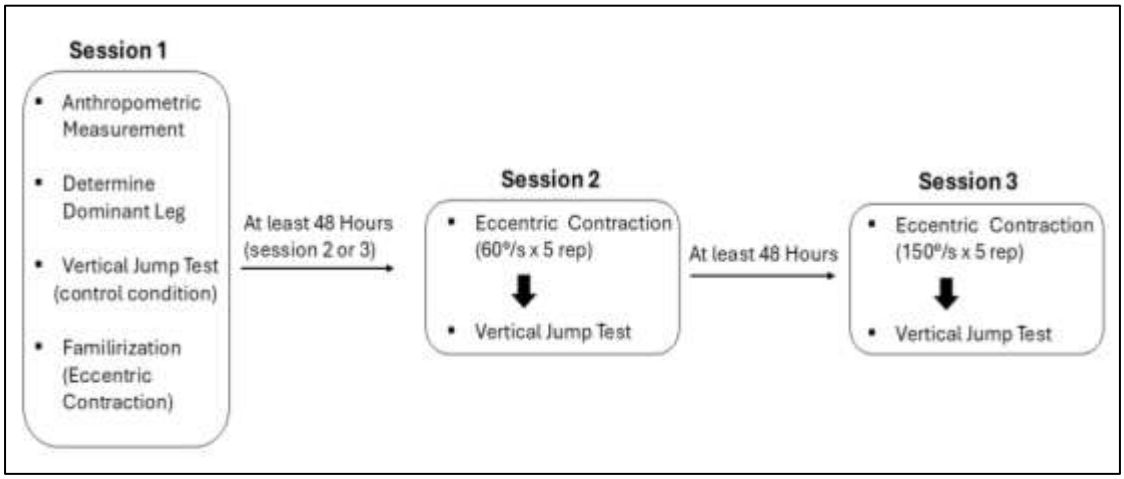

Figure 1. Experimental Design.

Subjects

The study included 8 male (age;22.37±3.62 years, height;179±5.6 cm, weight:85.01±21.36 kg, Training age;7±2 years) who were actively training. Subjects had a minimum of 5 years of resistance training experience, were actively training, and had no known neuromuscular disorders. Subjects with recently lower limb injuries, surgeries (within the last 6 months), or any musculoskeletal condition that might restrict eccentric exercise performance were excluded. As this was a preliminary study, no priori power analysis was performed using G*Power. Prior to the tests, participants were instructed to avoid intense physical activity for 72 hours and caffeine consumption for 2 hours. The study protocol was conducted in accordance with the latest version of the Declaration of Helsinki. Participants were informed about the potential risks and procedures of the study, and written informed consent was obtained.

Anthropometric Measurements

The height of the participants was measured without shoes, wearing shorts and a T-shirt. Height was measured with a manual stadiometer by determining the distance between the peak of the head and the sole of the foot. The data obtained were recorded in centimeters (cm). Body weight (kg), BMI (kg/m2), muscle mass (kg), and fat mass (kg) data were evaluated using bio-impedance Tanita (Tanita MC-980MA, Tokyo, Japan).

Eccentric Contraction via İsokinetic Dynamometer

Participants were tested in a seated position with their dominant leg on an isokinetic testing machine (Isoforce). The trunk, gluteal and hip regions were immobilized to prevent unwanted movements. During the measurements, the calibrated device was adjusted so that the range of motion was between 0° (full knee extension) and 90° (knee flexion). Eccentric contractions were performed in a single set of 5 repetitions at 60°/s and 150°/s, the common low and high angular velocities associated with torque production and neuromuscular activation, respectively (17). Participants were verbally motivated during the contractions. They were given all-out effort during to test.

Vertical Jump Test

Vertical Jump tests were performed with single leg (dominant leg) using My Jump Lab mobile application (18). All jumps were performed on a jump mat in order to correctly identify the moment of contact with the ground. The smartphone with the app was fixed on a tripod so that all images were recorded from a fixed angle, standardizing the measurement. Recordings were made using an iPhone 11 (Apple Inc., USA) at 1080p resolution and 60 frames per second (fps). The device was positioned approximately 3 meters away from the subjects at hip height to ensure consistency in angle and visibility. During the test, participants placed their hands at waist level and initiated a vertical jump with a single leg (dominant leg) from a squatting position corresponding to a knee flexion angle of approximately 120° (19). The dominant leg of the participants was determined by asking the question "Which leg would you use to kick the ball?" (20). In each condition, three repetitions were performed with a 1-minute rest interval and the best performance value was used for statistical analysis.

Statistical Analysis

All statistical analyses were performed using SPSS (IBM SPSS Statistics 25). The normality of the data distribution was assessed using the Shapiro–Wilk test. A one-way repeated measures ANOVA was conducted to examine the differences in jump performance across three conditions (control, 60°/s, and 150°/s) within the same group. Effect sizes were calculated using partial eta squared (η^2_p). Statistical significance was set at $p < 0.05$. Descriptive statistical data (mean ± standard deviation) for the control, 60°/s and 150°/s conditions are presented in a summary table. The performance values for the experimental conditions are compared with the control condition as a baseline. In addition, a paired sample t-test was performed to compare the torque values between 60°/s and 150°/s eccentric contraction conditions.

Ethical approval and institutional permission

The study was approved by Manisa Celal Bayar University Faculty of Medicine Health Sciences Ethics Committee (20.478.486/3122)

FINDINGS

As a result of the repeated measures ANOVA, there was no statistically significant difference in jump performance between interventions, $F(2, 14) = 1.66$, $p = .225$, $\eta^2_p = .192$. However, the partial eta squared value obtained indicates a high effect size. This suggests that even without statistical significance, the practical effects of the practices may be important (Figure 2). In addition to jump performance, peak eccentric torque values were compared between 60°/s and 150°/s conditions. The results showed that participants produced significantly higher torque at 60°/s (127.1 ± 10 Nm) compared to 150°/s (90.7 ± 28 Nm), (p = .003).

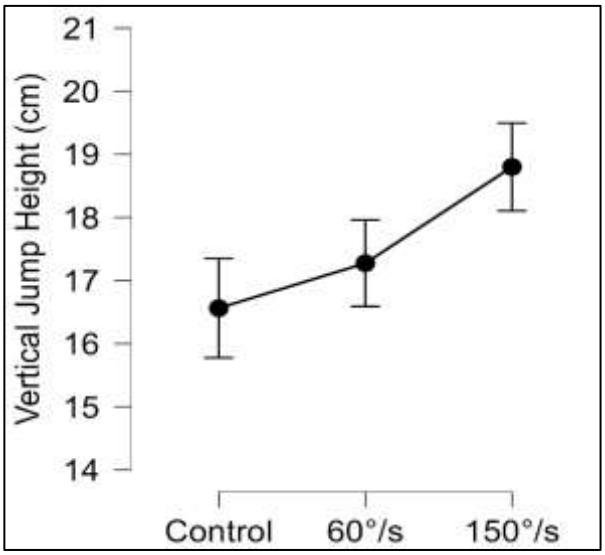

Figure 2. Mean vertical jump height under control, 60°/s, and 150°/s eccentric contraction conditions.

Table 1 presents descriptive statistics for vertical jump height according to the different intervention conditions (Control, 60°/s and 150°/s). The table includes effect sizes (Cohen's d) along with absolute (Δ cm) changes compared to the control condition. Although both eccentric protocols did not result in a statistically significant improvement, the 150°/s condition showed a significant increase in jump height and a moderate effect size compared to the control condition.

Table 1. Mean vertical jump height, absolute changes (Δ) and effect sizes (Cohen's *d*) compared to the control condition.

	Interventions	Mean ± SD	Δ (cm)	Cohen's *d*
Control	**60°/s**	17.27±3.87	+0.71	0.18
16.56±3.81	**150°/s**	18.80±4.16	+2.24	0.56

Note. Values represent group means (± SD) for vertical jump height of each condition. Δ (cm): Absolute change from control condition; Cohen's *d*: Effect size; 60°/s and 150°/s refer to the angular velocity of eccentric contractions.

DISCUSSION AND CONCLUSION

In this study, the effects of eccentric-based PAPE interventions performed in a single set of 5 repetitions at different angular velocities (60°/s and 150°/s) on jump performance were investigated. The findings showed that there was no statistically significant increase in jump height after both protocols (p>0.05). In addition, when the delta values were analyzed, jump height after 150°/s (+2.24 cm) was higher than 60°/s (+0.71 cm). This shows a tendency that an increase in angular velocity may contribute positively to performance by increasing the PAPE effect.

In the literature, it has been reported that torque production is either maintained or improved with increasing angular velocity in eccentric contractions, which may lead to more motor unit activation and increased muscle strength (21, 22). However, this development was not observed in the present study. The peak torque values produced by the participants in the 60°/s condition (127.1 Nm) were significantly higher than those in the 150°/s condition (90.7 Nm). This shows that lower angular velocities may also allow high force production in acute eccentric contractions. This difference may be due to factors such as decreased eccentric control at higher speeds, shorter time required for force production, or lack of technical proficiency. In chronic studies, it has been observed that eccentric loads at high speeds such as 180-210°/s cause more effective physiological adaptations (23, 24). These effects have been reported to be based on mechanisms such as increased motor unit recruitment during high-speed eccentric contractions and support of passive force production through Titin (25). Indeed, it has been reported that the type and intensity of contraction as well as the applied speed may play a determining role in the emergence of the PAPE effect (26). In this perspective, a higher angular velocity, such as 150°/s, increased jump performance more in the short term, supporting the idea that high-velocity eccentric contractions may enhance the PAPE effect. Similarly, in the literature has been reported that the relationship between muscle strength and jump performance may become better as angular velocity increases (27-30). Although these studies were mostly based on long-term training protocols, acute effects were evaluated in the present study. In the present study, the higher jump increase after eccentric loading at 150°/s compared to 60°/s (Δ +2.24 cm vs. +0.71 cm) may reflect the influence of the physiological processes described above on acute performance outcomes. The increase in the PAPE effect when angular velocity increases leads to the question "is there an optimal velocity range in angular velocity?". In this study, experiments at two different angular velocities showed a slight increase in potentiation with increasing velocity compared to the control. We would like to draw attention to the need for larger participant and detailed studies to optimize lower extremity angular velocity in future research.

In conclusion, this study examines the acute changes in jump performance of a single set of 5 repetitions of eccentric contractions performed at different angular velocities and showed that angular velocity may play a determining role in this change. In especially, eccentric contractions applied at higher angular velocity (150°/s) caused greater increases in jump performance, indicating that angular velocity may be an important factor in the emergence of the PAPE effect. The findings support that eccentric contractions can be used strategically not only for muscle strength development but also for the temporary enhancement of short-term explosive performance. In light of this, integrating eccentric contractions at high angular velocity (e.g., 150°/s) into pre-competition warm-up protocols may be considered as a potential method for short-term performance

enhancement. In branches where explosive force is critical, such practices may contribute to temporarily increasing performance outcomes such as jumping. However, such applications should be planned taking into account individual differences and should be previously evaluated whether the athlete has sufficient technical and physical capacity against eccentric load.

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Examination of Sports Science Faculty Students' Individual Entrepreneurial Orientation in Terms of Different Variables

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Abstract

Examination of Sports Science Faculty Students' Individual Entrepreneurial Orientation in Terms of Different Variables

This study was carried out to examine the individual entrepreneurial orientation of third and fourth grade students studying in the Coaching Education and Sport Management Departments of Sports Science Faculties in terms of different variables. The participants in our study were 245 students (age: 22.3 ± 1.6 years; height: 174.9 ± 9.5 cm; weight: 71.8 ± 14.2 kg) studying in the Coaching Education and Sport Management Departments at the Sports Science Faculties of Trakya, Çanakkale Onsekiz Mart, Yalova, Sakarya Applied Sciences and Muğla Sıtkı Koçman Universities. The participants' individual entrepreneurial orientation was assessed with the Individual Entrepreneurial Orientation Scale, while their physical activity levels were assessed with the short form of the International Physical Activity Questionnaire (IPAQ). In addition to these scales, the participants' body mass index (BMI) and whether they had received entrepreneurship-related education were recorded, and the effects of various variables, namely physical activity level, BMI, gender, department attended, and previous entrepreneurship education experience, on individual entrepreneurial orientation were statistically examined. It was observed that physical activity level and BMI values had no effect on the individual entrepreneurial characteristics of either male or female participants ($p > 0.05$). However, the total scale scores and scores in the subscales of risk taking, innovation, and proactiveness of students who had received entrepreneurship education differed statistically from those who had not received entrepreneurship education ($p < 0.05$). The scores of coaching education department students in the proactiveness subscale of the scale were higher than the scores of sport management department students ($p < 0.05$). In conclusion, it can be said that participation in any training related to entrepreneurship can change individual entrepreneurial orientation. Repeating the study with a larger sample to explain the effects of independent variables such as body mass index, gender, and physical activity level on individual entrepreneurial orientation may produce different results.

Keywords: Physical Activity Level, Individual Entrepreneurial Orientation, Gender, Body Mass Index.

Spor Bilimleri Fakültesi Öğrencilerin Bireysel Girişimcilik Yönelimlerinin Farkli Değişkenler Açısından İncelenmesi

Bu araştırma, Spor Bilimleri Fakültesi Antrenörlük Eğitimi ve Spor Yöneticiliği Bölümlerinde öğrenim gören 3 ve 4. sınıf öğrencilerin bireysel girişimcilik yönelimlerinin farklı değişkenler açısından incelenmesi amacıyla gerçekleştirildi. Çalışmamıza Trakya, Çanakkale Onsekiz Mart, Yalova, Sakarya Uygulamalı Bilimler ve Muğla Sıtkı Koçman Üniversitelerinin Spor Bilimleri Fakülteleri bünyesindeki Antrenörlük Eğitimi ve Spor Yöneticiliği bölümlerinde öğrenim gören 245 öğrenci (yaş: 22.3 ± 1.6 yıl; boy: 174.9 ± 9.5 cm; kilo: 71.8 ± 14.2 kg) katıldı. Katılımcılara ait bireysel girişimcilik yönelimleri Bireysel Girişimcilik Yönelimi Ölçeği ile fiziksel aktivite düzeyleri ise Uluslararası Fiziksel aktivite ölçeğinin kısa formu (IPAQ) ile değerlendirildi. Bu ölçeklere ek olarak, katılımcılara ait vücut kütle indeksi (VKİ) ve girişimcilikle ilgili eğitim alıp almadığı bilgileri de kaydedilerek IPAQ, VKİ, cinsiyet, öğrenim görülen bölüm ve girişimcilik eğitimi durumu gibi çeşitli değişkenlerin bireysel girişimcilik yönelimleri üzerindeki etkileri istatistiksel olarak incelendi. Fiziksel aktivite düzeyi ve VKİ değerlerinin gerek erkek gerekse kadın katılımcıların bireysel girişimcilik özellikleri üzerinde etkisinin olmadığı görüldü ($p>0.05$). Girişimcilikle ilgili eğitim alan öğrencilerin ölçek alt boyutlarından risk alma, yenilikçilik, proaktiflik ve ölçekten aldıkları toplam puan, girişimcilik eğitimi almayanlardan istatistiksel olarak farklılık gösterdi ($p<0.05$). Antrenörlük eğitimi bölümü öğrencilerinin ölçek proaktiflik alt boyutundan aldıkları puan, yöneticilik bölümü öğrencilerinin aldıkları puandan daha yüksekti ($p<0.05$). Sonuç olarak, girişimcilikle ilgili herhangi bir eğitime katılmanın bireysel girişimcilik yönelimlerini değiştirebileceği söylenebilir. Vücut kütle indeksi, cinsiyet, fiziksel aktivite düzeyi gibi bağımsız değişkenlerin bireysel girişimcilik yönelimi üzerindeki etkilerinin açıklanabilmesi için çalışmanın daha büyük örneklemle tekrarlanması farklı sonuçların alınmasına neden olabilir.

Anahtar Kelimeler: Fiziksel Aktivite Düzeyi, Bireysel Girişimcilik Yönelimi, Cinsiyet, Vücut Kütle İndeksi.

INTRODUCTION

Entrepreneurship is a concept that is discussed in many different disciplines and appears in different varieties, and for these reasons, it does not have a clear definition (1). In the 18th century, the Irish economist Richard Cantillon associated the concept of entrepreneurship with the concept of risk and defined it as the purchase of raw materials, services and production to sell at a predetermined price (2). In fact, risk stands out as one of the natural elements of entrepreneurship (3). Entrepreneurship involves behaviours such as taking initiative, using resources correctly and productively, managing socio-economic balance, taking a position against possible failures, and undertaking risks (4-6). Moreover, it incorporates values such as being innovative, generating new ideas, and being visionary. In this sense, it also includes creativity, which is associated with passionate implementation of innovations, and the ability to produce creative results (5). Entrepreneurial spirit, which results in increased production through the effective and efficient use of economic resources, also supports economic growth, and ensures the spread of innovative understanding in society through the advancement of creative and innovative ideas (6).

As entrepreneurship becomes more widespread in society and investment opportunities open doors to innovative ideas, the use of resources also leads to competition. New ideas that are tested to increase productivity highlight the main features of the concept of entrepreneurship (7).

There are numerous benefits that entrepreneurship contributes to economic development. Among these benefits, job creation, economic growth and the creation of an innovative social structure stand out. In order to provide these benefits, the individual's socioeconomic and cultural baggage, social habits, family structure, education level, quality of education, economic conditions and government incentives are very important. In this way, individuals with entrepreneurial potential can take action, thereby contributing to growth at the national level (8). Factors such as government policies, financial activities and access to foreign markets form the basis of entrepreneurship. Known as the entrepreneurship ecosystem, this system focuses on the rapid changes and innovation opportunities experienced at the global level (9).

In the light of this information, individual entrepreneurship can be interpreted as an individual's use of original ideas, skills and resources to set up a new business or initiate a project. The individual generates solutions in economic, social or cultural fields, and therefore, individual entrepreneurship is a phenomenon that incorporates these situational factors (10). Due to its social dimension, it can be thought that individual entrepreneurship also encompasses sport.

Entrepreneurial orientation at the corporate level in businesses is measured by three main dimensions known as proactiveness, innovation, and risk taking (11-13). Proactiveness helps businesses predict market opportunities and determine strategies accordingly. In this way, businesses rise over time to the position of shaping the competition in the markets in which they operate. Moreover, businesses that act proactively find it easier to identify products and services that will be in demand in the future (14). Innovation is a key factor in determining the performance of a business because the ability to introduce new products, processes and ideas increases the competitiveness of that business. Whilst innovation generally involves a certain amount of risk and positive results are not always guaranteed, it is accepted in the literature that businesses that innovate are generally more successful than those that do not (15). In fast-changing environments, it is unclear how much profit will be made with current business operations and processes. For this reason, businesses have to constantly seek new opportunities. In this case, businesses may need to take risks, take bold steps, and invest in uncertain environments. This involves investing in new technologies, launching innovative products on the market, and acting boldly (16).

METHOD

A correlational survey model with an immediate survey approach, which is one of the general survey models, was used as the research model. Within the scope of the sample size calculation, although it was determined that 165 university students needed to be reached, the sample size was specified as 245 in order to obtain better results (17). The participants in the study were third and fourth grade students studying in the Coaching Education and Sport Management Departments at Trakya University Kırkpınar Sports Science Faculty, Çanakkale Onsekiz Mart University Sports Science Faculty, Muğla Sıtkı Koçman University Sports Science Faculty, Sakarya Applied Sciences University Sports Science Faculty, and Istanbul Cerrahpaşa Sports Science Faculty.

The Individual Entrepreneurial Orientation Scale, whose Turkish validity and reliability study was conducted by Ercan & Yıldıran (18), and the short form of the International Physical Activity Questionnaire (IPAQ), whose Turkish validity and reliability study was carried out by Öztürk (19), were used as data collection tools. The level of individual entrepreneurship was determined as the independent variable of the study, while factors such as gender, physical activity level, department attended, body mass index, and previous entrepreneurship education experience were specified as the independent variables of the study.

Statistical Analysis

In our study, which was conducted to determine differences in participants' individual entrepreneurial orientation according to gender, previous entrepreneurship course participation, department attended, physical activity level and body mass index, statistical analysis of the data was carried out using the SPSS® Statistics for Windows version 23 software program (IBM, Armonk, NY; 2011). In the statistical comparisons that were made, parametric tests were preferred when the assumptions of normal distribution and sphericity tests performed on the relevant datasets were met, while nonparametric tests were preferred when they were not met. Whether the data of the relevant variables conformed to normal distribution was tested with the Shapiro-Wilk test and confirmed with skewness and kurtosis values (20). Mauchly's test of sphericity was used to test whether the variances of the differences between any two measurements were equal. The Mann-Whitney U test was used for between-group pairwise comparisons of mean differences within groups of independent variables that did not conform to normal distribution. Statistical analysis of independent variables requiring nonparametric testing is expressed as median [25%-75% percentile] values in the relevant tables. In parametric tests, mean and standard deviation values are given in the relevant tables. For the statistical analysis performed to determine individual entrepreneurial orientation according to physical activity level, groupings were made according to the IPAQ physical activity values obtained from the participants. In cases that met the assumptions of normality and sphericity, the independent samples t-test was used to compare two groups, while one-way multivariate analysis of variance (one-way MANOVA) was used to compare the means of more than two groups. Prior to one-way MANOVA, the univariate normality assumption was checked by normality tests and outliers, while the multivariate normality assumption was checked by calculating Mahalanobis distance values. To reveal the power of the statistical analysis, effect size values for all relevant tests were included (for the Mann-Whitney U test: r; 0.1 = small, 0.3 = medium, 0.5 = large effect size, and for the independent samples t-test: Cohen's effect size d; 0.2 = small, 0.5 = medium, 0.8 =

large effect size) (21-22). Statistical significance level throughout the whole statistical analysis was set at $p \leq 0.05$.

Ethical approval and institutional permission

The study was approved by the Non-Interventional Clinical Research Ethics Committee of Trakya University Faculty of Medicine with protocol number TÜTF-BAEK 2023/54 and decision number 02/25, dated 13.02.2023, and all practices were carried out in accordance with the Declaration of Helsinki.

FINDINGS

Descriptive characteristics of the sports science faculty students who participated in the study were compared. When the participants were compared in terms of age, height and weight according to their gender, it was determined that the groups showed normal distribution and the assumption of sphericity was met when evaluated within the groups in terms of age and weight ($p < 0.05$), while it was observed that the normal distribution assumption was not met in terms of height values ($p > 0.05$). Information on the comparison of the age and weight values within gender and between genders based on the results of the independent samples t-test and the height values of the two groups according to the results of the Mann-Whitney U test are shown in Table 1 below. The obtained results show that the participants are statistically different from each other in terms of their descriptive characteristics.

Table 1. Descriptive Characteristics of Participants

	Female (N = 84) Mean ± SD	**Male (N = 161) Mean ± SD**	**Female-Male (N = 245) p**
Age (years)	22 ± 1.37	22.4 ± 1.68	0.042*
Height (cm)	165.3 ± 6.22	179.9 ± 6.59	< 0.01*
Weight (kg)	58.5 ± 8.83	78.7 ± 11.1	< 0.01*

SD: Standard deviation. *p < 0.05

Individual Entrepreneurial Orientation According to Physical Activity Level

Based on the scores obtained from the IPAQ physical activity scale, male participants were found to be physically active at a moderate level (600<IPAQ<3000 MET-min/week) and at a high level (IPAQ>3000 MET-min/week) (19), and therefore, male participants were divided into two separate groups according to their physical activity level. As a result of the normal distribution and sphericity tests, it was seen that the datasets of the risk taking and innovation variables met the necessary assumptions, but that the datasets of the proactivity and total score variables did not meet the normal distribution assumption. Accordingly, the independent samples t-test was performed to determine whether there was a difference in individual entrepreneurial orientation of male students with different physical activity levels in terms of risk taking and innovation, while the Mann-Whitney U test was performed to determine whether there was a difference in individual entrepreneurial orientation in terms of proactivity and total score. Information on the statistical analysis conducted to compare individual entrepreneurial orientation of male sports science faculty students in terms of risk taking, innovation, proactiveness and total score according to their physical activity level is shown in Table 2.

According to the results of the pairwise comparisons, no significant difference was observed in individual entrepreneurial orientation (obtained from risk taking, innovation, proactiveness and total scores) in male sports science faculty students with different physical activity levels ($p > 0.05$).

Table 2. Comparison of Individual Entrepreneurial Orientation in Male Students According to Physical Activity Level

	PAL-Moderate (N = 65) Mean ± SD	PAL-High (N = 87) Mean ± SD	p	ES
Risk taking	10.8 ± 2.60	10.39 ± 2.89	0.367	0.15[d]
Innovation	14.43 ± 3.27	14.65 ± 2.99	0.661	0.07[d]
Proactiveness	11.87 ± 2.34	11.18 ± 2.76	0.146	0.14[r]
Total score	37.08 ± 6.75	36.08 ± 7.16	0.338	0.14[r]

PAL: Physical activity level; ES: Effect size; Cohen's effect size d: 0.2 = small, 0.5 = medium, 0.8 = large; r: 0.1 = small, 0.3 = medium, 0.5 = large; SD: Standard deviation. $p < 0.05$

According to the scores obtained from the IPAQ physical activity scale, female participants were found to be physically inactive (IPAQ<600), physically active at a moderate level (600<IPAQ<3000 MET-min/week), and physically active at a high level (IPAQ>3000 MET-min/week) (19), and therefore, female students were divided into three separate groups according to their physical activity level. In the statistical analysis conducted to determine whether the physical activity levels of female students with three different levels of physical activity had a significant effect on their individual entrepreneurial orientation, a one-way multivariate analysis of variance (one-way MANOVA) was performed to determine whether the risk-taking, innovativeness, proactiveness and total score values of female students differed according to their physical activity levels (Table-3). Prior to the test, the univariate normality assumption was checked with normality tests and outliers, while the multivariate normality assumption was checked by calculating Mahalanobis distance values, and it was seen that the datasets were normally distributed in both cases. Levene's test showed that error variances could be considered equal for risk taking ($p = 0.380$, $p > 0.05$), innovativeness ($p = 0.722$, $p > 0.05$), proactiveness ($p = 0.135$, $p > 0.05$) and total scores ($p = 0.569$, $p > 0.05$).

According to the MANOVA results, no significant difference was observed in individual entrepreneurial orientation in female sports science faculty students with different physical activity levels (obtained from risk taking, innovation, proactiveness and total scores) according to the combined dependent variable [F8-150 = 0.609, $p > 0.05$ Pillai's Trace = 0.064, partial $\eta 2 = 0.032$] (Table 3).

Table 3. Comparison of Individual Entrepreneurial Orientation in Female Students According to Physical Activity Level

	PAL-Inactive (N = 5) Mean ± SD	PAL-Moderate (N = 41) Mean ± SD	PAL-High (N = 34) Mean ± SD	p	ES
Risk taking	9.20 ± 1.64	10.07 ± 2.89	9.91 ± 2.86	0.805	0.006[η^2]
Innovation	12.40 ± 3.78	14.49 ± 3.15	14.88 ± 3.57	0.311	0.030[η^2]
Proactiveness	9.80 ± 4.66	11.27 ± 2.58	10.91 ± 3.14	0.557	0.015[η^2]
Total score	31.40 ± 9.69	35.56 ± 7.29	35.71 ± 8.20	0.507	0.018[η^2]

PAL: Physical activity level; ES: Partial eta-squared effect size η^2; $0.01 \leq \eta^2 < 0.06$ small, $0.06 \leq \eta^2 < 0.14$ medium, $\eta^2 \geq 0.14$ large; SD: Standard deviation. $p < 0.05$

Based on the scores obtained from the IPAQ physical activity scale, it was seen that the sports science faculty students were physically inactive (IPAQ<600), physically active at a moderate level (600<IPAQ<3000 MET-min/week), and physically active at a high level (IPAQ>3000 MET-min/week), and therefore, all male and female students participating in the study were divided into three separate groups according to their physical activity level. Descriptive statistical information on individual entrepreneurship parameters for the groups is shown in Table 4.

Table 4. Descriptive Statistics Values for Individual Entrepreneurship Parameters of Sports Science Faculty Students According to Physical Activity Level

	Risk Taking	Innovation	Proactiveness	Total Score
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
PAL-Inactive (n=19)	11.58 ± 3.04	15.90 ± 2.18	12.05 ± 2.70	39.53 ± 6.53
PAL-Moderate (n=105)	10.00 ± 2.78	14.49 ± 3.24	10.92 ± 2.85	35.30 ± 7.40
PAL-High (n=121)	10.37 ± 2.72	14.42 ± 3.24	11.52 ± 2.52	36.20 ± 7.06

SD: Standard deviation. $p<0.05$

At the normality test stage of the statistical analysis conducted to determine whether physical activity levels in students with three different physical activity levels had a significant effect on their individual entrepreneurial orientation, it was observed that the groups did not meet the necessary assumptions regarding any parameter of individual entrepreneurship. Therefore, the Kruskal-Wallis test was performed to see whether there was a difference between the individual entrepreneurship parameters of the three groups (Table 5).

Table 5. Comparison of Individual Entrepreneurial Orientation in Sports Science Faculty Students According to Physical Activity Level

	Mean ± SD	p*	$\chi^2_{(3)}$	ES
Risk Taking (n=245)	10.31 ± 2.79	0.056	5.76	0.02 η^2
Innovation (n=245)	14.57 ± 3.18	0.250	2.78	0.01 η^2
Proactiveness (n=245)	11.31 ± 2.69	0.161	3.65	0.01 η^2
Total Score (n=245)	36.08 ± 7.22	0.069	5.35	0.02 η^2

SD: Standard deviation; ES: Partial eta-squared effect size η^2; $0.01 \leq \eta^2 < 0.06$ small, $0.06 \leq \eta^2 < 0.14$ medium, $\eta^2 \geq 0.14$ large. *Kruskal-Wallis test p value. $p < 0.05$.

The obtained Kruskal-Wallis test results showed that there were statistically non-significant differences between the individual entrepreneurship parameters of the groups ($p > 0.05$). Based on this result, it can be said that individual entrepreneurial orientation in sports science faculty students with different physical activity levels is similar ($p > 0.05$).

Individual Entrepreneurial Orientation According to Body Mass Index Value

Body mass index values are considered in four different ranges: BMI < 18.5 kg/m2 (underweight), 18.5 ≤ BMI < 24.9 kg/m2 (normal), 25.0 ≤ BMI < 29.9 kg/m2 (overweight), and 30.0 ≤ BMI < 34.9 kg/m2 (obese). According to this classification, the students participating in our study were divided into two groups (those with normal weight and those who were overweight) based on their body mass index values below and above 30 kg/m2. As a result of the normal distribution and sphericity tests, the independent samples t-test was performed for pairwise comparisons for datasets where normal distribution and sphericity assumptions were met in the parameters of individual entrepreneurial orientation for the groups, while the Mann-Whitney U test was performed to determine whether there was a difference in individual entrepreneurial orientation in pairwise comparisons for datasets where these assumptions were not met. Descriptive information regarding the statistical analysis of individual entrepreneurial orientation in sports science faculty students in terms of risk taking, innovation, proactiveness and total score according to their body mass index values is shown in Table 6, while information on the pairwise comparisons of the relevant variables is shown in Table 7.

Table 6. Descriptive Statistics for Individual Entrepreneurial Orientation in Sports Science Faculty Students According to Body Mass Index Values

	BMI_1 Underweight (n = 15) Mean ± SD	BMI_2 Normal (n = 163) Mean ± SD
Risk Taking	10.08 ± 2.80	10.90 ± 2.67
Innovation	14.35 ± 3.14	15.15 ± 3.23
Proactiveness	10.91 ± 2.69	11.31 ± 2.72
Total Score	35.60 ± 7.11	37.36 ± 7.42

BMI: Body mass index; BMI-1: BMI <18.5 kg/m² (underweight), BMI-2: 18.5 ≤ BMI <24.9 kg/m² (normal), BMI-3: 25.0 ≤ BMI < 29.9 kg/m² (overweight), BMI-4: 30,0 ≤ BMI < 34,9 kg/m² (obese); SD: Standard deviation.

According to the results of the statistical analysis, it can be said that there is no statistically significant difference in individual entrepreneurial orientation of sports science faculty students according to their body mass index values ($p > 0.05$).

Table 7. Comparison of Individual Entrepreneurial Orientation in Sports Science Faculty Students According to Body Mass Index Values

	BMI		BMI$_1$ - BMI$_2$ (n = 245)		
	BMI$_1$ (n = 15) Mean ± SD	BMI$_2$ (n = 163) Mean ± SD	M [Min – Max]	p	ES
Risk Taking	10.08 ± 2.80	10.90 ± 2.67	11 [8 – 12]	0.055	0.12^r
Innovation	14.35 ± 3.14	15.15 ± 3.23	15 [13 – 17]	0.093	0.11^r
Proactiveness	10.91 ± 2.69	11.31 ± 2.72	12 [10 – 13]	0.889	0.01^r
Total Score	35.60 ± 7.11	37.36 ± 7.42	37 [31 – 42]	0.110	0.10^r

BMI$_1$: Normal weight; BMI$_2$: Overweight; SD: Standard deviation; M [Min – Max]: Median [25% –75% percentile]; ES: Unbiased effect size r; 0.1 = small, 0.3 = medium, 0.5 = large. $p < 0.05$

Individual Entrepreneurial Orientation According to Gender

As a result of the normal distribution and sphericity tests performed for the parameters of individual entrepreneurial orientation in participants divided into two separate groups, male and female, it was determined that the normal distribution and sphericity assumptions of the datasets were not met. Therefore, in pairwise comparisons of the datasets, the Mann-Whitney U test was conducted to determine whether there was a difference in individual entrepreneurial orientation according to gender. Information on the statistical analysis performed to compare individual entrepreneurial orientation in sports science faculty students in terms of risk taking, innovation, proactiveness and total score according to gender is shown in Table 8.

Table 8. Comparison of Individual Entrepreneurial Orientation of Sports Science Faculty Students According to Gender

	Gender		Female - Male (n = 245)		
	Female (n = 84) Mean ± SD	Male (n = 161) Mean ± SD	M [Min – Max]	p	ES
Risk Taking	9.88 ± 0.31	10.52 ± 0.22	11 [8 – 12]	0.085	0.12^r
Innovation	14.58 ± 0.36	14.56 ± 0.25	15 [13 – 17]	0.786	0.02^r
Proactiveness	10.99 ± 0.32	11.47 ± 0.20	12 [10 – 13]	0.196	0.08^r
Total Score	35.32 ± 0.84	36.47 ± 0.55	37 [31 – 42]	0.359	0.06^r

SD: Standard deviation; M [Min – Max]: Median [25% –75% percentile]; ES: Unbiased effect size r; 0.1 = small, 0.3 = medium, 0.5 = large. $p < 0.05$

According to the statistical analysis results, it can be said that there is no statistically significant difference in individual entrepreneurial orientation of sports science faculty students according to gender ($p > 0.05$).

Individual Entrepreneurial Orientation According to Entrepreneurship Course Participation Status

Participants who attended and did not attend the entrepreneurship course were divided into two separate groups according to their course participation status. As a result of the normal distribution and sphericity tests performed on the datasets for the parameters of individual entrepreneurial orientation in participants according to their entrepreneurship course participation status, it was seen that the normal distribution and sphericity assumptions were not met. Therefore, the Mann-Whitney U test was conducted to determine whether course participation status made a difference to individual entrepreneurial orientation in pairwise comparisons of data sets. Information on the statistical analysis performed to compare individual entrepreneurial orientation in sports science faculty students in terms of risk taking, innovation, proactiveness and total score according to their course participation status is shown in Table 9.

Table 9. Comparison of Individual Entrepreneurial Orientation in Sports Science Faculty Students According to Entrepreneurship Course Participation Status

	Course Participation		Course Participants - Course Non-Participants (n = 245)		
	Course Participants (n = 18) Mean ± SD	Course Non-Participants (n = 227) Mean ± SD	M [Min – Max]	p	ES
Risk Taking	11.94 ± 0.45	10.18 ± 0.19	11 [8 – 12]	0.010*	0.16r
Innovation	16.78 ± 0.61	14.39 ± 0.21	15 [13 – 17]	0.004*	0.18r
Proactiveness	12.67 ± 0.53	11.20 ± 0.18	12 [10 – 13]	0.023*	0.14r
Total Score	40.83 ± 1.43	35.70 ± 0.48	37 [31 – 42]	0.009*	0.17r

SD: Standard deviation; M [Min – Max]: Median [25% −75% percentile]; ES: Unbiased effect size r; 0.1 = small, 0.3 = medium, 0.5 = large. *p < 0.05

According to the statistical analysis results, it was determined that regarding sports science faculty students' participation in the entrepreneurship course, there were statistically significant differences in favour of students participating in the course in terms of all parameters of individual entrepreneurial orientation. Based on this result, it can be said that participation in the course has a weak statistically significant effect on individual entrepreneurship in terms of all parameters ($p<0.05$).

Individual Entrepreneurial Orientation According to Department Attended

The participant group of our study consisted of students enrolled in coaching education or sport management departments at the faculty of sports science. Participants were divided into two separate groups to determine whether there was a difference in individual entrepreneurial orientation according to the department they attended. As a result of the normal distribution and sphericity tests performed on the datasets for the parameters of individual entrepreneurial orientation in the participants according to the department they attended, it was seen that the normal distribution and sphericity assumptions were not met. Therefore, in pairwise comparisons of the datasets, the Mann-Whitney U test was conducted to determine whether receiving education in the department students attended made a difference to individual entrepreneurial orientation. Information on the statistical analysis conducted to compare individual entrepreneurial orientation in sports science faculty students in terms of risk taking, innovation, proactiveness and total score according to the department they attended is shown in Table 10.

Table 10. Comparison of Individual Entrepreneurial Orientation in Sports Science Faculty Students According to their Chosen Department

	Department		Department1 - Department2 (n = 245)		
	CED (n = 126) Mean ± SD	SMD (n = 119) Mean ± SD	M [Min – Max]	p	EB
Risk Taking	10.17 ± 0.26	10.45 ± 0.24	11 [8 – 12]	0.589	0.03r
Innovation	14.55 ± 0.28	14.59 ± 0.29	15 [13 – 17]	0.939	0.01r
Proactiveness	11.71 ± 0.23	10.87 ± 0.25	12 [10 – 13]	0.025*	0.14r
Total Score	36.32 ± 0.63	35.82 ± 0.67	37 [31 – 42]	0.568	0.04r

CED: Coaching Education Department; SMD: Sport Management Department; Department1: CED student; Department2: SMD student; SD: Standard deviation; M [Min – Max]: Median [25% −75% percentile]; ES: Unbiased effect size r; 0.1 = small, 0.3 = medium, 0.5 = large. *p < 0.05

According to the results of the statistical analysis, a statistically significant difference was determined in the individual entrepreneurial orientation of sports science faculty students according to the department they attended, in favour of the coaching education department, but in the proactiveness parameter only. According to this result, it can be said that receiving coaching education has a weak statistically significant effect on sports science faculty students' individual entrepreneurship orientation in terms of the proactiveness parameter of individual entrepreneurship ($p < 0.05$).

Individual entrepreneurial orientation of sports science faculty students has become a very important issue nowadays. In a period when entrepreneurship in the fields of sports, health and fitness is increasing, it is invaluable for sports science students to possess entrepreneurial and innovative ideas (3). Robert and Bukodi (23) stressed the importance of the role played by education in developing entrepreneurial qualities. The education factor should be evaluated from its professional aspect, which promotes work experience, and from its academic aspect, which fosters general knowledge. For example, Bird (24) argued that receiving education in entrepreneurship is very important for business owners to ensure high-quality products and services, especially in some branches of industry. Kuratko (25) defined entrepreneurship by stating that entrepreneurship is considered as a powerful influence during a lively time period associated with change, vision and creativity.

Besides the theoretical and practical knowledge that sports science students acquire in their courses, they can also turn their passion for sport into entrepreneurial opportunities. For example, they can start their own businesses in areas such as sports coaching, gym management, and sports equipment sales. Moreover, they can also be successful in personal branding and digital entrepreneurship by opening blogs or social media accounts on healthy living (5).

Individual entrepreneurship encourages young people to think innovatively and helps them to improve their skills in starting and managing their own businesses (3). Sports science faculty students can contribute to the sports industry by developing creative and effective projects. Moreover, students with entrepreneurial spirit have the potential to create employment and can have a positive impact on the economy. Individual entrepreneurial orientation in sports science faculty students brings out the entrepreneurial spirit of young people who are interested in sports and healthy living and increases their contribution to the sector. Supporting and encouraging these students will help them develop innovative business ideas that will benefit sports fans and health enthusiasts (3).

In this study, sports science faculty students' age, height and weight characteristics were compared according to their gender. It was determined that the groups independently showed normal distribution in terms of age and weight and met the assumption of sphericity. However, the height values did not meet the assumption of normal distribution. According to the results of the independent samples t-test and Mann-Whitney U test, it was determined that age and weight values were different within gender and between genders, and that the height values were also different ($p < 0.05$).

No significant difference was observed in individual entrepreneurial orientation (obtained from risk taking, innovativeness, proactiveness and total scores) among male sports science faculty students with different physical activity levels ($p > 0.05$).

As a result of the statistical analysis, no significant effect was detected on individual entrepreneurial orientation female sports science faculty students with different physical activity levels. This also means that female students' risk taking, innovativeness, proactiveness and total score values did not show a significant difference according to their physical activity levels. However, in the results of studies conducted by Akman and Bektaş (26), Kılıç, Keklik & Çalış (27), and Aksel & Bağcı (28), it was stated that there was a relationship between students' entrepreneurial orientation and the gender variable.

In this study, it was found that entrepreneurial orientation in male and female participants did not meet the assumptions of normal distribution and sphericity. Therefore, the Mann-Whitney U test was used to examine the difference in gender-related entrepreneurial orientation. According to the statistical analysis, a significant relationship was found between the entrepreneurship course participation status of sports science faculty students and their individual entrepreneurial orientation. This shows that course participation had a statistically significant effect on individual entrepreneurship ($p < 0.05$). However, according to the research results of Saber (3), there was no significant difference between the gender variable and the perception of students studying at the school of physical education and sports and the faculties of sports science regarding the concept of individual entrepreneurship.

The Mann-Whitney U test is a nonparametric test used to check median differences between groups. As a result of this test, a statistically significant difference was determined between the individual entrepreneurial orientation of sports science faculty students according to their entrepreneurship course participation status.

Based on these findings, it can be said that course participation had a statistically significant effect on individual entrepreneurship. In other words there was a significant difference between individual entrepreneurial orientation in faculty students who attended the course and those who did not. This suggests that students' participation in the entrepreneurship course may have had a positive effect on individual entrepreneurship skills ($p < 0.05$).

According to the results of the examination of individual entrepreneurial orientation in students enrolled in coaching education or sport management departments at the faculty of sports science, it was determined that the datasets did not meet the assumptions of normal distribution and sphericity. Therefore, the Mann-Whitney U test was performed to examine whether there was a difference between the two departments. According to the results, in the analysis of individual entrepreneurial orientation in sports science faculty students, a statistically significant difference was detected only in the proactiveness parameter. This means that proactivity emerged as the most significant factor influencing students' entrepreneurial orientation ($p < 0.05$).

It can be stated that receiving coaching education or sport management education had a statistically significant effect on students' individual entrepreneurship. This shows that entrepreneurial orientation in these student groups differed when other parameters were taken into account, and that the entrepreneurial potential in students receiving a certain education was positively affected.

In this study, individual entrepreneurial orientation in sports science faculty students was examined according to their gender, physical activity levels and educational programmes. Considering the findings of the study, some important conclusions emerge. Firstly, age, height and weight characteristics were examined according to gender and differences between genders were detected. According to Korkmaz's (29) study, it was stated that there was a relationship between students' entrepreneurial orientation and age. In that study, it was revealed that age was related to self-confidence and innovation, type of learning was related to innovation and risk taking, and the presence of family entrepreneurs had a significant relationship with self-confidence, innovation and the need for success. Similarly, Aksel and Bağcı's (28) study concluded that there was a significant relationship between entrepreneurial orientation and age.

In addition, no significant difference was found between entrepreneurial orientation in male students with different physical activity levels. Moreover, no significant effect was detected on entrepreneurial orientation in female students with different physical activity levels. Furthermore, it was determined that the individual entrepreneurial orientation of the participants did not meet the assumptions of normal distribution and sphericity. The Mann-Whitney U test showed that there was a significant relationship between course participation status and individual entrepreneurial orientation.

As it is known, there is a lack of research regarding entrepreneurship among sports science students. Therefore, we believe that this study will help fill that gap. However, this can also be considered one of the limitations of the study.

DISCUSSION AND CONCLUSION

In conclusion, it was determined that being a student in either the Coaching Education or Sport Management department had a statistically significant effect on certain individual entrepreneurship parameters.

However, when individual entrepreneurial orientation was examined in general, although differences were found under certain conditions, no significant differences were observed under other conditions. Accordingly, further studies may be needed and the impact of different factors on individual entrepreneurship can be examined in more detail. In addition, the failure of datasets to meet the assumptions of normal distribution and sphericity is an issue that should be taken into consideration in future studies. In line with these findings, the following recommendations are presented to researchers in order to contribute to the literature:

- It is recommended that courses on individual entrepreneurship be added to university programmes. These courses can help students develop entrepreneurial skills.

- Mentorship programmes and internship opportunities should be offered to students to enable them to benefit from entrepreneurship opportunities in the field of sports. In this way, students can find the opportunity to combine their theoretical knowledge with practical experiences.

- Organising awareness-raising events related to entrepreneurship can encourage students to discover their entrepreneurial potential.

- The chance for students to interact with professionals in the sector can be increased by organising entrepreneurship conferences and seminars.

- Workshops can be organised with expert speakers to provide students with basic training on finance and business issues.

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Footwear Preferences of Scouts Who Are Members of the Scouting Federation of Turkey

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Abstract

The aim of this study is to determine the footwear preferences of individuals who are members of the Turkish Scouting Federation and actively participate in scouting activities and camps. The research model was constructed using the general survey method. Data were collected from a total of 390 active scouts through the administration of the "Footwear Preference Scale" and a "Personal Information Form." Responses from 31 participants who either gave irrelevant answers to the instructions or did not respond at all were excluded from the analysis. Thus, the final dataset consisted of responses from 359 scouts, including 153 females and 206 males. The collected data were analyzed using the SPSS 23 software package. For variables with two groups, the Mann-Whitney U test was applied, while the Kruskal-Wallis test was used for variables with more than two groups. In order to identify the relationships between the groups and the variables in detail within multiple-group comparisons. As a result of the analyses, significant relationships were identified across all sub-dimensions of footwear preference factors—excluding the variables of price and socio-environmental factors—with comfort, quality, brand, gender, age, scouting experience, and monthly household income. A closer examination of the data revealed that as scouts' status or the duration of their active participation in scouting increased, their preference for footwear used in camps and scouting activities became more function-oriented, with less emphasis on style and trends. These findings indicate that within the Turkish Scouting Federation, the importance attached to functionality in footwear selection is directly proportional to the time spent in scouting and camp activities. Furthermore, it was concluded that gender, perceptions of quality and brand, and monthly household income are among the determining factors in scouts' footwear preferences. These findings indicate that within the Turkish Scouting Federation, the importance attached to functionality in footwear selection is directly proportional to the time spent in scouting and camp activities. Furthermore, it was concluded that gender, perceptions of quality and brand, and monthly household income are among the determining factors in scouts' footwear preferences.

Keywords: Scout Footwear, Footwear Preferences, Footwear Selection, Scouting Equipment

Özet

Türkiye İzci Federasyonuna Üye İzcilerin Ayakkabı Tercihleri

Bu çalışmanın amacı, Türkiye İzcilik Federasyonuna üye olan ve izcilik faaliyetleri ile kamplara aktif olarak katılan bireylerin ayakkabı tercihlerini belirlemektir. Araştırma modeli genel tarama yöntemi kullanılarak oluşturulmuştur. Veriler, toplam 390 aktif izciden "Ayakkabı Tercih Ölçeği" ve "Kişisel Bilgi Formu" uygulanarak toplanmıştır. Anket talimatlarına alakasız yanıt veren veya hiç yanıt vermeyen 31 katılımcının verileri analiz dışında bırakılmıştır. Böylece

analizlerde 153'ü kadın, 206'sı erkek olmak üzere toplam 359 izcinin verileri kullanılmıştır. Toplanan veriler SPSS 23 paket programı kullanılarak analiz edilmiştir. İki gruptan oluşan değişkenler için Mann-Whitney U testi, ikiden fazla gruptan oluşan değişkenler için ise Kruskal-Wallis testi uygulanmıştır. Çok gruplu karşılaştırmalarda ise gruplar ile değişkenler arasındaki ilişkilerin ayrıntılı bir şekilde incelenmesi amacıyla analizler gerçekleştirilmiştir. Yapılan analizler sonucunda, konfor, kalite, marka, cinsiyet, yaş, izcilik deneyimi ve aylık hane gelir düzeyi değişkenleri ile ayakkabı tercih faktörlerinin tüm alt boyutları arasında, fiyat ve sosyo-çevresel faktörler hariç, anlamlı ilişkiler tespit edilmiştir. Verilerin daha yakından incelenmesiyle, izcilerin kıdemi ya da izcilik faaliyetlerine katılım süresi arttıkça kamp ve izcilik faaliyetlerinde kullanılan ayakkabı tercihlerinin tarz ve trendlere olan ilgiden uzaklaşıp işlevselliğe yönelik hale geldiği görülmüştür. Bu bulgular, Türkiye İzcilik Federasyonu bünyesindeki bireylerde ayakkabı seçiminde işlevselliğe verilen önemin, izcilik ve kamp faaliyetlerinde geçirilen süre ile doğru orantılı olarak arttığını göstermektedir. Ayrıca, cinsiyet, kalite ve marka algısı ile aylık hane geliri değişkenlerinin de izcilerin ayakkabı tercihinde belirleyici faktörler arasında yer aldığı sonucuna ulaşılmıştır.

Anahtar Kelimeler: İzci Ayakkabıları, Ayakkabı Tercihleri, Ayakkabı Seçimi, İzci Ekipmanları

INTRODUCTION

Footwear preference is shaped by individuals' lifestyles, aesthetic perceptions, socio-cultural factors, and income levels. However, the factors influencing footwear choices are not limited to these. Research indicates that climatic conditions also affect individuals' footwear preferences, and that younger age groups with a heightened awareness of style and brand tend to prefer popular brands, associating these choices with social acceptance (1-6). Additionally, with the rise of sneaker culture, certain brands have gained symbolic value, leading users to choose athletic shoes in everyday life as an expression of their personal style (7-10). While fashion, aesthetics, and trends undeniably influence footwear preferences, other studies have demonstrated that ergonomic sole structures and breathable materials also play a crucial role in footwear selection(11).

Functionality occupies a significant position among the factors that shape individuals' footwear preferences. Footwear intended for daily use or specialized activities is evaluated not solely based on aesthetic appeal and brand perception, but also according to features that align with their intended purpose of use. For instance, footwear designed for extended walking or challenging terrain conditions offers supportive sole construction, non-slip outsoles, and anatomically-appropriate insoles, whereas footwear selected for urban use prioritizes lightweight construction, breathability, and versatility in styling combinations. Furthermore, the emphasis users place on foot health prompts them to consider particularly heel and ankle support, flexibility, and shock-absorbing sole characteristics (12).

Studies on brand loyalty across different demographic groups have demonstrated that the association of certain footwear brands or models with specific status or group identity can directly influence individuals' preferences (13). Within this context, decisions regarding footwear selection are made through the concurrent evaluation of aesthetics, ergonomics, durability, and symbolic values.

In this context, the aim of this study is to determine the factors affecting the footwear preferences of a specific group that already experiences a sense of unity and belonging through wearing uniforms and being accepted as members of a collective. Therefore, the sample group was selected from members of the Turkish Scouting Federation, who gather to improve their skills for living in nature.

This study specifically focuses on scouts, as they represent a unique user group whose footwear needs are shaped not only by general consumer preferences but also by the functional and environmental demands of scouting activities. Understanding their footwear preferences can provide valuable insights for designing shoes that are both performance-oriented and aligned with the identity and values of the scouting community.

While no specific academic studies focusing solely on the footwear preferences of scouts were encountered during the literature review, the findings of this study are significant for filling this gap in the field. However, existing research highlights that scouts, like other outdoor activity participants, should wear footwear that is well-fitted, comfortable, provides ankle support, and is durable (14, 15). Furthermore, a scouting-related website also emphasizes that appropriate footwear selection for scouts should take into account the type of activity, the estimated walking distance, and the weight to be carried(16).

METHOD

This study on scouts' footwear preferences was designed within the scope of quantitative research methods, as it aims to measure individuals' current attitudes, behaviors, and preferences. The general survey model was employed to describe specific characteristics of sample groups selected from larger populations.

Study Group

In footwear use, shoes are chosen with greater sensitivity for special contexts. One such context is scouting. Scouts prefer special footwear according to the conditions of use. For this reason, the study group consists of scouts who are members of the Turkish Scouting Federation (TİF) and engage in scouting activities at a professional level.

The study data were obtained from 391 scouts selected using a convenience sampling method. Responses from 32 individuals who either gave irrelevant answers or failed to comply with the survey instructions were excluded. Consequently, the final sample consisted of 359 scouts, including 153 females and 206 males.

Individuals under the age of 18 were excluded from the study group, as they are unable to make independent footwear choices, do not possess economic autonomy, and do not participate in scouting activities as actively as adults. Therefore, in the analysis of footwear preferences by age, participants were grouped as under 20 years old (18–20) and over 20 years old.

Within the Turkish Scouting Federation, each scouting level is designated by a distinct title (17), and the participants included in the study represented seven different levels of seniority. These are as follows:

Scout Volunteers: Individuals over the age of 18 who are involved in scouting activities but are not authorized to train scouts.

Scouts: Individuals trained by scout leaders up to the age of 18. Scout leaders are certified personnel authorized to train scouts (holding an LTK certificate).

Unit-Leading Scout Leaders: Leaders who are actively responsible for training and managing scout units.

Non-Unit-Leading Scout Leaders: Individuals who participate in scouting activities but are not involved in training scouts.

In addition to these, there are rank distinctions for leaders who have completed branch-specific training:

2 Wood Badge Holder, 3 Wood Badge Holder and 4 Wood Badge Holder.

Data Collection Tools and Scale

A "Personal Information Form" developed by the researchers was used to collect demographic data such as gender, age, duration of scouting experience, household income, and scouting level. To determine footwear preferences, the "Footwear Preference Scale," developed by Uzun and Karaçam (18) and approved by the Scientific Ethics Committee of the Faculty of Architecture and Design on 09.12.2024 (decision no. 06), was utilized and was administered to volunteer members of the Turkish Scouting Federation between February and March 2025. This scale includes sub-dimensions such as comfort, style, quality, price, brand preference, and social and environmental factors.

The scale is a 5-point Likert-type instrument, ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). It was developed based on a comprehensive literature review and expert feedback. Validity and reliability analyses were conducted during the development process, and the Cronbach's alpha coefficient for the overall scale was reported as 0.89, indicating high internal consistency.

Data Analysis

The data were analyzed using SPSS (Statistical Package for the Social Sciences) version 23.0 for Windows. To determine whether the data followed a normal distribution, the Kolmogorov-Smirnov and Shapiro-Wilk tests were applied. According to the results of both tests, the p-values for all variables were found to be less than 0.05, indicating that the data did not follow a normal distribution. Therefore, non-parametric tests were preferred for the analyses. So the Mann–Whitney U test was used for comparisons between two groups. The

internal consistency of the scale was calculated using Cronbach's alpha. The results were evaluated at a 95% confidence interval, with significance set at $p<0.05$.

The confidence interval was determined to be 95%. Based on the Shapiro-Wilk normality test, all variables were found to deviate from a normal distribution ($p < 0.05$). Furthermore, the groups lacked homogeneity in their distributions. Therefore, the Mann–Whitney U test was applied to variables with two groups, while the Kruskal–Wallis test was used for variables with more than two groups. Specifically, Tamhane's T2 non-parametric test was preferred because it does not assume equal variances between groups and is suitable for analyzing pairwise comparisons in cases of heterogeneity of variances and non-normal distribution.

Table 1. Normality Test

	Static	df	Sig.	Statistic	df	Sig.
Confort	,195	359	,000	,791	359	,000
Quality	,358	359	,000	,605	359	,000
Price	,162	359	,000	,853	359	,000
Brand Preference	,049	359	,041	,985	359	,001
Social and Environmental Factors	,068	359	,000	,958	359	,000

FINDINGS

The demographic characteristics of the 391 participants who completed the Footwear Preference Scale are presented in Table 2.

Table 2. Descriptive Statistics		**n**	**%**
Gender	Male	170	43,5
	Female	221	56,5
Age	18-20	142	36,3
	21-30	75	19,2
	31-40	46	11,8
	41-50	72	18,4
	50 +	56	14,3
Monthly Household İncome	0-20.000	56	14.3
	20,001-35,000	80	20.5
	35,001-50,000	128	32.7
	50,001-65,000	66	16.9
	65,001 +	61	15.6
Scouting Period	0-1 year	59	15.1
	1-2 year	46	11.8
	2-3 year	33	8.4
	3-4 year	26	9.2
	4-5 year	26	5.6
	5-10 year	67	17.1
	10-15 year	65	16.1
	15 year +	69	17.6
Scouting Level	Scouting Volunteer	117	30
	Scout	37	9,5
	Leader	63	16,1
	Unit-Leading Leader	83	21,2
	Non-Unit-Leading Leader	20	5,1
	Assistant Leader	40	10,2
	2 Wood Badge Holder	15	3,8
	3 Wood Badge Holder	16	4,1

Using the Footwear Preference Scale, the footwear choices of 391 scouts affiliated with the Turkish Scouting Federation were initially collected, but only the data from 359 participants with valid responses were included in the analysis during scouting activities and camps. Due to the presence of more than two groups in the independent variables, post-hoc tests were conducted using Bonferroni-adjusted p-values. The interpretation of the findings was based on the data presented in the Tests of Between-Subjects Effects table.

Table 3. Kruskal-Wallis Test Results Based on Participants' Comfort Perception and Scouting

	Comfort
Kruskal-Wallis H	15,414
Df	8
p	,052
p>,05	

Since the mean value in the Kruskal–Wallis test was very close to the significance threshold of .052, a post-hoc test was conducted to determine which of the seven scouting levels had a statistically significant relationship compared to the other groups.

Table 4. Post-Hoc Comparison Table Based on Participants' Comfort Perception and Scouting Level

Scouting Level (I)	**Scouting Level (J)**	**Mean Difference (I-J)**	**Sig. (p)**
4 Wood Badge Holder	**Scouting Volunteer**	,61212	,001
	Scout	,49189	,000
	Leader	,42414	,000
	Unit-Leading Leader	,37895	,000
	Non-Unit-Leading Leader	,28889	,000
	Assistant Leader	,30556	,001
	2 Wood Badge Holder	,41667	,229
	3 Wood Badge Holder	,31667	,519
P<05			

According to the Comfort Perception and Scouting Level Post-Hoc Table, a significant relationship was identified between the dependent variable of comfort and scouting level. Specifically, it was found that only scouts at level 4 Wood Badge Holder had a significantly different perception of comfort compared to scouts in the other groups.

Table 5. Kruskal-Wallis Table Based on Participants' Perception of Quality and Scouting Level

	Quality
Kruskal-Wallis H	13,578
Df	8
p	,093
p>,05	

Since the result of the Kruskal–Wallis test was .093, no statistically significant difference was found.

Table 6. Kruskal-Wallis Test Results Based on Participants' Perception of Price and Scouting Level

	Price
Kruskal-Wallis H	4,528
Df	8
p	,807
p>,05	

In the Kruskal–Wallis test, the mean value was .807, which does not indicate a statistically significant result and is considerably higher than the accepted significance threshold. Therefore, a post-hoc test was not conducted to determine whether the Price Perception factor differed among the groups.

Table 7. Kruskal-Wallis Test Results Based on Participants' Footwear Brand Perceptions and Scouting Level

	Brand Preference
Kruskal-Wallis H	11,113
Df	8
p	,195
p>,05	

In the Kruskal–Wallis test, the mean value was .195, which does not indicate a statistically significant result and is considerably higher than the accepted significance threshold. Therefore, a post-hoc test was not performed.

Table 8. Kruskal-Wallis Test Results Based on Participants' Sensitivity to Social and Environmental Factors in Footwear Production and Marketing, and Scouting Level

	Social and Environmental Factors
Kruskal-Wallis H	8,851
Df	8
p	,355
p>,05	

In the Kruskal–Wallis test, the mean value was .355, which does not indicate a statistically significant result. Since this value is considerably higher than the accepted significance threshold, a post-hoc test was not conducted.

Table 9. Mann–Whitney U Test Results for Participants' Footwear Preferences by Gender

	Gender	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**F**
Comfort	Woman	153	195,34	29887,50		
	Man	206	168,60	34732,50	13411,50	**,013***
Quality	Woman	153	177,56	27166,50		
	Man	206	181,81	37453,50	15385,50	,653
Price	Woman	153	181,75	27808,50		
	Man	206	178,70	36811,50	15490,50	,778
Brand Preference	Woman	153	176,85	27058,50		
	Man	206	182,34	37561,50	15277,50	,620
Social and Environmental Factors	Woman	153	197,14	30168,50		
	Man	206	167,27	34457,50	13165,50	**,007***
p<,05						

Among the scouts who participated in the study, 153 were female and 206 were male. When examining the relationship between participants' gender and their footwear preferences, statistically significant differences were found in the sub-dimensions of comfort and social and environmental factors.

Table 10. Mann–Whitney U Test Results for Participants' Footwear Preferences by Age

	Age	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**F**
Comfort	Younger than 20	203	172,97	35112,00		
	Older than 20	106	189,15	296508,00	14406,000	,130
Quality	Younger than 20	203	177,14	35959,50		
	Older than 20	106	183,72	28660,50	15253,500	,486
Price	Younger than 20	203	183,12	37172,50		
	Older than 20	106	175,95	27447,50	15201,500	,507
Brand Preference	Younger than 20	203	190,72	38715,50		
	Older than 20	106	166,05	25904,50	13658,500	**,025***
Social and Environmental Factors	Younger than 20	203	170,70	34652,50		
	Older than 20	106	192,10	29967,50	13946,500	,052
p<,05						

Of the scouts who participated in the study, 203 were under the age of 20, while 106 were over 20. When examining the relationship between participants' age and their footwear preferences, a statistically significant difference was found only in the brand preference sub-dimension.

Table 11. Mann–Whitney U Test Results for Participants' Footwear Preferences by Scouting Duration

	Scouting Duration (Year)	N	Mean Rank	Sum of Ranks	U	F
Comfort	Less then 5	177	173,82	30767,00	15014,000	,250
	More than 5	182	186,01	33853,00		
Quality	Less then 5	177	169,55	30010,00	14257,000	**,028***
	More than 5	182	190,16	34610,00		
Price	Less then 5	177	187,11	33118,00	14849,000	,190
	More than 5	182	173,09	31502,00		
Brand Preference	Less then 5	177	171,43	30342,50	14589,500	,122
	More than 5	182	188,34	34277,50		
Social and Environmental Factors	Less then 5	177	171,43	30678,00	14925,000	,228
	More than 5	182	188,34	33942,00		
p<,05						

Among the scouts who participated in the study, 177 had been members of the Turkish Scouting Federation (TSF) for less than five years, while 182 had been members for more than five years. When examining the relationship between the duration of scouting experience and footwear preferences, a statistically significant difference was found only in the quality preference sub-dimension.

Table 12. Mann–Whitney U Test Results for Participants' Footwear Preferences by Monthly Household Income

	Monthly Household Income	N	Mean Rank	Sum of Ranks	U	F
Comfort	Minimum wage or less	247	179,38	44307,00	13679,000	,862
	Above minimum wage	112	181,37	20313,00		
Quality	Minimum wage or less	247	179,86	44424,50	13796,500	,964
	Above minimum wage	112	180,32	20195,50		
Price	Minimum wage or less	247	188,73	46616,00	11676,000	**,015***
	Above minimum wage	112	160,75	18004,00		
Brand Preference	Minimum wage or less	247	180,93	44689,00	13603,000	,801
	Above minimum wage	112	177,96	19931,00		
Social and Environmental Factors	Minimum wage or less	247	182,33	45036,00	13256,000	,527
	Above minimum wage	112	174,86	19584,00		
p<,05						

In footwear preferences, price was found to be an important factor for the 247 scouts whose household income was at or below the minimum wage, whereas for the 112 scouts with household income above the minimum wage, price was relatively less important in their footwear choices.

DISCUSSION AND CONCLUSION

Scouting encourages individuals to connect with nature and adopt a lifestyle that prioritizes simplicity and resilience (19). In this context, preferences regarding basic equipment such as footwear are naturally influenced more by factors like ease of use, durability, and comfort rather than brand preferences that may symbolize social status. When examining the relationship between scouting status and footwear preferences, it was found that scouts at level 4 Wood Badge Holder had a different perception of comfort compared to other scouts. This finding aligns with literature that explains how status-based consumption behavior influences preferences (11, 15).

In shaping the perception of quality in footwear, individuals' consumption attitudes, value judgments, and brand loyalty play a significant role (6, 20). The analyses revealed that voluntary scouts and level 4 scouts did not differ significantly from other scout groups in terms of quality perception, suggesting that these groups share similar social norms and cognitive patterns when evaluating quality. Especially in groups characterized by voluntary and systematic participation, quality perceptions appear to be shaped by experiential foundations and common consumer values (21). Thus, the absence of significant differences between these groups may indicate that quality perception is shaped not only by product characteristics but also by group dynamics and consumer culture.

Analyses among scout groups showed that neither status (e.g., leadership position, seniority) nor scouting experience significantly affected perceptions of price and brand. Although demographic characteristics, social status, and experience level are generally considered determining factors in consumer behavior(22, 23), the findings suggest that structures based on solidarity, functionality, and harmony with nature, such as scouting, influence consumer behavior differently. This highlights the dominance of functional consumption values over symbolic consumption elements (23).

Additionally, the adoption of egalitarian principles within the group may limit the tendency to express identity through brand consumption (24). The principles of scouting, which encourage modesty in social interactions, also lead individuals to make footwear choices in accordance with group norms rather than personal identity.

Although awareness regarding social responsibility and environmental sustainability has increased among consumers in recent years, this awareness does not always translate into behavior across all consumer groups (24, 25). While it might be expected that groups with a lifestyle closely connected to nature—like scouts—would prefer footwear brands that prioritize social and environmental factors, the analyses show that this tendency remains limited regardless of status or experience. The fact that experienced groups like the level 4 scouts do not favor such brands is a noteworthy contradiction. This may be due to two reasons: first, the products of environmentally responsible companies may not adequately meet scouts' needs for ergonomics and durability—reflecting a gap between the 'ideal' and the 'real' often discussed in consumer behavior literature (25). Second, limited accessibility due to high prices or lack of availability may reduce the likelihood of purchase (26), especially for functionality-focused scouts. Consumer decisions are shaped not only by values and awareness but also by the structure of the market and the quality of product supply (27, 28). Thus, a positive attitude toward eco-friendly products may not translate into behavior if such products are underrepresented in the supply chain.

Research on gender differences in consumer behavior shows that men and women have different priorities when choosing products (29, 30). In this study, it was found that men placed more importance on comfort in footwear compared to women. This finding aligns with previous studies indicating that male consumers prioritize performance-related features such as functionality and durability (31, 32). Furthermore, the analysis revealed that women are more likely than men to buy footwear from companies that consider environmental factors (33). This supports existing literature suggesting that women are more sensitive to sustainability, ethical production, and eco-friendly brand policies (34, 35). Studies conducted in Turkey also indicate a higher level of environmental sensitivity among female consumers (36).

Age is a key demographic variable that affects purchasing decisions in consumer behavior. Studies show that younger individuals tend to prioritize brand preference more and view brands as a means of expressing identity, belonging, and social approval (37, 38). This trend was also observed among scouts. According to the findings, younger scouts placed greater importance on brand in footwear preferences compared to those over 20. This may be due to their lack of experience in scouting, leading to more image- and brand-driven choices rather than functional ones. It is also possible that younger individuals have not yet developed the awareness that brand-based acceptance is not applicable in scouting groups (39). In contrast, older and more experienced scouts showed a more functional approach to brands, prioritizing durability, comfort, and ergonomics. This reflects a shift from brand-centric to need-based preferences that comes with age and growing consumer knowledge (40). Moreover, studies emphasize that internal satisfaction becomes more influential than external validation in older consumers' decisions, leading them to focus more on quality (41).

Experience is one of the key factors influencing quality perception in product preferences. It is well known that individuals who regularly use products under similar conditions develop a more selective and informed attitude over time (42). In scouting, which involves challenging environmental conditions, it has been observed that expectations for footwear performance and quality increase with the length of experience. As consumer behavior evolves, quality tends to be defined more in terms of a product's ability to fulfill its function (24). The harsh conditions of scouting activities continuously raise the expectations of experienced scouts regarding their footwear. Moreover, long-term scouting experience also affects expectations about product lifespan. Experienced scouts tend to prefer long-lasting, easy-to-maintain footwear that can adapt to various climates, linking the perceived value of quality with product usage duration (43).

According to consumer behavior literature, individuals tend to strike a balance among quality, brand, and price when choosing products. However, for consumers in lower-income groups, price often takes precedence over other attributes (26). Given that comfort and quality are critical for scouting footwear, the fact that scouts from households earning at or below the minimum wage base their choices primarily on price highlights the cost sensitivity in custom footwear production. Studies show that low-income consumers, especially in functional consumption areas, tend to prioritize price over quality (36). The findings of this study confirm that price is a more significant factor for scouts with lower household income, while it is less important for those with higher income. This price-oriented behavior can reduce performance and increase safety risks in long-term scouting activities. Since comfort and quality-enhancing features raise production costs (44), compromising these can render the product inadequate for field use. Therefore, developing products that balance affordability and quality would be a sustainable solution for both producers and consumers.

Based on the findings of this study, it can be concluded that among members of the Turkish Scouting Federation, the importance placed on functionality when selecting footwear for camps and activities increases proportionally with scouting experience. Additionally, gender, quality and brand perception, and household income were found to be significant factors influencing footwear preferences.

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The Effects of Whole-Body Electromyostimulation Training on Body Composition in Sedentary Adults

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Abstract

It is necessary to determine the effects of whole-body electromyostimulation (WB-EMS) training, which is an innovative training method that is based on voluntary muscle activation by providing muscle contraction with electrical currents applied externally through the skin to muscle tissues and motor points and saves time by being applied in a short time, on body composition, which is one of the basic requirements of healthy life in inactive adults. The study aimed to explore the impact of WB-EMS training on body composition in sedentary adults. Fifty-five healthy adults (27 male, 28 female) aged 30-39 who did not engage in regular exercise voluntarily participated in the study. Participants were divided into two groups: the training group (TG, n=27) and the control group (CG, n=28). The training group performed WB-EMS training twice weekly for eight weeks, while the control group continued their usual routines without any training intervention. Body composition measurements were taken before and after the training program using the Tanita BC 418 model device. A 2*2 Repeated Measures ANOVA was employed to compare pre-test and post-test measures, and the data were analyzed using SPSS 25.0 (SPSS Inc., Chicago, IL, USA). The significance level was set at $p<0.05$. The results showed significant changes in body weight, body fat percentage, and body mass index due to time and group-time interactions ($p<0.05$). However, no significant interaction was related to lean body mass ($p>0.05$). The eight-week WB-EMS training program decreased body weight, body fat percentage, and body mass index among sedentary adults, while lean body mass remained unchanged. Therefore, WB-EMS training creates significant changes, especially in the body's fat tissue. WB-EMS training, which enables high muscle activation and time efficiency within a short duration, may be recommended as an intervention to reduce body fat mass in healthy adults who do not exercise regularly.

Keywords: Electromyostimulation (EMS), body composition, body mass index

Özet

Sedanter Yetişkinlerde Tüm Vücut Elektromyostimülasyon Antrenmanının Vücut Kompozisyonu Üzerine Etkileri

Kas dokularına ve motor noktalara deri yoluyla dışarıdan uygulanan elektrik akımları ile kas kasılmasını sağlayarak istemli kas aktivasyonuna dayanan, kısa sürede uygulanarak zaman kazandıran yenilikçi bir antrenman yöntemi olan tüm vücut elektromiyostimülasyon (WB-EMS) antrenmanının sedanter yetişkinlerde sağlıklı yaşamın temel gereksinimlerinden biri olan vücut kompozisyonu üzerindeki etkilerinin belirlenmesi gerekmektedir. Bu nedenle çalışmada, WB-EMS antrenmanının aktif olmayan yetişkinlerde vücut kompozisyonu üzerindeki etkilerinin incelenmesi

amaçlanmıştır. Çalışmaya günlük yaşamlarında egzersiz yapmayan 30-39 yaş arası elli beş (27 erkek, 28 kadın) sağlıklı yetişkin gönüllü olarak katılmıştır. Katılımcılar iki gruba ayrılmıştır: antrenman grubu (AG, n=27) ve kontrol grubu (KG, n=28). Antrenman grubu sekiz hafta boyunca haftada iki kez WB-EMS antrenmanı yaparken, kontrol grubu herhangi bir antrenman programı olmaksızın rutin yaşamlarına devam etmiştir. Vücut kompozisyonu ölçümleri Tanita BC 418 model cihaz kullanılarak antrenman programı öncesinde ve sonrasında gerçekleştirilmiştir. Ön ve son test ölçümleri 2*2 Tekrarlı Ölçümler ANOVA kullanılarak karşılaştırılmıştır. Veriler SPSS 25.0 (SPSS Inc., Chicago, IL, ABD) programında analiz edilmiştir ve anlamlılık düzeyi $p<0.05$ olarak belirlenmiştir. Zaman ve grup-zaman etkileşimlerinde vücut ağırlığı, vücut yağ yüzdesi ve vücut kitle indeksi sonuçları anlamlı bulunmuştur ($p<0.05$). Ancak, yağsız vücut kütlesi için herhangi bir etkileşim bulunmamıştır ($p>0.05$). Aktif olmayan yetişkinlerde sekiz haftalık WB-EMS antrenman programı vücut ağırlığını, vücut yağ yüzdesini ve vücut kitle indeksini azaltırken, yağsız vücut kitlesini değiştirmemiştir. Dolayısıyla, WB-EMS antrenmanı özellikle vücudun yağ dokusunda önemli değişiklikler meydana getirmektedir. Kısa sürede yüksek kas aktivasyonu ve zaman tasarrufu sağlayan WB-EMS sistemi antrenmanının, düzenli egzersiz yapmayan sağlıklı yetişkinlerde vücut yağ kütlesini azaltmak amacıyla uygulanması önerilebilir.

Anahtar Kelimeler: Elektromiyostimülasyon (EMS), vücut kompozisyonu, vücut kütle indeksi

INTRODUCTION

Electromyostimulation (EMS) is an innovative training method that enables the activation of fast motor units, which are challenging to engage voluntarily. This is achieved by applying electrical currents externally through the skin to the muscle tissues and motor points, thereby enhancing performance (11). Since the introduction of EMS and its subsequent advancements, its applications in sports have expanded significantly over time. The adjustable current parameters and the isokinetic contractions facilitated by EMS allow for a variety of training methods tailored to individual needs. Research has demonstrated that EMS serves as a comprehensive option for strength training (7).

EMS (Electromyostimulation) is used in various fields, particularly for rehabilitating muscle-related injuries and addressing postural disorders. Modern whole-body EMS (WB-EMS) devices stimulate all major muscle groups simultaneously while allowing for gentle movements. These devices are gaining popularity in the health and fitness sector. WB-EMS is often praised for its time-saving benefits and positive effects on body composition (21). The use of EMS devices is on the rise, and they are recognized as a modern approach to sports and rehabilitation. They are user-friendly and can easily be operated at home or outdoors. The advantages of using EMS include reducing treatment time and costs while enhancing the overall effectiveness of workouts. Research indicates that after just a few training sessions with EMS, muscle resistance improves, and muscle hypertrophy occurs, benefiting both athletes and non-athletes. EMS specifically targets weakened muscle tissues and helps mobilize hard-to-reach muscles by inducing contractions through electrical stimulation. Furthermore, it can enhance athletic performance and facilitate quicker recovery from muscle injuries (2,8,18).

EMS is a widely used method for muscle strengthening across sports, medical rehabilitation, and functional recovery. Numerous studies have explored the impact of electrical stimulation on the strengthening of skeletal muscles, the improvement of muscle function following knee surgery, and the prevention of atrophy during periods of immobilization (1,13,23,27). In recent years, EMS has been adopted as a transcutaneous method for inducing muscle contractions and strengthening exercises in athletes. A key distinction of EMS research compared to other studies in this area is its ability to activate specific muscle fibers that are difficult to engage voluntarily, thus enabling targeted contraction and strengthening of these muscles. Electrical stimulation is applied superficially to the muscle's center using electrodes, resulting in a rapid and powerful contraction. Today, many professional athletes utilize EMS training to enhance their performance and accelerate muscle recovery (19).

Body composition refers to the different components that make up the body, including bone, adipose (fat) tissue, muscle tissue, other organic matter, and extracellular fluids. It can be broadly categorized into two groups: fat mass and lean mass (25). Lean mass encompasses bones, muscles, nerves, water, blood vessels, and other organic matter, while fat mass can be further classified into three types: storage fat, subcutaneous fat, and essential fat. Body composition measurement provides important insights into various physical parameters, such as a person's movement efficiency, speed, coordination, and overall fitness. The first step in

measuring body composition is to determine body density, which can then be used to calculate body fat percentage (6).

Training with the EMS system is an innovative technology that initially focused on rehabilitation and treatment. However, it has gained popularity among coaches, athletes, and sports scientists as an effective training method. EMS involves applying electrical currents to muscle tissue or motor points. Modern EMS devices can stimulate all major muscle groups simultaneously at a designated intensity during slow movements. As a result, their use in the health and fitness sectors is on the rise. One of the significant advantages of EMS is its time-saving nature and its positive impact on body composition. Its practicality and ease of use, particularly due to its ergonomic design, make it appealing. In recent years, whole-body EMS (WB-EMS) devices have become more popular than localized EMS options. The fitness industry frequently promotes exercise programs that are low in intensity but save time while still benefiting fitness and body composition. Recent studies have shown positive effects of EMS on body composition and fitness parameters. There is growing interest in the potential benefits of a method like WB-EMS, which offers a high level of muscle activation in a shorter duration compared to traditional training methods. This is particularly relevant for individuals who do not engage in regular exercise or struggle to find time for workouts. However, only a limited number of studies have explored the effects of WB-EMS training on physical, physiological, and motor characteristics, particularly body composition. More research is needed to investigate the impact of WB-EMS training on body composition, an essential aspect of a healthy lifestyle for inactive individuals. Therefore, our study aimed to examine the effects of whole-body EMS training on body composition in sedentary adults.

METHOD

Research Design and Participants

The study was conducted using a pre-posttest model, one of the experimental research designs. A power analysis was performed to determine the appropriate number of subjects using G*Power 3.1. In total, 55 healthy adults (27 male, 28 female) who did not engage in regular physical exercise and had no health issues participated voluntarily. The participants were divided into two groups: training group (TG, n=27) and control group (CG, n=28). The mean age of the training group was 33.52 ± 2.87 years, while the mean age of the control group was 34.75 ± 3.01 years. The average height of the training group was 169.30 ± 8.55 cm, compared to 170.75 ± 7.98 cm for the control group. The content and risks associated with the study were explained in detail to all participants, who were then asked to sign a consent form confirming their voluntary participation. Prior to the start of the study, approval was obtained from the Selçuk University Clinical Research Ethics Committee for all phases of the research (Protocol number: 105/04.09.2024).

Research Procedure

Before the pre-test measurements, participants underwent a two-week adaptation period to adapt to the device and electrical currents. The training group participated in whole-body EMS training twice a week for eight weeks, ensuring at least 72 hours between training sessions. Meanwhile, the control group continued their daily activities without participating in any training program. Body composition measurements were taken both before and after the training program.

Training Protocol

Adaptation practices were implemented so participants could adapt to the device and the incoming electrical currents. These practices included 20 minutes of walking, jogging, and static stretching exercises, conducted twice a week for two weeks before the training program and the pre-test measurements. The Miha Bodytec (GmbH, Gersthofen, Germany) wearable EMS device was utilized for the whole-body EMS (WB-EMS) training. WB-EMS was applied during eccentric contractions, with the participants returning to the starting position during the rest intervals. The WB-EMS involved the application of a bipolar electric current with the following parameters: frequency of 85 Hz, pulse width of 350 μs, a current pulse duration of 6 seconds, and a rest interval of 4 seconds (9). In the WB-EMS protocol, electrodes were positioned over the primary muscle groups, including the pectoral region (pectoralis major and minor), abdominal area (rectus abdominis), upper and lower back (latissimus dorsi, erector spinae, iliopsoas), upper extremities (deltoids, biceps, triceps), gluteal region (gluteus maximus), and lower limbs (quadriceps and hamstrings). The training equipment was moistened to ensure optimal delivery of electrical impulses to the muscles. Current intensity was

individualized and modified as needed throughout each session. To improve participant adaptation and reduce the risk of experimental harm, a 2–3-minute familiarization phase with electrical stimulation was conducted prior to every training session (24). Participants underwent 20 minutes of WB-EMS training twice a week for 8 weeks. The first 10 minutes of each session consisted of non-specific exercises, including squats, chest presses, shoulder presses, and lat pull-downs. The following 10 minutes incorporated biceps curls, triceps extensions, glute bridges, and plank exercises. In the initial four weeks of the training program, exercises were performed using body weight only. Additional weights were introduced in the subsequent four weeks, tailored to everyone's capacity. Standard warm-up and cool-down exercises were carried out before each workout.

Numerous studies employ a controlled maximum pulse intensity determined by the individual's pain tolerance, commonly referred to as the maximum tolerated current. This approach can lead to high muscle tension and restrict the dynamic range of motion (4,18). The maximum tolerable electrical intensity was self-assessed by participants before the session, with stimulation applied at 80–100% of this value. The intensity was fine-tuned based on performance during dynamic movement tasks. Careful and sensitive management of the current intensity is crucial for achieving positive results. Additionally, various factors, such as skin, fat, and muscle thickness, can affect the impedance differences in the stimulated areas. To tailor the exercise intensity to everyone, participants maintained a rate of perceived exertion (RPE) ranging from "difficult (heavy)" to "very difficult" (Borg CR-10 scale, 6 to 10) during the training sessions (3).

Body Composition

The measurements were conducted using the Tanita BC 418 model (Tanita Body Composition Analyzer, Type BC-418MA, Japan) with the Bio-Electrical Impedance method at the beginning and end of the 8-week training program. Anthropometric data, including body weight, body fat percentage, lean body mass, and body mass index (BMI), were systematically collected and subjected to analysis.

Statistical Analysis

Normality of the data was evaluated both statistically—via the Shapiro-Wilk test, skewness, and kurtosis—and graphically using histograms and Q-Q plots. Means and standard deviations were used in the data presentation. A 2*2 Repeated Measures ANOVA was performed to examine the differences in pre- and post-test values between the groups. The percentage changes for each group were calculated from the pre-test to the post-test. Additionally, Group, Time, and Group*Time interaction effects, along with effect size estimates, were calculated. Statistical analyses were performed using SPSS version 25.0 (SPSS Inc., Chicago, IL, USA), with the level of significance set at $p<0.05$.

FINDINGS

Table 1. Body composition pre/post-test values by groups

Variables	Group	N	Pre-Test	Post-Test	% Change
			$\bar{x}$ ± SD	$\bar{x}$ ± SD	
Body Weight (kg)	TG	27	78,837 ± 13,47	75,807 ± 13,83	**% 3,84**
	CG	28	74,836 ± 13,36	75,096 ± 13,13	% -0,35
Lean Body Mass (kg)	TG	27	56,411 ± 12,24	56,304 ± 12,35	% 0,19
	CG	28	55,961 ± 11,50	55,129 ± 10,98	% 1,49
Body Fat Percentage (%)	TG	27	28,648 ± 8,01	25,796 ± 7,86	**% 9,96**
	CG	28	25,279 ± 6,33	26,725 ± 5,81	% -5,72
Body Mass Index (kg/m^2)	TG	27	27,544 ± 3,60	26,333 ± 3,71	**% 4,40**
	CG	28	25,579 ± 3,06	25,604 ± 3,07	% -0,10

TG: Training Group; CG: Control Group; $\bar{x}$: Mean, SD: Standard deviation

Table 1 presents the pre-test and post-test body composition values and the percentage changes for the participants categorized by study groups. In the training group (TG), body weight, body fat percentage, and body mass index decreased by 3.84%, 9.96%, and 4.40%, respectively. However, there was no significant change in lean body mass, which showed a slight increase of only 0.19%. In contrast, the control group (CG) exhibited no significant differences in the measured variables.

Table 2. ANOVA results of repeated measures for body composition

Variables	Interaction	F	p	Effect Size
Body Weight (kg)	**G**	0,424	0,518	0,008
	T	31,591	**0,000***	**0,373**
	G*T	44,610	**0,000***	**0,457**
Lean Body Mass (kg)	**G**	0,066	0,798	0,001
	T	2,998	0,089	0,054
	G*T	1,784	0,187	0,033
Body Fat Percentage (%)	**G**	0,420	0,520	0,008
	T	6,501	**0,014***	**0,109**
	G*T	60,804	**0,000***	**0,534**
Body Mass Index (kg/m^2)	**G**	2,229	0,141	0,040
	T	35,125	**0,000***	**0,399**
	G*T	38,148	**0,000***	**0,419**

G: Group comparison; T: Time comparison; G*T: Group-Time interaction; *p<0,05.

The results of the repeated measures ANOVA for the participants' body composition are presented in Table 2. Statistically significant findings were observed for body weight, body fat percentage, and body mass index (BMI) in terms of time and group-time interactions ($p < 0.05$). However, no significant interaction was found for lean body mass values.

DISCUSSION AND CONCLUSION

Our study investigated the effects of WB-EMS training on body composition parameters in sedentary adults, including body weight, body fat percentage, body mass index (BMI), and lean body mass. The primary finding of our research was that an eight-week WB-EMS training program resulted in significant reductions in body weight, body fat percentage, and BMI, while having no effect on lean body mass.

Due to its portability and time efficiency, the WB-EMS system is increasingly favored as an alternative training method. It is particularly popular among adults who struggle to find time for daily exercise, lead sedentary lifestyles, and aim to lose weight. As the usage of this training method grows, research on its physical and physiological effects is becoming more common. A key indicator of physical characteristics is body weight. In an eight-week study involving sedentary women, Özdal and Bostancı (2016) reported a significant decrease in body weight with EMS training. Similarly, Çetin et al. (2017) observed notable reductions in body weight in sedentary women over eight weeks of EMS training. Kirişçioğlu et al. (2019) found that participating in EMS training twice weekly for eight weeks significantly lowered body weight in sedentary women. Our study also demonstrated that an eight-week WB-EMS training program significantly decreased adult body weight. These findings align with previous studies regarding the body weight variable. Overall, the literature and our results indicate that body weight significantly decreases with WB-EMS training.

The WB-EMS can enhance various body composition indices, including BMI and body fat mass. This improvement leads to a healthier body shape and a reduced risk of metabolic diseases. BMI and body fat mass are widely used measures that indicate the amount of fat stored in the body and its distribution. By improving these metrics, WB-EMS can help mitigate the risk of health issues associated with obesity and enhance overall well-being (13). Research studies support the effectiveness of WB-EMS training. For instance, Kirişçioğlu et al. (2019) found that EMS training conducted twice a week for eight weeks significantly reduced BMI, body fat percentage, and body fat mass in sedentary women. Similarly, Kim and Jee (2020) determined that eight weeks of EMS exercises significantly reduced body fat mass and fat percentage among healthy women. Kılıç et al. (2018) reported that a six-week WB-EMS training program significantly decreased fat mass, fat percentage, and BMI in sedentary adults. Kemmler et al. (2010) noted that 14 weeks of WB-EMS training significantly reduced subcutaneous body fat mass in adult women. Willert et al. (2019) found that 16 weeks of WB-EMS training significantly decreased body fat mass in overweight adult women. Furthermore, Jose Amaro-Gahete et al. (2018) indicated that a six-week WB-EMS training program significantly reduced body fat mass and BMI in recreational runners. Park et al. (2021) reported that an eight-week EMS exercise program significantly decreased body fat percentage and fat mass in adult women. A review by Rodrigues-Santana et al. (2023) concluded that the WB-EMS training program significantly reduces body fat mass. These findings align with our study's duration, methodology, and results. The literature and our research indicate that body fat mass

and percentage decrease significantly with WB-EMS training. One primary reason for this effect may be the intense muscle activation and increased calorie burning associated with the WB-EMS method. By sending electrical impulses directly to the muscles, WB-EMS causes them to contract and stimulates up to 90% of muscle fibers, compared to just 30-40% stimulated during conventional exercise. This heightened muscle activation can accelerate metabolism and lead to a greater calorie burn. Another factor contributing to this effect is the increased metabolic rate and fat oxidation with WB-EMS training. The training elevates the basal metabolic rate by causing the muscles to work more intensely, enabling the body to burn more calories even at rest. The accelerated metabolism during WB-EMS training also prompts the body to utilize fat as an energy source (23).

Research indicates that the WB-EMS training method effectively increases lean body mass and muscle mass while reducing adipose tissue components such as body fat mass, fat percentage, and BMI. For example, Kemmler et al. (2016) found that 16 weeks of WB-EMS training significantly enhanced lean body mass in healthy adult men. Similarly, Zink-Rückel et al. (2021) reported that a 16-week WB-EMS program positively impacted lean body mass in amateur golfers. Furthermore, Kemmler et al. (2017) demonstrated that 16 weeks of WB-EMS training significantly increased muscle mass in obese adult men. Kim and Jee (2020) also showed that eight weeks of EMS exercises led to a notable increase in skeletal muscle mass in healthy women. Additionally, Willert et al. (2019) confirmed that 16 weeks of WB-EMS training significantly boosted lean body mass in overweight adult women. In their review, Rodrigues-Santana et al. (2023) concluded that the WB-EMS training program significantly positively impacts muscle mass. However, unlike the studies mentioned, our study found that WB-EMS training did not significantly change lean body mass. This discrepancy may be due to the longer duration of the WB-EMS training program in previous studies compared to ours. Furthermore, the limited effects of WB-EMS on lean body mass could be attributed to variations in training parameters, such as the number of beats per second, contraction time, rest time, training content, and intensity.

In conclusion, an eight-week WB-EMS training program for sedentary adults significantly reduced body weight, body fat percentage, and body mass index, while lean body mass remained unchanged. This indicates that WB-EMS training effectively decreases body fat, particularly in adipose tissue. The WB-EMS system, which achieves high muscle activation quickly, can be recommended as an effective method for reducing body fat mass, even in adults who do not exercise regularly.

The study has several limitations. Essential variables, such as daily nutritional status and caloric intake, were not controlled, which is crucial for accurately assessing changes in body composition components like body weight and fat mass. Additionally, muscle mass was not explicitly measured in the assessment of lean body mass. Addressing these limitations in future research will enhance methodological quality, leading to a more effective evaluation of the effects of WB-EMS on body composition.

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The Profiles of Narcissism and Self-Esteem Among Anabolic Androgenic Steroid Users in the Sport of Bodybuilding: A Cross-Sectional Study

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Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.

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Abstract

Background: Contrary to common assumptions, bodybuilders who abstain from anabolic-androgenic steroids (AAS) may exhibit higher levels of narcissism and self-esteem compared to AAS users. This study aimed to compare these psychological traits between AAS users and non-users to construct a distinct psychometric profile. Methods: An analytical cross-sectional study was conducted across 16 gyms in Turkey. Data were collected from 25 AAS users and 41 non-users using the Narcissistic Personality Inventory (NPI-16) and the Two-Dimensional Self-Esteem Scale (self-liking/self-competence). Logistic regression analyzed the predictive effects of narcissism and self-esteem on AAS use. Results: Non-users scored significantly higher on narcissism (Odds raito (OR) = 1.48), global self-esteem (OR = 1.11), self-competence (OR = 1.18), and self-liking (OR = 1.21) than users. These findings suggest that natural training may reinforce self-enhancement tendencies, reducing reliance on AAS. Conclusion: Bodybuilders who refrain from AAS display stronger narcissistic traits and elevated self-esteem, including its sub-dimensions. This paradoxical profile highlights the potential psychological benefits of natural training, challenging stereotypes about AAS users.

Keywords: anabolic steroids; bodybuilding; narcissism; self-esteem; psychological profile

Vücut geliştirme sporunda anabolik androjenik steroid kullananlarda narsisizm ve öz saygı profilleri: kesitsel bir çalışma

Özet

Yaygın varsayımların aksine, anabolik-androjenik steroidlerden (AAS) uzak duran vücut geliştiriciler, AAS kullanıcılarına kıyasla daha yüksek düzeyde narsisizm ve öz saygı sergileyebilirler. Bu çalışma, AAS kullanıcıları ve kullanmayanlar arasında bu psikolojik özellikleri karşılaştırarak belirgin bir psikometrik profil oluşturmayı amaçlamaktadır. Yöntemler: Türkiye'deki 16 spor salonunda analitik kesitsel bir çalışma yürütülmüştür. Veriler, Narsistik Kişilik Envanteri (NPI-16) ve İki Boyutlu Benlik Saygısı Ölçeği (kendini beğenme/öz yeterlilik) kullanılarak 25 AAS

kullanıcısı ve 41 kullanıcı olmayan kişiden toplanmıştır. Narsisizm ve benlik saygısının AAS kullanımı üzerindeki yordayıcı etkileri lojistik regresyon ile analiz edilmiştir. Sonuçlar: Kullanıcı olmayanlar, narsisizm (Odds oranı (OR) = 1,48), genel öz saygı (OR = 1,11), öz yeterlilik (OR = 1,18) ve kendini beğenme (OR = 1,21) konularında kullanıcılara göre önemli ölçüde daha yüksek puan aldı. Bu bulgular, doğal antrenmanın öz geliştirme eğilimlerini güçlendirerek AAS'ye olan bağımlılığı azaltabileceğini göstermektedir. Sonuç: AAS'den kaçınan vücut geliştiriciler, alt boyutları da dahil olmak üzere daha güçlü narsisistik özellikler ve yüksek öz saygı sergilemektedir. Bu paradoksal profil, doğal antrenmanın potansiyel psikolojik faydalarını vurgulayarak AAS kullanıcıları hakkındaki klişeleri çürütmektedir.

Anahtar Kelimeler: Anabolik steroidler; vücut geliştirme; narsisizm; öz saygı; psikolojik profil.

INTRODUCTION

The pursuit of an idealized physique has become a defining feature of modern bodybuilding culture, driven by societal pressures to achieve muscularity and aesthetic perfection (1,2). Within this context, anabolic-androgenic steroids (AAS) have emerged as a controversial yet prevalent tool for enhancing performance and appearance, particularly among competitive bodybuilders (2,3). While the physiological risks of AAS are well-documented—including cardiovascular dysfunction, hormonal imbalances, and psychiatric effects (3,4)—the psychological drivers of AAS use remain less understood. Notably, the relationship between AAS use and traits like narcissism and self-esteem presents a paradox: while some studies associate steroid use with pathological narcissism and low self-worth (4,5), others suggest that AAS users may seek these substances to compensate for fragile self-esteem or body dissatisfaction (5-9). This discrepancy underscores the need for a clearer psychometric profile of AAS users, particularly in comparison to their non-using counterparts.

In contemporary psychology, narcissism is broadly categorized into two types: Grandiose narcissism, characterized by overt confidence, dominance and entitlement, aligns with the stereotypical 'arrogant' personality (10–13). Individuals with this trait exhibit high levels of extraversion, self-assurance and a need for admiration, which may superficially align with the competitive ethos of bodybuilding. Vulnerable narcissism, on the other hand, is marked by hypersensitivity to criticism, covert insecurity, and fluctuating self-esteem. Vulnerable narcissists often compensate for these traits with fantasies of superiority (10–13). This subtype may be particularly relevant to anabolic-androgenic steroid (AAS) users who seek pharmacological enhancement to mitigate body image insecurities (12–15). Bodybuilding is a unique arena for narcissistic expression where physical appearance is the means and the end of success. While some researchers posit that AAS users exhibit elevated grandiose narcissism, others argue that steroid use may be a maladaptive coping mechanism for underlying inadequacy. This dichotomy is similar to the 'muscle dysmorphia' phenomenon, whereby athletes perceive themselves as being insufficiently muscular despite having objective evidence to the contrary (17-18).

Self-esteem, a cornerstone of psychological well-being, is increasingly recognized as a multifaceted construct, particularly in high-performance contexts such as competitive bodybuilding (19, 20). Traditional unidimensional models of self-esteem often fail to capture the nuanced ways in which individuals evaluate themselves (19, 20). In contrast, the Two-Dimensional Self-Esteem Model, comprising self-liking and self-competence, provides a more granular understanding of self-worth (19–22). The self-liking dimension reflects the emotional aspect of self-esteem, representing an individual's subjective evaluation of their inherent worth as a social being (21, 22). High self-liking is associated with emotional resilience, social confidence, and a stable sense of belonging. In bodybuilding, self-liking may be related to athletes' satisfaction with their physique as a marker of social acceptance or attractiveness (21–23). The self-competence dimension encapsulates the cognitive-evaluative aspect, measuring perceived efficacy in achieving goals (20–23). It aligns with Bandura's (1977) concept of self-efficacy, which is critical in sports contexts where mastery and control are emphasized (24). For bodybuilders, self-competence may manifest as confidence in training outcomes or the ability to resist taking performance-enhancing drugs (20, 23). These dimensions interact dynamically: while self-liking anchors global self-worth, self-competence fuels motivation and goal-directed behavior. However, discrepancies between the two, such as high self-competence paired with low self-liking, may lead to maladaptive behaviors. Prior studies on AAS users have predominantly examined global self-esteem, overlooking these sub-dimensions. This study addresses this gap by examining self-esteem in more detail, offering insights into whether AAS use is linked to deficits in self-liking (e.g. body dissatisfaction) or self-competence (e.g. perceived training efficacy). (23).

Previous studies have been limited by small sample sizes, cultural homogeneity and a focus on extreme pathology. Despite evidence that non-users may derive greater psychological benefits from natural training, few studies have directly compared narcissism and self-esteem between AAS users and non-users in bodybuilding. This study addresses these gaps by comparing narcissism and self-esteem (including sub-dimensions) between Turkish bodybuilders who use AAS and those who do not, and by evaluating predictive relationships between these traits and AAS use via regression analysis. By clarifying these relationships, the study aims to inform interventions that promote a healthier self-perception and reduce the reliance on AAS among high-risk athletic populations.

METHOD

Experimental Approach to the Problem

To examine the hypothesis of the present investigation, Narcissistic Personality Inventory and Two-Dimensional Self-Esteem Scale were applied to collect data. The narcissism personality inventory and, the two-dimensional self-esteem scale were used for body building athletes. While 25 of these athletes were using steroid substances, 41 of them were not using steroid substances. The values of narcissism, self-esteem and self-esteem sub-dimensions were associated with steroid substance use. Finally, we developed a linear regression model to estimate the effects of narcissism, self-esteem, and self-esteem subscales on whether or not to use steroid substances.

Subjects

A total of 66 bodybuilding athletes were examined. These athletes regularly do bodybuilding training for 2 hours a day, every day of the week. The mean (SD) age was 24.55 ± 4.23 years for the 66 body building athletes. Before conducting the scales, all subjects were informed of the risks of the study and gave informed consent.

Procedures

The researchers used two instruments to collect data. The first of these instruments is the Narcissistic Personality Inventory, the 16-item version of which was standardized into the Turkish language by Atay (26) and re-adapted into the Turkish language by Gungor and Selcuk (27). The other instrument is the two-dimensional self-esteem (self-liking/self-competence scale). This scale has been developed by Tafarodi and Swann [22] and adaptation to Turkish language by Doğan [28]. This scale has two dimensions, 16 items, and the responses were provided as a 5-point scale. The athletes used approximately 20 minutes of time to respond to information on narcissism and self-esteem. The scale order was consistent: narcissism and self-esteem. The methodology used when administering the narcissism and self-esteem scales is summarized in the following paragraphs.

Narcissistic Personality Inventory-16 (NPI-16)

This is a self-report scale developed by Raskin and Hall (29) according to the DSM-III criteria for narcissistic personality disorder. Ames et al (30) created the 16-item form of the NPI, and each of these forms has two statements. One of these statements indicates a narcissistic trait. Participants are asked to read these item pairs and mark the statement that they think reflects them. The adaptation to the Turkish study was done by Atay (26), and Gungor and Selcuk (27) revised and reordered some of the statements. The Cronbach's alpha internal consistency coefficient of the scale was calculated as 0.75 and 0.74. It is assumed that as the scores obtained from the scale, whose total score can range from 0 to 16, increase, the grandiose narcissistic traits of the participants increase.

Two-dimensional self-esteem (Self-Liking/Self-Competence Scale)

This scale was developed by Tafarodi and Swann [22] and adapted to the Turkish language by Doğan [28]. This scale has two dimensions, 16 items, and the responses are given in the form of a five-point scale. The sum of the two scores will be used to determine the level of self-worth. Items 1, 3, 5, 6, 7, 9, 11, and 15 of the scale are related to the self-like subdimension, and items 2, 4, 8, 10, 12, 13, 14, and 16 are related to the self-competence dimension. Tafarodi and Swann (22) concluded that the scale confirmed its two-factor structure

based on the confirmatory factor analysis ($\chi 2$ = 6.56, df = 103, CFI = .92, RMSEA = .006), and they also found that the internal consistency coefficients for the sub-dimensions and the total scale were between .82 and .90. The scale was found to be reliable and valid in the Turkish language by Doğan (28). The researcher concluded from the confirmatory factor analysis that the two-dimensional structure of the scale was validated ($\chi 2$=258.40, df=98, CFI=0.97, RMSEA=0.049) and determined the internal consistency coefficients ranging from 0.72 to 0.83 for the subdimensions and total score of the scale. The Cronbach alpha coefficient for the total score was determined as .89.

Data Collection

The data for the research were collected in a face-to-face interview. If participants wished to participate in the study, they signed an informed consent form.

Statistical Analysis

Statistical analysis were performed using IBM SPSS statistics software (version 27). Data are presented as mean ± SD. The normality of the variables was assessed with the Kolmogorov-Smirnov test. Intraclass correlation coefficient (ICC) and coefficient of variation (CV) for absolute reliability were used to analyze the reliability of the performance tests. Ninety-five percent confidence intervals (CIs) were calculated for both the ICC and the CV. The dependent variable in the model was whether steroid substances are used. For the regression analysis, binary logistic regression analysis was assessed to determine the effect of steroid substance on narcissism, self-esteem and its subdimensions. Significant differences were accepted at $p \leq 0.05$.

Ethical approval and institutional permission

Ethical committee approval was obtained to conduct this study (Ethics Committee of Selcuk University the Faculty of Sports Sciences' Non-Invasive Clinical Research Ethics Committee: 26/10/2023:114). Participants in the study were informed of the purpose and scope of the study. This study was carried out according to the tenets of the Declaration of Helsinki.

FINDINGS

In Table 1, in terms of the narcissism variable, 18 out of 25 people who used steroid substances were predicted correctly in this model, while 35 out of 41 people who did not use steroids were predicted correctly (In Table 1). On the other hand, when the self-esteem sub-dimensions were evaluated, in terms of the self-competence sub-dimension, it was seen that 10 of the 25 people who used steroid substances were predicted correctly in this model, while 33 of the 41 people who did not use steroids were predicted correctly. At the same time, in terms of the self-liking sub-dimension, 12 out of 25 people who used steroids were predicted correctly in this model, while 34 out of 41 people who did not use steroids were predicted correctly. When evaluated over the total self-esteem, it was seen that 14 out of 25 people who used steroid substances were predicted correctly in this model, while 34 out of 41 people who did not use steroid substances were predicted correctly (Table 1).

Table 1. 2x2 Correct Classification Percentage for Logistic Regression Model

		Predicted		
	Observed	Steroids (-)	Steroids (+)	% Correct
Narcissism	Steroids (-)	35	6	85.4
	Steroids (+)	7	18	72.0
Self-esteem	Steroids (-)	34	7	82.9
	Steroids (+)	11	14	56.0
Self-Competence sub-dimension	Steroids (-)	33	8	80.5
	Steroids (+)	15	10	40.0
Self-Liking sub-dimension	Steroids (-)	34	7	82.9
	Steroids (+)	13	12	48.0

Subjects who do not use steroids are 1.47 times more likely to be narcissists than those who do (In Table 2). Therefore, the fact that the subjects participating in the study tend not to use steroids, but rather not to use

them, makes them even more narcissistic. One unit change in narcissism affects not using steroids by 0.39 units. It can be said that subjects who do not use steroids are 1.11 times more likely to have self-esteem, 1.18 times more self-competence sub-dimension, and 1.20 times more likely to have self-liking sub-dimension than those who do. Therefore, the fact that the subjects participating in the study tend not to use steroids, but rather not to use them, brings them to a greater sense of self-esteem, self-competence sub-dimension and self-liking sub-dimension. One unit change in self-esteem affects not using steroids by 0.10 units, one unit change in self-competence sub-dimension affects not using steroids by 0.167 units, and one unit change in self-liking sub-dimension affects not using steroids by 0.18 units (Table 2).

Table 2. The output of the logistic regression. Log odds, odds ratio, and confidence intervals (95% CI) for odds ratio and p values of the coefficients.

Model Coefficients: Steroid		95% Confidence Interval					
Predictor	**Estimate**	**Lower**	**Upper**	**SE**	**Z**	**p**	**Odds ratio**
Intercept	-3.384	-5.114	-1.655	0.882	-3.83	<.001	0.0339
Narcissism	0.392	0.182	0.601	0.107	3.66	<.001	1.4795
Intercept	-7.022	-11.103	-2.941	2.082	-3.37	<.001	0.0009
Self-esteem total score	0.102	0.040	0.164	0.032	3.21	0.001	1.11
Intercept	-5.535	-8.857	-2.214	1.695	-3.27	0.001	0.0039
Self-Competence sub-dimension	0.167	0.059	0.274	0.055	3.05	0.002	1.1813
Intercept	-6.853	-11.025	-2.680	2.129	-3.22	0.001	0.0011
Self-Liking sub-dimension	0.189	0.068	0.309	0.062	3.07	0.002	1.2079

When the effect of independent variables on the dependent variable is examined, one unit change in narcissism, self-esteem total score, self-competence sub-dimension, and self-liking sub-dimension affects not using steroids by 0.392, 0.102, 0.167, and 0.189 units, respectively (In Figure 1).

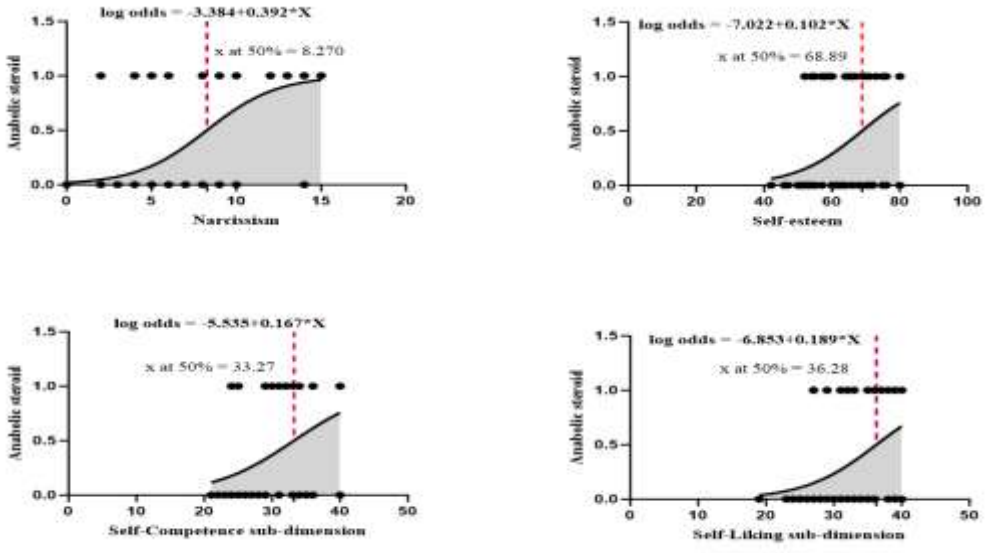

Figure 1. When the effect of independent variables on the dependent variable is examined, one unit change in narcissism, self-esteem total score, self-competence sub-dimension, and self-liking sub-dimension affects not using steroids by 0.392, 0.102, 0.167, and 0.189 units, respectively.

Test of the predictive power of narcissism, self-competence sub-dimension, self-liking sub-dimension, and self-esteem using receiver operating characteristic curve. Areas under the curve (AUC) and p-values are presented. The area under the ROC curve (AUC) was used to compare the predictive power of these four

variables individually and in combination. Analysis was performed anabolic steroid users (n = 41) and non-users (n = 25) among volunteers (In Figure 2).

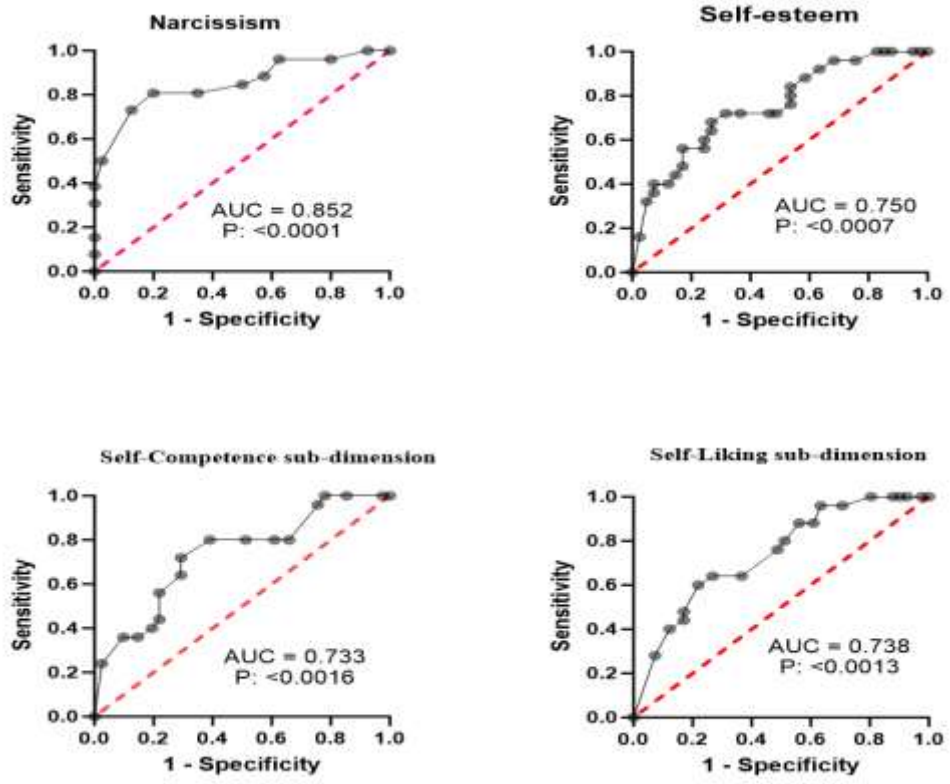

Figure 2. Testing the predictive power of narcissism, self-competence sub-dimension, self-liking sub-dimension, and self-esteem using receiver operating characteristic curve. Areas under the curve (AUC) and p values are indicated. The predictive power of these four variables, individually and in combination, was compared using the area under a ROC curve (AUC). Analysis was performed anabolic steroid users (n = 41) and non-users (n = 25) volunteers.

DISCUSSION AND CONCLUSION

In this study, which examined the narcissism and self-esteem profiles of anabolic androgenic steroid (AAS) users in the sport of bodybuilding, it was found that bodybuilders were more prone to not using steroids in terms of narcissism and self-esteem. In a study that does not overlap with our study to establish a psychometric profile of anabolic steroid users, Porcerelli and Sandler (31) examined weightlifters and bodybuilders who used and did not use anabolic steroids on an objective assessment of narcissism and clinical ratings of empathy. Participants were 16 weightlifters and bodybuilders who reported using anabolic steroids within the last year and a comparison group of 20 weightlifters who had not used steroids. Narcissism was assessed using the Narcissistic Personality Inventory and clinical ratings of empathy. The steroid users had significantly higher scores on the dimensions of pathological narcissism and significantly lower scores on the clinical ratings of empathy. An association between anabolic steroid use and narcissistic personality traits is documented in these preliminary findings. In a study examining whether steroid use may be associated with body image concerns in athletes, the sample of 139 male athletes recruited from fitness centers included 43 bodybuilders, 48 runners, and 48 martial artists (tae kwon do practitioners). Bodybuilders reported significantly more body dissatisfaction, high volume desire, high thinness desire, and increased bulimic tendencies than other athlete groups. In addition, measures of perfectionism, ineffectiveness, and low self-esteem were significantly elevated among bodybuilders. They also reported the highest rates of use of anabolic steroids and the most liberal attitudes toward the use of steroids. Steroid users reported that the most important reason for their use of steroids was to improve their physical appearance. Steroid users reported a greater desire to gain muscle mass, a greater fear of immaturity, and a greater tendency to bulimia nervosa

than did non-steroid users (32). Another study identified an experimental group of bodybuilders who had not used AAS for more than 18 months (n=12). A group of controls (n=12), all of whom reported that they did not use or had never used AAS, were also included in the study during this period. The user group was significantly heavier than the control group and exhibited abnormal personality traits in contrast to the control group. The personality traits of AAS users before they started using AAS were not different from the personality traits of controls. There were significant differences between pre and post personality traits in the AAS user group (33). Cooper and colleagues found that the narcissistic personality scores of individuals who used steroids were higher than those of individuals who did not use steroids (33). In one study, a group of females (n = 30) and a group of male competitive bodybuilders (n = 29) who met diagnostic criteria for anorexia nervosa were evaluated on a battery of psychological measures and their participation in exercise was reported. After separating the male sample into steroid users and non-steroid bodybuilders, the entire analysis was repeated. The results revealed that bodybuilders who used steroids were more narcissistic than those who did not (34).

The sample group of a study consisted of a total of 42 bodybuilding athletes who used steroids and did sports voluntarily (35). In addition, a control group of 22 people was created and they did not use steroids. The 16-item Narcissistic Personality Inventory (NPI-16) was used as a data collection tool. The narcissism level of athletes before steroid treatment was determined as (8, 5714), and the narcissism level of athletes after steroid treatment was determined as (13, 4286). According to the results of statistical analysis, it was determined that there was an increase in the narcissism levels of athletes after steroid treatment. When this result is evaluated according to narcissistic personality traits, it can be said that athletes like their body and physical characteristics more after anabolic steroid treatment. On the other hand, in our study, participants who do not use steroids are 1.4795 times more likely to be narcissists than those who do. Therefore, the fact that the subjects participating in the study tend not to use steroids, but rather not to use them, makes them even more narcissistic. Since narcissism is an individual's excessive admiration for their own physical and mental abilities, according to our study, these individuals do not use steroids.

While this study provides valuable insights into the psychological profiles of AAS users and non-users, several limitations should be acknowledged. First, the modest sample size (n = 66) and exclusive focus on male bodybuilders may limit the generalizability of the findings. Future research should include larger, more diverse cohorts, including women and athletes at different competitive levels, to validate these results. Second, the cross-sectional design precludes causal inferences; longitudinal studies tracking narcissism and self-esteem before and after AAS initiation could clarify directional relationships. Third, self-reported measures of AAS use and psychological traits may be susceptible to response biases (e.g., underreporting steroid use or overstating self-esteem). Incorporating biochemical verification of AAS use and multi-informant assessments (e.g., peer ratings of narcissism) could enhance reliability. Additionally, cultural factors specific to the Turkish context (e.g., societal attitudes toward body image) may influence the results, warranting cross-cultural replications. Finally, unmeasured confounders—such as body dysmorphia, training intensity, or social support—could mediate the observed relationships and should be explored in future work. Despite these constraints, the study offers a foundational understanding of the paradoxical psychological dynamics between AAS users and non-users.

In our study, it can be said that subjects who do not use steroids are 1.11 times more likely to have self-esteem, 1.18 times more self-competence sub-dimension, and 1.20 times more likely to have self-liking sub-dimension than those who do. Therefore, the fact that the subjects participating in the study tend not to use steroids, but rather not to use them, brings them to a greater sense of self-esteem, self-competence sub-dimension and self-liking sub-dimension. A study from 2010 (36) indicated AAS abuse may be linked to certain social and psychological characteristics of the user, such as low self-esteem, afflicted hostility, childhood conduct disorder, and a tendency towards high-risk behavior.

In conclusion, this study revealed a paradoxical psychological profile among bodybuilders: those who abstained from AAS exhibited significantly higher levels of narcissism, self-esteem, and its sub-dimensions (self-competence and self-liking) compared to users. These findings challenge prevailing assumptions that AAS use is driven by or exacerbates grandiose self-perception, suggesting instead that natural training may

foster stronger self-enhancement tendencies. The results underscore the need to reconsider motivational frameworks for AAS use, emphasizing non-pharmacological factors (e.g., social validation or intrinsic satisfaction) that shape bodybuilders' self-concept. Future research should explore longitudinal dynamics and cultural moderators to clarify causality and generalizability. Clinically, these insights highlight the potential benefits of psychological interventions that bolster self-esteem and healthy narcissism in athletes, reducing reliance on performance-enhancing substances. By illuminating the complex interplay between psychology and AAS use, this study contributes to a more nuanced understanding of athlete well-being in high-pressure sporting environments.

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Relationship Between Vertical Jump Parameters And Changes In Agility Performance Following Post-Activation Potentiation In Elite Fencers*

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Abstract

This study aimed to examine the relationship between vertical jump-derived neuromuscular parameters and agility performance changes following post-activation potentiation (PAP) protocols in elite fencers. Seventeen elite male fencers (age: 17.29 ±1.93 years) performed vertical jump assessments—countermovement jump (CMJ), squat jump (SJ), and drop jump (DJ)—using the Opto jump Next system. Reactive strength index (RSI), relative power, and other jump metrics were recorded. PAP was elicited via Smith machine split squat protocols (dominant, non-dominant, bilateral legs), while agility was measured using a 4-2-2-4 test at 1-, 3-, 5-, and 7-minutes post-PAP, timed via photocell gates. A repeated-measures ANOVA was conducted to examine differences in agility performance over time and across conditions. A significant main effect of time was observed on agility performance ($F(4,64) = 11.103$, $p < 0.001$, $\omega^2 = 0.110$), while no significant main effect of condition emerged. A small but significant interaction effect ($F(12,192) = 1.866$, $p = 0.041$, $\omega^2 = 0.017$) suggested time-dependent differences among conditions. However, post hoc tests and simple effects analyses did not yield significant contrasts. Regression models revealed that DJ flight time and DJ height were the most consistent predictors of agility changes, particularly in the bilateral and control groups. CMJ and SJ variables demonstrated moderate predictive relevance. Although PAP protocols led to temporal improvements in agility, no substantial differences were found between conditions. Vertical jump-derived parameters, especially DJ characteristics, may help identify individuals more responsive to PAP. These findings suggest the need for individualized PAP programming in elite fencers.

Keywords: Post-activation potentiation (PAP), Vertical jump, Agility performance, Fencing

Özet

Elit Eskrimcilerde Dikey Sıçrama Parametreleri ile Post Aktivasyon Potansiyasyonu Sonrası Çeviklik Performansındaki Değişim Arasındaki İlişki

Bu çalışma, elit eskrimcilerde dikey sıçrama kaynaklı nöromüsküler parametrelerle post-aktivasyon potansiyasyonu (PAP) sonrası çeviklik performansındaki değişimler arasındaki ilişkiyi incelemeyi amaçladı. On yedi elit erkek eskrimci (yaş: 17,29 ±1,93 yıl), Opto jump Next sistemi kullanılarak karşı hareket sıçraması (CMJ), squat sıçraması (SJ) ve drop jump

(DJ) testlerini gerçekleştirdi. Reaktif kuvvet indeksi (RSI), relatif güç ve diğer sıçrama ölçümleri kaydedildi. PAP, Smith machine split squat protokolleriyle (dominant, nondominant, bilateral bacaklar) uygulandı; çeviklik performansı ise 1., 3., 5. ve 7. dakikalarda 4-2-2-4 çeviklik testiyle ve fotosel sistemiyle ölçüldü. Zaman içinde ve koşullar arasında çeviklik performansındaki farklılıkları incelemek için tekrarlı ölçümlerde ANOVA kullanıldı. Zaman ana etkisi anlamlıydı ($F(4,64) = 11,103$, $p < 0,001$, $\omega^2 = 0,110$), ancak uygulama ana etkisi anlamlı çıkmadı. Küçük ama anlamlı bir etkileşim etkisi ($F(12,192) = 1,866$, $p = 0,041$, $\omega^2 = 0,017$), zamanla gruplar arasında farklılıkların oluştuğunu gösterdi. Ancak post hoc ve basit etkiler analizlerinde anlamlı farklar gözlemlenmedi. Regresyon analizleri, özellikle bilateral ve kontrol gruplarında DJ uçuş süresi ve DJ yüksekliğinin çeviklik değişimlerinin en tutarlı yordayıcıları olduğunu gösterdi. CMJ ve SJ değişkenleri ise orta düzeyde yordayıcı olarak belirlendi. PAP protokolleri çeviklikte zaman içinde iyileşmeler sağlasa da gruplar arasında anlamlı farklılıklar gözlemlenmedi. Bu bulgular, elit eskrimcilerde PAP uygulamalarının bireysel olarak yapılandırılması gerektiğine işaret etmektedir.

Anahtar kelimeler: Post-aktivasyon potansiyasyonu (PAP), Dikey sıçrama, Çeviklik performansı, Eskrim

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INTRODUCTION

Vertical jump performance is widely recognized as a reliable indicator of lower-body neuromuscular capabilities, especially in sports requiring rapid force production such as fencing (10, 11). Fencing is a high-intensity, intermittent combat sport characterized by explosive actions including lunges, directional changes, and sudden accelerations (1, 16). These movements demand a high level of lower-body power and reactive strength to ensure quick responses and maintain tactical advantage during bouts.

Countermovement Jump (CMJ) and Squat Jump (SJ) tests are commonly used to assess different components of explosive strength. While the SJ evaluates concentric strength in isolation, the CMJ leverages the stretch-shortening cycle (SSC), which reflects an athlete's ability to use stored elastic energy and reflexive neural mechanisms for greater force production (2). The difference between CMJ and SJ outcomes—often referred to as "elastic strength"—offers further insights into the efficiency of neuromuscular coordination and SSC utilization (3).

Drop Jump (DJ) assessments, on the other hand, incorporate both eccentric and concentric components, providing valuable information on reactive strength via the Reactive Strength Index (RSI). RSI is defined as the ratio of jump height to ground contact time and has been shown to strongly correlate with explosive sports performance (7, 6). In fencing, where rapid deceleration and re-acceleration are critical, a high RSI may be particularly advantageous.

Post-Activation Potentiation (PAP) is a physiological phenomenon whereby prior high-intensity muscular contractions temporarily enhance subsequent performance, particularly in explosive tasks (10). PAP is believed to result from mechanisms such as increased phosphorylation of myosin regulatory light chains, heightened motor neuron excitability, and improved synchronization of motor units (15). The practical application of PAP in athletic settings often involves the use of heavy-resistance or ballistic exercises prior to performance tasks like sprinting or jumping (13, 8).

While the physiological mechanisms underlying PAP are well-established, recent literature has extensively explored the optimal strategies and modulating factors for its practical application. For instance, a meta-analysis by Seitz et al. (13) demonstrated that PAP effects, though generally small to moderate across various explosive tasks, are significantly influenced by an individual's strength level, training experience, and specific conditioning activity parameters like type, intensity, and rest intervals. Similarly, Garbisu-Hualde et al. (8), in their review, emphasized the critical role of conditioning activity intensity (suggesting 85-90% 1RM for higher effects) and sufficient rest periods (7-8 minutes for experienced athletes) in maximizing potentiation, further highlighting the nuanced approach required for effective PAP implementation.

Although the term PAP is frequently used in the literature, it is important to distinguish it from "Post-Activation Performance Enhancement" (PAPE), as suggested by Cuenca-Fernández et al. (5) and Boullosa (3). PAP refers to the transient increase in muscle force following a conditioning activity, typically measured during electrically evoked twitch contractions. In contrast, PAPE describes voluntary performance

improvements in tasks such as jumping or sprinting following a high-intensity activation exercise. Given that most sport-specific studies—including the present research—assess voluntary athletic tasks rather than involuntary twitch responses, the term PAPE is more appropriate to describe the observed phenomena. PAPE involves distinct physiological mechanisms such as increased muscle temperature, intracellular fluid shifts, and fiber-type-specific rate of force development improvements, which go beyond the neural potentiation mechanisms associated with PAP. While the current study retains the PAP terminology for consistency with common usage, it aligns more closely with the characteristics of PAPE.

Although PAP has been shown to acutely improve performance in sprinting and jumping activities (17), individual responses to PAP protocols vary widely. This variation may stem from intrinsic neuromuscular characteristics, such as strength levels, fiber-type composition, and previous training experience (14). Given the movement characteristics of fencing, it is plausible that vertical jump parameters—particularly those reflecting SSC and reactive strength—could serve as predictors of PAP responsiveness in agility tasks. To date, no study has specifically examined whether vertical jump-derived metrics such as RSI or elastic strength predict agility responses following PAP in elite fencers.

Therefore, the aim of this study is to investigate the relationship between vertical jump-derived neuromuscular parameters (CMJ, SJ, DJ, RSI) and changes in agility performance following a standardized PAP protocol in elite fencers. Using repeated measures ANOVA to detect condition and time effects, and regression to determine predictive parameters.

METHOD

Seventeen elite male fencers (age: 17.29 ±1.93 years), each with a minimum of three years of competitive experience, voluntarily participated in this study. Initially, twenty-two athletes were recruited; however, five were excluded from the final analysis due to injuries or scheduling conflicts with competitions. All procedures were approved by the Institutional Ethics Committee, and written informed consent was obtained from each participant prior to data collection.

A within-subject repeated-measures design was employed to examine the relationship between vertical jump-derived neuromuscular parameters and PAP effects on agility performance. Each participant completed vertical jump testing and PAP-based agility assessments on separate days to prevent fatigue-induced confounding.

Vertical jump assessments included CMJ, SJ and DJ, performed in a standardized warm-up and testing protocol. Each jump type was performed three times with 1 minutes rest time provided, and the best trial was used for analysis. Testing was conducted using the Optojump Next system (Microgate, Bolzano, Italy), a validated optical measurement device for vertical jump analysis.

Measured variables included: CMJ height (cm), SJ height (cm), Elastic Strength (CMJ − SJ height difference), Relative Power in CMJ and SJ (W/kg), DJ variables: box height (cm), ground contact time (s), flight time (s), jump height (cm), reactive strength index (RSI; m/s), and relative power (W/kg).

For the DJ test, athletes began from a box height of 30 cm. The height was progressively increased in 10 cm increments until the RSI showed a consistent decrease, indicating reduced efficiency in reactive force output. Some participants reached up to 70 cm. Sufficient rest (~60 seconds) was allowed between trials to prevent fatigue accumulation.

The PAP intervention consisted of split squat exercises performed on a Smith machine at 80% of the participant's previously established one-repetition maximum (1RM). Each condition—dominant leg, non-dominant leg, and bilateral—was applied in randomized order, with participants completing 3 sets of 4 repetitions per condition. A control condition involving no PAP stimulus was also included. The split squat exercise was selected due to its sport-specificity to fencing stance and its ability to isolate unilateral force production, which is critical in fencing actions.

Following each PAP condition, participants performed a standardized 4-2-2-4 agility test at 1, 3, 5, and 7 minutes post-exercise. Baseline (pre-PAP) performance was also recorded. The agility test was timed using a wireless photocell timing system (Witty Timing System, Microgate, Bolzano, Italy), ensuring high temporal

precision. To ensure accurate capture of the potentiation time course, only one attempt was performed at each time point, immediately upon the start of the minute.

All statistical analyses were conducted using JASP software Version 0.19.2 Intel. Descriptive statistics (mean ±SD) were calculated for all measured variables. The assumption of normality was assessed using the Shapiro–Wilk test, and potential outliers were identified using z-scores and boxplots. Variables not meeting normality assumptions were visually inspected and verified for robustness before inclusion in parametric analyses.

To assess the acute effect of PAP on agility performance, a 2-way repeated-measures ANOVA was conducted with time (Pre, 1st, 3rd, 5th, and 7th minutes) and condition (dominant leg, non-dominant leg, bilateral, control) as within-subject factors. Where no significant interaction was found, main effects were reported. Additionally, to explore group differences at each individual time point, simple main effects analyses were performed across the four conditions.

To quantify the performance changes, delta scores were computed by subtracting the pre-test agility score from the best post-PAP agility score for each condition. These delta values were used as dependent variables in multiple linear regression analyses, with vertical jump parameters (e.g., CMJ height, SJ height, RSI, relative power outputs) as predictors. Fencing experience (years) and general sports background were included as covariates to control for inter-individual differences in training history.

Furthermore, Pearson's correlation coefficients were calculated to examine the relationships between vertical jump variables and agility improvements. These results were visualized in a correlation heatmap, providing insight into the associations between neuromuscular characteristics and PAP-induced agility responses.

All statistical significance levels were set at $p < 0,05$. Where appropriate, effect sizes (e.g., partial eta-squared for ANOVA, standardized beta for regression) and 95% confidence intervals were reported in accordance with current standards for transparent and meaningful statistical reporting in sports science research (9).

Ethical approval and institutional permission

All procedures were approved by the Çanakkale Onsekiz Mart University Scientific Research and Publication Ethics Committee (Approval No: 03/46, dated 29.02.2024, Project Code: 2024-YÖNP-0115), and written informed consent was obtained from each participant prior to data collection.

FINDINGS

Descriptive statistics for the participants (N = 17) are presented in Table 1. The mean age of the fencers was 17.29 years (SD = 1.93), with a mean sport experience of 11.18 years (SD = 1.33) and fencing-specific experience of 10.29 years (SD = 1.65). The average body mass was 72.64 kg (SD = 10.16), with a mean height of 178.24 cm (SD = 6.47). The mean body fat (%) was 20.48% (SD = 5.91), while the average fat mass and lean mass were 14.92 kg (SD = 5.31) and 57.72 kg (SD = 8.81), respectively. Muscle mass was recorded with a mean of 54.83 kg (SD = 8.40). Strength levels, as measured by one-repetition maximum (1RM) for the lower limbs, revealed a mean of 107.19 kg (SD = 23.06) for the right leg and 96.14 kg (SD = 22.25) for the left leg. The Shapiro-Wilk test indicated that all variables, except fat mass ($p = .040$), were normally distributed ($p > 0.05$).

Table 1. Descriptive Statistics

	N	Mean	SD	SW	P-value of SW	Min-Max
Age (year)	17	17.294	1.929	897	0.61	15-21
Sport Age (year)	17	11.176	1.334	0,918	0.138	8-13
Fencing Age (year)	17	10.294	1.649	0,938	0.294	7-13
Body Mass (kg)	17	72.641	10.162	0,937	0.288	56.2-88
Height (cm)	17	178.235	6.467	0,960	0.635	165.5-190
Body Fat (%)	17	20.482	5.914	0,910	0.100	11.9-35.3
Fat Mass (kg)	17	14.918	5.310	0,821	0.4	9.6-30.6
Lean Mass (kg)	17	57.724	8.806	977	0.925	40.1-73.1
Muscle Mass (kg)	17	54.835	8.395	0,977	0.923	38.1-69.5
Dom Leg 1RM (kg)	17	107.193	23.056	0,933	0.244	58.953-138.683
Non dom Leg 1RM (kg)	17	96.138	22.250	0,946	0.400	47.563-127.293

Note. N = Number of participants; 1RM = One-repetition maximum; Dom = dominant; nondom = nondominant SD = Standard deviation; SW = Shapiro Wilk; $p < 0.05$ indicates statistical significance.

Pearson correlation reveals several significant relationships between agility, power, strength, and anthropometric variables (Figure 1). Notably, bilateral agility performance at the 1st trial was negatively correlated with height ($r = -0.660$, $p = 0.004$) and positively correlated with body fat (%) ($r = 0.616$, $p = 0.008$), suggesting that taller athletes and those with higher body fat tend to have slower agility times. Furthermore, agility at various time points (particularly on the non-dominant side and in bilateral trials) was negatively associated with lean and muscle mass, indicating that increased muscularity may not directly enhance agility performance. Conversely, jump-related power variables (e.g., DJ Power Max, RSI Max) showed strong positive correlations with right and left leg 1RM values, as well as with CMJ and SJ heights, underscoring the close relationship between lower-limb strength and explosive power performance (e.g., DJFT Max–Left Leg 1RM: $r = 0.750$, $p < 0.001$). These findings emphasize the multifactorial nature of agility and power performance in elite athletes and highlight the importance of tailoring training programs to address both body composition and neuromuscular capacity.

Figure 1. Correlation Heatmap relationships between agility, power, strength, and anthropometric variables

Note. Only statistically significant ($p < 0.05$) relationships are color-emphasized.

Backward linear regression analyses were performed to identify significant neuromuscular predictors of best agility performance in each group. The final models retained different sets of predictors across the four experimental conditions (Table 2.).

In the Dominant Leg Group, significant predictors were drop jump height (β = 9,85; t = 2,29; p = 0,045) and left leg 1RM strength (β = -3,12; t = -2,75; p = 0,020). Additionally, squat jump power (p = 0,056), right leg 1RM (p = 0,063), and DJ flight time (p = 0,059) were included in the model but did not reach statistical significance.

In the Non-dominant Leg Group, DJ flight time (β = 12,98; p = 0,041) emerged as a significant predictor. Other variables such as DJ height, DJ power, and RSI were retained in the model but showed marginal p-values.

In the Bilateral Group, both DJ height (β = -11,87; p = 0,011) and DJ flight time (β = 11,96; p = 0,011) significantly predicted agility performance.

For the Control Group, significant predictors included DJ flight time (β = 15,84; p = 0,007), DJ height (β = -12,49; p = 0,017), DJ power (β = -21,48; p = 0,011), and RSI (β = 18,55; p = 0,013). Only the final stepwise regression results are reported. CMJ and SJ variables were included in initial models but did not meet inclusion criteria based on $p < 0.10$ threshold.

Tablo 2. Summary of Final Backward Linear Regression Models Predicting Best Agility Performance in Four Experimental Groups

Predictors	β (Dom)	t	p	β (Non Dom)	t	p	β (Bilat)	t	p	β (Cont)	t	p
Dom Leg 1RM	2.642	2.088	0.063	—	—	—	—	—	—	—	—	—
Non Dom Leg 1RM	-3.115	-2.753	0.020	—	—	—	—	—	—	—	—	—
SJ Height	1.214	2.109	0.061	—	—	—	—	—	—	—	—	—
SJ Power	-1.478	-2.164	0.056	—	—	—	—	—	—	—	—	—
DJ Fligth	-9.166	-2.127	0.059	12.980	2.287	0.041	11.959	2.927	0.011	15.844	3.281	0.007
DJ Height	9.851	2.285	0.045	-10.828	-2.050	0.063	-11.874	-2.906	0.011	-12.489	-2.279	0.017
DJ Power	—	—	—	-15.561	-1.841	0.091	—	—	—	-21.476	-2.986	0.011
RSI	—	—	—	13.462	1.790	0.099	—	—	—	18.545	2.898	0.013

Note. Only significant predictors retained in the final models are presented. β = standardized regression coefficient. Dom = Dominant leg split squat (SS). NonDom = nondominant SS. Bilat = bilateral SS. Cont = control group. 1RM = 1 repetition maximum. SJ = squat jump. DJ = drop jump. FT = flight time. RSI = reactive strength index.

A mixed-design ANOVA was conducted to examine the effects of time and condition on the best agility performance. The main effect of time was statistically significant, $F(4, 64) = 11.103$, $p = 0.0001$ $\omega^2 = 0.110$, indicating that agility performance changed significantly across different time points (Table 3.).

The main effect of condition was not significant, $F(3, 48) = 0.517$, $p = 0.673$, $\omega^2 = 0.000$, suggesting no overall difference in agility performance between the different experimental protocols.

However, the interaction effect between condition and time was statistically significant, $F(12, 192) = 1.866$, $p = 0.041$, $\omega^2 = 0.017$. This indicates that the pattern of change in agility performance over time varied depending on the condition applied.

Table 3. One-Way ANOVA Results for Best Agility Scores Across Experimental Groups.

Cases	Sum of Squares	df	Mean Square	F	p	ω^2
Condition	0.353	3	0.118	0.517	0.673	0.000
Residuals	10.939	48	0.228			
Time	1.993	4	0.498	11.103	0.0001	0.110
Residuals	2.873	64	0.045			
Condition ✻ Time	0.627	12	0.052	1.866	0.041	0.017
Residuals	5.381	192	0.028			

Note, Type III Sum of Squares. [a] Mauchly's test of sphericity indicates that the assumption of sphericity is violated ($p < .05$)

While the mixed ANOVA indicated a statistically significant condition × time interaction ($p = 0.041$), subsequent post hoc comparisons did not yield significant differences between specific time points within or between conditions. This suggests that although the interaction effect was present, the pairwise contrasts lacked sufficient power or effect size to reach significance. Descriptive trends may nonetheless point to condition-specific temporal patterns that warrant further investigation.

To further examine the significant interaction effect between time and condition, a series of simple effects analyses were conducted. One-way ANOVAs were performed at each time point to assess the effect of condition. The results revealed that the effect of condition was not statistically significant at any specific time point (all $p > 0.05$). However, the comparison at the 1st minute approached statistical significance ($F(3, 48) = 2.341$, $p = 0.085$), suggesting a possible trend that may warrant further investigation in future studies (Table 4). Although the overall condition × time interaction was significant ($p = 0.041$), Bonferroni-adjusted post hoc comparisons did not reveal statistically significant differences between specific conditions at each time point (all $p > 0.05$). The effect size ($\omega^2 = 0.017$) indicates a small effect according to conventional bench marks (9).

These findings indicate that although the interaction effect was statistically significant, the between-condition differences at individual time points did not reach significance, potentially due to limited power or subtle variations.

Table 4. Simple Main Effects -Condition

Level of Time	Sum of Squares	df	Mean Square	F	p
Pre (1)	0.218	3	0.073	0.820	0.489
1st	0.462	3	0.154	2.341	0.085
3rd	0.101	3	0.034	0.603	0.616
5th	0.064	3	0.021	0.287	0.835
7th	0.137	3	0.046	0.823	0.488

Note, Type III Sum of Squares

DISCUSSION AND CONCLUSION

The present study aimed to investigate the relationship between vertical jump performance and changes in agility following PAP protocols in elite fencers. The findings indicate a significant main effect of time on agility performance, although the interaction effect between condition and time, while statistically significant, yielded only a small effect size. Notably, post hoc comparisons did not reveal significant pairwise differences between the PAP conditions, suggesting that while temporal changes occurred, these changes were not condition-specific.

The improvement observed in agility performance over time may reflect a general neuromuscular facilitation process rather than a condition-dependent PAP response. This finding is partially consistent with the work of Sale (12) and Tillin & Bishop (15), who highlighted that PAP responses are highly individual and influenced by numerous factors including training status, strength level, and muscle fiber type composition. The small effect size in the condition × time interaction supports this notion, aligning with Seitz et al. (13), who noted that not all conditioning activities yield measurable performance enhancements in all athletes.

The absence of significant PAP effects may relate to insufficient loading intensity, lack of individual optimization, or interference from fatigue, as noted by Seitz et al. (13).

Although none of the post hoc comparisons were statistically significant, the effect size and direction of change suggest a possible trend in agility enhancement following the protocol. As shown by Markovic et al. (10) and Bobbert & van Ingen Schenau (2), the efficiency and coordination in vertical force production are important predictors of explosive athletic performance, including agility. However, it appears that in this study, the PAP protocols employed (e.g., various Smith Split Squat variations) may not have elicited sufficient neuromuscular stimulation to generate significant acute agility improvements, as also discussed by Seitz & Haff (14).

Additionally, the relationship between countermovement jump (CMJ) parameters and agility performance showed moderate correlations, suggesting a shared neuromuscular foundation. Previous research by Cormie et al. (4) and Meylan et al. (11) supports this relationship, indicating that the neuromechanical qualities underlying vertical jump also contribute to change-of-direction capabilities. However, due to the specificity of fencing movements and the unique nature of agility in this sport, transfer from vertical jump-based potentiation to fencing-specific agility may be limited.

Our findings regarding the relationships between vertical jump parameters and agility performance align with and extend existing literature, highlighting the complex interplay of various physical qualities in athletic movements. Cormie et al. (4)'s investigation into the countermovement jump (CMJ) demonstrated that training status not only influences peak performance variables but also significantly impacts the entire force-, power-, and velocity-time curves of the jump. Their work underscores that adaptations to training are multifaceted, affecting various phases of explosive movements. In our study, observed correlations between jump variables (e.g., SJ Power, DJ Height Max) and agility parameters suggest that similar underlying force and power production capacities, which are adaptable through training as shown by Cormie et al. (4), contribute to effective agility performance. Furthermore, the findings of Meylan et al. (11), who examined the reliability and interrelationships of unilateral jumps and their ability to predict sprint and change-of-direction (COD) performance, provide valuable context . Their study indicated that various single-leg jump assessments are relatively independent and represent distinct strength/power qualities, with limited predictive ability for sprint and COD. While our study examined bilateral and control agility, Meylan et al.'s (11) observations regarding the specificity of jump types and their modest predictive power for COD reinforce the notion that agility is a complex, multi-component ability. Our correlation analyses, therefore, offer insights into specific interdependencies between vertical jump metrics and agility, complementing prior research by shedding light on these relationships within an elite fencing population.

In terms of methodology, this study applied the 4-2-2-4 agility test, which evaluates directional change and acceleration-deceleration ability—qualities central to fencing performance, as highlighted by Turner et al. (16). Despite the high relevance of the chosen test, the lack of significant contrasts between PAP conditions may reflect the need for more individualized or sport-specific PAP interventions.

Practical applications

The findings of this study suggest that while PAP protocols may induce slight improvements in agility performance over time, these effects are not uniformly significant across all athletes or conditioning modalities. Therefore, strength and conditioning coaches working with elite fencers should apply PAP strategies selectively and monitor individual responses closely.

Given the absence of robust differences between PAP conditions, coaches may consider integrating jump-based assessments, such as CMJ metrics, into training diagnostics to better understand an athlete's readiness

and responsiveness to potentiation stimuli. Additionally, the timing and intensity of PAP protocols should be carefully calibrated, possibly through pre-testing or athlete profiling, to ensure that the potentiation effect aligns with competition demands. Practitioners may consider unilateral split squat protocols at 80% 1RM with 3–7 minutes rest before agility drills to explore possible potentiation effects.

Finally, practitioners are encouraged to focus on long-term development of power and reactive strength—qualities known to underpin both vertical jumping and agility—rather than relying solely on acute potentiation effects for performance enhancement.

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The Examination of the Relationship between Mental Toughness and Physical Activity Levels of Sports Science Faculty Students

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Abstract

Mental toughness and physical activity level of sports science students are supporting factors in coping with their intense academic, sports, and athletic demands. The aim of this research is to examine the relationship between mental toughness and physical activity levels of sports science faculty students. In this study, descriptive survey and a correlational survey model was used, which is one of the general screening methods of quantitative type, to determine the interactions between multiple variables. The data were collected from a total of 361 students, 179 females and 182 males, from the 1st, 2nd, 3rd and 4th grades of the Physical Education and Sports Teaching, Sports Management, Coaching Training and Recreation departments of Selçuk University Faculty of Sports Sciences by convenience sampling method. "Sports Mental Toughness Inventory (SMTI)", "International Physical Activity Questionnaire (IPAQ)" and "Personal Information Form" whose validity and reliability studies were conducted in Turkey were used to collect the data. Since the data did not show normal distribution, X2 was used to determine the difference between the distributions of the groups, Mann Whitney U was used to compare the binary groups, Kruskall Wallis was used to compare the triple groups, and sequential correlation coefficient analyzes were used to determine the relationship between the variables. The findings of this study show that the level of physical activity changes according to age groups, not gender factor. In females, except for the SMTI maintain sub-dimension, there are significant differences due to the differences between low and high and medium and high exercise level groups in terms of other confidence, control and SMTI total scores. In males, there were significant differences in the endurance sub-dimension of SMTI from low and medium level exercise groups, and in other sub-dimensions from low and high exercise groups. In female and male students, a significant relationship was found between physical activity level and confidence and total score of mental toughness inventory in sports. However, no significant relationship was found between physical activity level and continuity sub-dimension. In male students, a significant relationship was found between physical activity level and confidence, control and total scores of mental toughness inventory in sports. As in females, no significant relationship was observed between physical activity level and continuity sub-dimension in males. As a result, it can be said that as the level of physical activity increases in both male and female students, mental toughness in sports also increases. It can be concluded that as the level of physical activity increases in both male and female students, mental toughness in sports also increases.

Slightly more than half of the male students in sports sciences participate in vigorous physical activities, while slightly less than half of the female students participate in vigorous physical activities. The level of physical activity varies according to age rather than gender.

Keywords: Physical acitivity level, Mental thougness, Gender and Age.

Özet

Spor Bilimleri Fakültesi Öğrencilerinin Zihinsel Dayanıklılık ve Fiziksel Aktivite Düzeyleri Arasındaki İlişkinin İncelenmesi

Spor Bilimleri Öğrencilerinin Zihinsel Dayanıklılığı ve Fiziksel Aktivite Düzeyi, yoğun akademik, spor ve atletik talepleriyle başa çıkmada destekleyici faktörlerdir. Bu araştırmanın amacı, spor bilimleri fakültesi öğrencilerinin zihinsel dayanıklılıkları ile fiziksel aktivite düzeyleri arasındaki ilişkiyi incelemektir. Bu çalışmada, çoklu değişkenler arasındaki etkileşimleri belirlemek için nicel türde genel tarama yöntemlerinden biri olan betimsel tarama ve ilişkisel tarama modeli kullanılmıştır. Veriler, Selçuk Üniversitesi Spor Bilimleri Fakültesi Beden Eğitimi ve Spor Öğretmenliği, Spor Yöneticiliği, Antrenörlük Eğitimi ve Rekreasyon bölümlerinin 1, 2, 3 ve 4. sınıflarındaki toplam 179'u kadın, 182'si erkek olmak üzere 361 öğrenciden kolayda örnekleme yöntemiyle toplanmıştır. Veri toplamak için geçerlilik ve güvenilirlik çalışmaları Türkiye'de yapılmış olan "Spor Zihinsel Dayanıklılık Envanteri (SZDE)", "Uluslararası Fiziksel Aktivite Anketi (UFAA)" ve "Kişisel Bilgi Formu" kullanılmıştır. Veriler normal dağılım göstermediğinden, grupların dağılımları arasındaki farkı belirlemek için X2, ikili grupları karşılaştırmak için Mann Whitney U, üçlü grupları karşılaştırmak için Kruskall Wallis ve değişkenler arasındaki ilişkiyi belirlemek için sıralı korelasyon katsayı analizleri kullanılmıştır. Bu çalışmanın bulguları, fiziksel aktivite düzeyinin cinsiyet faktörüne değil, yaş gruplarına göre değiştiğini göstermektedir. Kadınlarda, SZDE sürdürme alt boyutu hariç olmak üzere, diğer özgüven, kontrol ve SZDE toplam puanları açısından düşük-yüksek ve orta-yüksek egzersiz düzeyi grupları arasındaki farklardan kaynaklanan anlamlı farklılıklar bulunmaktadır. Erkeklerde ise, SZDE'nin dayanıklılık alt boyutunda düşük ve orta düzey egzersiz gruplarından, diğer alt boyutlarda ise düşük ve yüksek egzersiz gruplarından anlamlı farklılıklar gözlemlenmiştir. Kadın ve erkek öğrencilerde, fiziksel aktivite düzeyi ile sporda zihinsel dayanıklılık envanterinin özgüven ve toplam puanı arasında anlamlı bir ilişki bulunmuştur. Ancak, fiziksel aktivite düzeyi ile sürdürme alt boyutu arasında anlamlı bir ilişki saptanmamıştır. Erkek öğrencilerde, fiziksel aktivite düzeyi ile sporda zihinsel dayanıklılık envanterinin özgüven, kontrol ve toplam puanları arasında anlamlı bir ilişki bulunmuştur. Kadınlarda olduğu gibi, erkeklerde de fiziksel aktivite düzeyi ile sürdürme alt boyutu arasında anlamlı bir ilişki gözlenmemiştir. Sonuç olarak, hem kadın hem de erkek öğrencilerde fiziksel aktivite düzeyi arttıkça, spordaki zihinsel dayanıklılığın da arttığı söylenebilir. Spor bilimlerindeki erkek öğrencilerin yarısından biraz fazlası şiddetli fiziksel aktivitelere katılırken, kadın öğrencilerin yarısından biraz azı şiddetli fiziksel aktivitelere katılmaktadır. Fiziksel aktivite düzeyi, cinsiyetten çok yaşa göre değişmektedir.

Anahtar Kelimeler: Fiziksel aktivite düzeyi, Zihinsel dayanıklılık, Cinsiyet ve Yaş.

INTRODUCTION

Although the literature demonstrates that participation in physical activity (PA) among adults can provide both physical and psychological benefits (47, 45, 51), according to a study by the U.S. Centers for Disease Control and Prevention (CDC), only 53.1% of adults meet the physical activity guidelines for aerobic exercise, and merely 23.5% meet the guidelines for both aerobic and muscle-strengthening activities (5). In Turkey, a study involving 1,033 females and 1,196 males aged 14–95 found that 12.3% of females (n=127) and 14.5% of males (n=173) reported participating in regular physical activities for a total of three years in the past (15). In a study conducted with 539 university students from different cities, the rate of those with adequate FA level was determined as 31.7% (59). These findings underscore the importance of investigating not only motivational factors but also individual characteristics, such as psychological resilience, to promote PA.

In this context of identifying factors that enhance participation and adherence to physical activity, mental toughness has been recognized as one of the most critical psychological traits related to elite athletes' outcomes and success. However, until recently, athletes, coaches, applied sport psychologists, and researchers have shown limited interest in examining this concept (12). Similarly, while mental toughness is a significant factor influencing athletes' performance (12), the relationship between mental toughness and physical activity levels among Sport Sciences students holds substantial importance for both their academic performance and future careers.

Mental toughness is often described as a set of psychological skills—such as concentration, determination, self-confidence, and a sense of control—that determine effective coping with challenges (29). It is also linked

to sport awareness, embracing challenges, and the desire to succeed (24). Additionally, mental toughness is defined as the ability to recover from failure (10) or to persist toward goals despite adversity (30). Some researchers argue that mental toughness encompasses cognitive, behavioral, and emotional components (49, 13). In the literature, mental toughness has been approached as a relatively stable trait comprising three factors: control, stability, and confidence (49). Furthermore, Clough et al. (10) proposed that mental toughness should be defined as a personality trait determining responses to challenges or pressure, regardless of circumstances, and presented a four-factor model consisting of control, confidence, challenge, and commitment.

When examining changes in the sub-dimensions of mental toughness in sports based on age, gender, and physical activity levels, mental toughness is considered a multidimensional construct comprising multiple sub-dimensions rather than a unidimensional one (10). Although these sub-dimensions are labeled differently across theoretical models, they generally include concepts such as control, confidence, challenge, commitment, focus, and resilience (23, 29).

Factors such as age, gender, and physical activity level are thought to cause distinct variations in the sub-dimensions of mental toughness. These variations are closely tied to individuals' biological, psychological, and social developmental processes. Younger individuals may exhibit less developed and more variable mental toughness sub-dimensions (40), whereas with age, increases in control, confidence, and focus can be observed due to experience and learning (12). During maturity, sub-dimensions like resilience and commitment may become more pronounced as individuals gain competence in managing challenges and regulating emotions (19).

In a study similar to ours, (39) compared mental toughness between male and female university basketball players and found higher levels among males. Mental toughness was predictive of performance levels only in males.

While mental toughness is a key factor influencing athletes' motivation and persistence in sports (22), physical activity is a critical component of a healthy lifestyle. The International Physical Activity Questionnaire (IPAQ) is widely used to assess physical activity levels across global populations (11). Sport Sciences students, as a group with high knowledge and awareness of physical activity and health, tend to be more active than the general population (26). It was indicated that Sport Sciences students engage in higher levels of physical activity compared to the general population (42, 48). Similarly, research in Turkey observed that Sport Sciences students participate in more moderate-to-vigorous physical activity and spend less time sedentary than the general population (32). However, some studies suggest their physical activity levels may be lower than expected (27), potentially due to intense academic schedules, exam stress, and poor time management. Additionally, Sport Sciences students may prefer competitive or specific sports, whereas the general population might engage in daily activities like walking or gardening. Thus, while IPAQ data generally show higher activity levels among Sport Sciences students, this trend may not hold universally across countries or student groups. Further comparative studies are needed to better understand influencing factors.

The relationship between mental toughness and physical activity levels among Sport Sciences students is crucial for their academic performance and future careers. Mental toughness—defined as perseverance, determination, focus, and the ability to overcome challenges—can help students manage intense academic and athletic demands. It supports high performance in theoretical and practical courses, training, and competitions, while aiding recovery from setbacks like injuries or failures. Regular physical activity enhances morphological, cardiorespiratory, muscular, metabolic, and motor fitness components, promoting holistic wellness, reducing stress, improving mood, and boosting mental health.

Thus, this study aims to investigate variations in the control, stability, and confidence sub-dimensions of the Mental Toughness Inventory among male and female Sport Sciences students across different departments, considering physical activity, age, and gender. The research holds potential to enhance athlete performance, promote healthy lifestyles, and contribute to the field of Sport Sciences. Additionally, it may inform strategies to strengthen students' mental toughness, fostering long-term engagement in sports.

METHOD

This section presents the research model, population and sample, data collection tools, and data analysis methods related to investigate the relationship between mental toughness and physical activity (PA) levels among students at Selçuk University's Faculty of Sports Sciences.

Research Model

This study utilized a descriptive survey and a correlational survey model to assess the current state of variables. Survey models are research approaches that aim to describe a phenomenon, individual, or object as it exists within its own conditions, without external manipulation. Correlational survey models, on the other hand, are designed to determine the existence and/or degree of co-variation between two or more variables (31).

Population and Sample

In this study titled "The Examination of the Relationship between Mental Toughness and Physical Activity Levels of Sports Science Faculty Students", ethical approval was obtained from the Selçuk University Health Sciences Institute Ethics Committee with the decision dated 12/12/2024 and numbered E-40990478-896321, in compliance with the Ethics Committee Guidelines.

The research employed the convenience sampling method. Convenience sampling is a non-random sampling method where the sample group is selected from the population based on the researcher's judgment. In convenience sampling, data is collected from the population in the easiest, fastest, and most economical way (33), who stated that the convenience sampling method is used in 53% of applied studies. Similarly, Kurtuluş (35) reported that approximately 90% of studies conducted in Turkey utilize the convenience sampling method.

Within the scope of this study, the population consisted of students enrolled in the Sports Sciences Faculties of state universities in Turkey during the 2023-2024 academic year spring semester (1st, 2nd, 3rd, and 4th grades). The sample, however, comprised students from Selçuk University Faculty of Sports Sciences, studying in different departments (Physical Education and Sports Teaching, Sports Management, Coaching Education, and Recreation) and across different grades (1st, 2nd, 3rd, and 4th) during the same semester.

For data collection, a combination of methods—face-to-face interviews, postal surveys, and online surveys (8, 43)—was employed. The sample included a total of 361 students including 179 females and 182 males from Selçuk University Faculty of Sports Sciences.

Data Collection Instruments

Demographic Information Form

Demographic form was used to collect information on the personal characteristics of the participants, including the gender, age, weekly training duration, and smoking and alcohol consumption status of the Sports Science Faculty students.

Sports Mental Toughness Inventory (SMTI)

The Sports Mental Toughness Inventory (SMTI) was developed by Sheard et al. (50) to measure the level of mental toughness in sports settings. The inventory consists of 14 items and includes three sub-dimensions (Confidence, Continuity, and Control) in addition to overall mental toughness. The scale is a 4-point Likert-type (1 = Completely False; 4 = Completely True). The Cronbach's Alpha values for the original sub-dimensions of the scale were calculated as 0.81 for Confidence, 0.74 for Continuity, and 0.71 for Control. In the SMTI, the three sub-dimensions are defined as follows:

Confidence sub-dimension: Belief in one's abilities to achieve goals in challenging situations and perceiving oneself as better than competitors (Items 1, 5, 6, 11, 13, 14).Control sub-dimension: Maintaining composure, staying controlled, and remaining relaxed under pressure or unexpected circumstances (Items 2, 4, 7, 9).Continuity sub-dimension: Taking responsibility, concentrating, and striving toward set goals (Items 3, 8, 10, 12).

The Turkish adaptation of the inventory was performed by Altıntaş and Bayar Koruç (2). The findings of this study confirmed that the 14-item SMTI is a valid and reliable measurement tool for Turkish athletes. The Cronbach's Alpha values for the sub-dimensions in this adaptation were calculated as 0.84 for Confidence, 0.51 for Continuity, and 0.79 for Control.

International Physical Activity Questionnaire (IPAQ)

The International Physical Activity Questionnaire (IPAQ) was developed by Craig et al. (11) to assess individuals' physical activity levels. The validity and reliability study of the scale for Turkey was conducted by (44).

The questionnaire is self-administered and evaluates a one-week assessment of physical activity levels. It consists of seven questions, which provide information on time spent sitting, walking, engaging in moderate-intensity activities, and vigorous-intensity activities.

For Calculation physical actiivity level, the scoring for walking, moderate-intensity activities, and vigorous-intensity activities involves multiplying the duration (in minutes and days) by the following MET coefficients:

Walking: 3.3 MET

Moderate-intensity activities: 4 MET

Vigorous-intensity activities: 8 MET

The sum of these products yields a total score in MET-minutes (44). Total physical activity score includes the sum of duration (minutes) and frequency (days) for walking, moderate-intensity, and vigorous-intensity activities. Also sitting time (sedentary behavior level) is calculated separately and does not use MET coefficients. This method allows individuals' weekly activity profiles to be expressed in a standardized scientific unit (MET-minutes).

Data Analysis

SPSS 23.0 software was used for data analysis. Since the normality of the data distribution was not confirmed by the Kolmogorov-Smirnov and Shapiro-Wilk tests, the Mann-Whitney U Test was employed for comparisons between two groups. For multiple comparisons, the Kruskal-Wallis H Test was applied, and when a significant difference was found between groups, the Mann-Whitney U Test was used again to determine the source of the difference.

To examine the relationship between mental thoughness and physical activity levels among Faculty of Sports Sciences students, Spearman's Rank Correlation Coefficients (r) were calculated. For interpreting the correlation coefficients; a result between 0.70–1.00 was considered a high correlation, while 0.30–0.70 indicated a moderate correlation and 0.00–0.30 indicated a low correlation (7). In all statistical analyses, the significance level was set at 0.05 confidence level.

FINDINGS

Results of this study were presented in Table 1, 2, 3, 4, 5, 6, 7, 8 ve 9.

Table 1. Comparison of the distribution of physical activity levels between male and female students

	Physical Activity Levels			
Gender	Low	Moderato	High	Total
[1]Females	63 (35,20%)	36 (20,11%)	80 (44,69%)	179 (100%)
[2]Males	53 (29,12%)	28 (15,38%)	101 (55,49%)	182 (100%)
[3]Total	116 (32,13%)	64 (17,73%)	181 (50,14%)	361 (100%)

*p<0.05, ** p<0.01.

Crosstabs Analyse X2=4,274, sd=1, Asymp. Sig.= ,118 (There is no significant difference between the distribution of physical activity levels of males and females.

1 There is a significant difference between the distribution of physical activity levels in females (sd,2, X2 16,503, Asymp. Sig.0.000**).

2 There is a significant difference between the distribution of physical activity levels in males (sd,2, X2 45,374, Asymp. Sig.0.000**).

3 There is a significant difference between the distribution of physical activity levels in the entire group (females + males). (sd,2, X2 57.114, Asymp. Sig.0.000**).

Table 2. Comparison of age group distribution of male and female students

	Age Groups				
Gender	18-20 years	21-23 years	24-26 years	27 years and over	Total
Females	60	42	52	25	179
	(33,52%)	(23,46%)	(29,05%)	(13,97%)	(100%)
Males	43	28	23	88	182
	(23,63%)	(15,38%)	(12,64%)	(48,35%)	(100%)
Total	103	70	75	113	361
	(28,53%)	(19,39%)	(20,78%)	(31,30%)	(100%)

*p<0.05, ** p<0.01.

Crosstabs Analyse X2=51,922, sd=3, Asymp. Sig.= ,000** (There is a significant difference between the distribution of age groups between male and female students).

Tablo 3. Comparison of significant differences between male and female students in physical activity levels and sub-dimensions of the mental toughness inventory in sports

Variables	Groups	N	M.	S.D.	z	MWU	Asymp. Sig.
Physical Activity Level (1-3 levels)	Females	179	2,10	0,89	-1,863	14602	,063
	Males	182	2,26	0,88			
	Total	361	2,18	0,89			
SMTI Confidence	Females	179	17,16	3,19	-1,666	14647	,096
	Males	182	17,76	3,14			
	Total	361	17,47	3,17			
SMTI Control	Females	179	9,00	1,84	-,737	15572	,461
	Males	182	9,12	1,67			
	Total	361	9,06	1,76			
SMTI Continuity	Females	179	10,56	1,46	-1,476	14879	,140
	Males	182	10,78	1,26			
	Total	361	10,67	1,36			
SMTI Total	Females	179	36,73	4,27	-1,746	14564	,081
	Males	182	37,66	4,16			
	Total	361	37,20	4,24			

*p<0.05, ** p<0.01.

Table 4. Changes in the sub-dimensions of the Mental Toughness Inventory in Sports and SMTI Total Scores of female students according to their physical activity levels.

Variables	PA Level	N	M.	S.D.	sd	X^2	Asymp. Sig	p
SMTI Confidence	Low (A)	63	16,67	2,39	2	6,857	,032*	A-C, ,017*
	Moderato (B)	36	16,53	3,12				
	High (C)	80	17,84	3,64				
	Total	179	17,16	3,19				
SMTI Control	Low (A)	63	8,59	1,77	2	7,917	,019*	A-C, ,005**
	Moderato (B)	36	8,81	2,01				
	High (C)	80	9,41	1,75				
	Total	179	9,00	1,84				
SMTI Continuity	Low (A)	63	10,59	1,28	2	1,383	,501	No Difference
	Moderato (B)	36	10,69	1,31				
	High (C)	80	10,49	1,65				
	Total	179	10,56	1,46				
SMTI Totaly	Low (A)	63	35,84	3,67	2	9,839	,007**	A-C, ,003** B-C, 0,037*
	Moderato (B)	36	36,03	4,07				
	High (C)	80	37,74	4,62				
	Total	179	36,73	4,27				

*p<0.05, ** p<0.01.

Tablo 5. Changes in the sub-dimensions of the Mental Toughness Inventory in Sports and SZDE Total Scores of male students according to their physical activity levels.

Variables	PA Level	N	M.	S.D.	sd	X^2	Asymp. Sig	p
SMTI Confidence	Low (A)	53	16,77	3,31	2	8,396	,015*	A-C, 0,004**
	Moderato (B)	28	17,36	3,12				
	High (C)	101	18,40	2,92				
	Total	182	17,76	3,14				
SMTI Control	Low (A)	53	8,47	1,83	2	12,465	,002**	A-C, 0,001**
	Moderato (B)	28	9,11	1,64				
	High (C)	101	9,47	1,50				
	Total	182	9,12	1,67				
SMTI Continuity	Low (A)	53	10,51	1,25	2	4,639	,098	A-B, 0.031*
	Moderato (B)	28	11,18	1,31				
	High (C)	101	10,81	1,23				
	Total	182	10,78	1,26				
SMTI Total	Low (A)	53	35,75	4,27	2	17,285	,000**	A-C, 0,000**
	Moderato (B)	28	37,64	4,86				
	High (C)	101	38,67	3,54				
	Total	182	37,66	4,16				

*p<0.05, ** p<0.01.

Table 6. Changes in physical activity levels, sub-dimensions of the Mental Toughness Inventory in Sports, and SMTI Total Scores among female students according to age groups.

Variables	Age Groups Level	N	M.	S.D.	df	X^2	Asymp. Sig	p
Physical Activity Levels (1-3 levels)	18-20 years (A)	60	2,10	0,88	3	8,679	,034*	A<C; 0,031* A>D; 0,034* B<C; 0,010** C>D: 0,022*
	21-23 years (B)	42	1,88	0,92				
	24-26 years (C)	52	2,37	0,84				
	27 years and above (D)	25	1,88	0,88				
	Total	179	2,10	0,89				
SMTI Confidence	18-20 years (A)	60	17,57	2,65	3	3,937	,268	No Difference
	21-23 years (B)	42	17,60	3,18				
	24-26 years (C)	52	16,73	3,61				
	27 years and above (D)	25	16,36	3,37				
	Total	179	17,16	3,19				
SMTI Control	18-20 years (A)	60	9,13	1,86	3	1,205	,752	No Difference
	21-23 years (B)	42	9,07	1,67				
	24-26 years (C)	52	8,94	2,06				
	27 years and above (D)	25	8,68	1,63				
	Total	179	9,00	1,84				
SMTI Continuity	18-20 years (A)	60	10,70	1,23	3	2,274	,517	No Difference
	21-23 years (B)	42	10,40	1,36				
	24-26 years (C)	52	10,48	1,70				
	27 years and above (D)	25	10,68	1,63				
	Total	179	10,56	1,46				
SMTI Total	18-20 years (A)	60	37,40	3,33	3	3,944	,268	No Difference
	21-23 years (B)	42	37,07	4,31				
	24-26 years (C)	52	36,15	4,80				
	27 years and above (D)	25	35,72	4,95				
	Total	179	36,73	4,27				

*p<0.05, ** p<0.01.

Table 7. Changes in physical activity levels, sub-dimensions of the Mental Toughness Inventory in Sports, and SMTI Total Scores among male students according to age groups

Variables	Age Groups Level	N	M.	S.D.	sd	X^2	Asymp. Sig	p
Physical Activity Levels (1-3 levels)	18-20 years (A)	43	2,60	0,73	3	13,971	,003**	A>D; 0,003**
	21-23 years (B)	28	2,46	0,79				
	24-26 years (C)	23	2,30	0,82				
	27 years and above (D)	88	2,02	0,93				
	18-20 years (A)	182	2,26	0,88				
SMTI Confidence	21-23 years (B)	43	18,47	3,38	3	5,266	,153	No Difference
	24-26 years (C)	28	17,96	3,18				
	27 years and above (D)	23	16,52	2,81				
	18-20 years (A)	88	17,68	3,03				
	21-23 years (B)	182	17,76	3,14				
SMTI Control	24-26 years (C)	43	9,47	1,88	3	4,578	,205	No Difference
	27 years and above (D)	28	9,29	1,96				
	18-20 years (A)	23	9,39	1,67				
	21-23 years (B)	88	8,83	1,42				
	24-26 years (C)	182	9,12	1,67				
SMTI Continuity	27 years and above (D)	43	10,84	1,13	3	3,777	,287	No Difference
	18-20 years (A)	28	11,14	1,18				
	21-23 years (B)	23	10,78	1,13				
	24-26 years (C)	88	10,64	1,37				
	27 years and above (D)	182	10,78	1,26				
SMTI	18-20 years (A)	43	38,77	4,26	3	5,539	,136	No Difference

Total	21-23 years (B)	28	38,39	4,78
	24-26 years (C)	23	36,70	3,66
	27 years and above (D)	88	37,15	3,94
	18-20 years (A)	182	37,66	4,16

*p<0.05, ** p<0.01.

Table 8. The relationship between physical activity levels of female students and sub-dimensions of the Mental Toughness in Sports Inventory and SMTI Total Score

Variables	Physical Activity Level	SMTI Confidence	SMTI Control	SMTI Continuity	SMTI Total
SMTI Confidence	,184*				
SMTI Control	,210**	,231**			
SMTI Continuity	-,024	,082	-,304**		
SMTI Total	,227**	,896**	,491**	,232**	
Age	,024	-,144	-,062	-,019	-,148*

*p<0.05 There is a significant relationship; ** p<0.01 There is a significant relationship.
SMTI = Sports Mental Toughness Inventory.

Table 9. The relationship between physical activity levels of female students and sub-dimensions of the Mental Toughness in Sports Inventory and SMTI Total Score

Variables	Physical Activity Level	SMTI Confidence	SMTI Control	SMTI Continuity	SMTI Total
SMTI Confidence	,215**				
SMTI Control	,261**	,189*			
SMTI Continuity	,029	,195**	-,172*		
SMTI Total	,304**	,908**	,439**	,371**	
Age	-,277**	-,065	-,152*	-,090	-,130

*p<0.05 There is a significant relationship; ** p<0.01 There is a significant relationship.
SMTI = Sports Mental Toughness Inventory.

DISCUSSION AND CONCLUSION

Engagement in physical activity (PA) is widely recognized as a cornerstone of health, offering both physical and psychological benefits for adults. Physically, PA reduces the risk of coronary heart disease, diabetes-related complications, and mortality while improving overall functionality, lowering blood pressure, and decreasing stroke risk (5). Notably, it also mitigates the incidence of colon and breast cancer, underscoring its role in chronic disease prevention (57). Psychologically, PA alleviates depression and depressive symptoms, enhances positive affect, reduces perceived stress, and improves mental health outcomes (45, 51). These benefits are not limited to general health; emerging research highlights PA's neuroprotective effects. Aerobic exercise, for instance, enhances cognitive functions such as memory, attention, and executive control by increasing cerebral blood flow and promoting neural plasticity (54). Such effects are particularly pronounced in aging populations, suggesting PA's potential to delay neurodegenerative decline.

Despite these well-documented advantages, adherence to PA guidelines remains suboptimal. The CDC reports that only 53.1% of U.S. adults meet aerobic exercise recommendations, and a mere 23.5% comply with combined aerobic and muscle-strengthening guidelines (5). This gap between knowledge and action underscores the need for targeted interventions to promote PA participation.

Our study explored PA levels among sports sciences students, a population expected to exhibit high engagement due to their academic focus. Cross-tabulation analysis revealed no statistically significant gender differences in exercise distribution (low/moderate/high) (Table 1). Female students reported 35.20% low,

35.20% moderate, and 44.69% high activity levels, while male students showed 29.12% low, 15.38% moderate, and 55.49% high. Aggregated data indicated 50.14% of students engaged in high-intensity PA.

The prevalence of low activity (32.13%) suggests that the entrance exam criterions for physical education and sports teaching, coach education, and sports management departments in Türkiye are inadequate. Current criteria prioritize coordination courses without minimum thresholds, potentially failing to identify truly skilled candidates. Restructuring these exams to assess foundational motor skills (e.g., agility, balance, coordination combined with movement skills) and enforcing a top-50% ranking cutoff could improve selection rigor. Çeker et al., (15) reported that Türkiye's low national PA participation—12.3% of women and 14.5% of men.

Low activity prevalence (32.13%) shows that the entrance exam criteria for physical education and sports teaching, coach education and sports management departments in Türkiye are inadequate. Age-related differences complicate generalizations. Table 2 highlights significant disparities in PA levels across age groups (18–20, 21–23, 24–26, 27+ years) between genders, suggesting that age-specific PA interventions may be necessary.

Mental toughness—a psychological construct encompassing resilience, confidence, and persistence—exhibits gender disparities in literature, with males often scoring higher (17, 53). However, our study found no significant gender differences in mental toughness sub-dimensions (confidence, control, persistence) among sports students, regardless of PA levels (Table 3). This contrasts with Şahin et al. (52), who reported high PA levels in sports students, and Nicholls et al. (40), who linked mental toughness to gender, age, and experience in athletes (n=677). Discrepancies may stem from variations in activity intensity, competitiveness, or sample homogeneity.

Males generally engage in PA more frequently than females, a gap widening during adolescence and persisting into adulthood (4). Societal gender roles, limited access to PA opportunities, and motivational differences contribute to this divide (16). While males often excel in confidence and control subscales, females outperform in persistence (Moritz et al., 2000; 39). However, inconsistencies across studies suggest mental toughness is shaped by biological, psychological, and social factors. For example, Madrigal et al. (2013) found female athletes scored higher in persistence, while Gucciardi et al. (23) reported no gender differences in mental toughness overall.

A robust positive correlation exists between PA levels and mental toughness (23, 29). PA enhances self-efficacy, stress management, and emotional regulation—key components of mental toughness. However, this relationship is nuanced and gender-specific.

High-intensity PA correlates strongly with total mental toughness scores in women (Table 4). Confidence and control sub-dimensions were lower in low/moderate PA groups, while persistence showed no significant differences (Table 8). Wilson and Rodgers (56) similarly found active women scored higher in mental toughness, aligning with Crust's (12) assertion that PA fosters goal focus and self-efficacy.

High PA males outperformed low PA peers in confidence, control, and total mental toughness (Table 5). Moderate PA males also scored higher in persistence than low PA counterparts (57). Crust et al. (12) attributed these findings to PA's role in enhancing stress management and focus. However, like females, persistence showed no PA-linked correlation (Table 9), suggesting domain-specific effects.

The persistence sub-dimension of mental toughness—defined as sustained commitment to goals despite adversity—appears less influenced by physical activity than by intrinsic psychological factors. Clough et al. (10) argue that persistence is distinct from other mental toughness components, as it hinges on personality traits like conscientiousness, intrinsic motivation, and goal orientation. Their study, involving 300 athletes, revealed that persistence correlated more strongly with long-term goal commitment ($r = 0.45$) than with physical fitness metrics ($r = 0.18$). This aligns with Bandura's (3) self-efficacy theory, where belief in one's capabilities drives perseverance. For instance, marathon runners who set incremental performance goals exhibit higher persistence, regardless of training intensity (14). Thus, while PA fosters confidence and control, persistence may require targeted cognitive-behavioral interventions, such as mindfulness training or motivational interviewing (25).

Age-related declines in physical activity is a global health challenge. Physical activity (PA) levels peak during adolescence and early adulthood, as noted by Bauman et al. (4) in their 20-country survey (n = 12,000). Youth (ages 15–24) averaged 60 minutes of moderate-to-vigorous PA daily, compared to 30 minutes among adults aged 35–44. This decline accelerates with age: Eime et al. (16) found a 40% reduction in PA participation between ages 18–25 and 45–54 in Australian adults (n = 5,000). There are many contributing factors affecting physical activity level. The first of these is time constraints. For example; career and familial responsibilities reduce leisure time for PA (28). The second of these is the health Barriers. For example; chronic conditions like arthritis or cardiovascular disease limit mobility (Patel et al., 2021). The third of these is Sociocultural Shift. For example; aging populations in high-income countries face sedentary lifestyles due to urbanization and automation (WHO, 2018). Despite these trends, PA remains critical for healthy aging. Holt et al. (28) demonstrated that older adults engaging in 150 minutes/week of moderate PA had 30% lower risks of cognitive decline and 25% fewer depressive episodes over a 10-year follow-up.

Mental toughness evolves dynamically across life stages, shaped by both biological maturation and environmental experiences. Firstly, Youth (15–24 years) adolescence marks the formative phase for mental toughness. Crust et al. (12) tracked 200 junior athletes (ages 14–18) over three years, finding that structured PA programs increased self-efficacy scores by 22% and persistence by 15%. Neuroplasticity during this period enhances adaptability to stressors, such as competitive setbacks or academic pressures (54). Secondly, Adulthood (25–64 years) middle-aged adults often exhibit compensatory strategies. Gucciardi et al. (23) studied 150 athletes (ages 30–50), noting that while raw mental toughness scores declined by 12% compared to youth, experiential factors like emotional regulation and strategic planning offset this drop. Thirdly, older adulthood (65+ years), cognitive reserve and PA synergistically preserve mental toughness. Holt et al. (28) reported that seniors (n = 500) participating in tai chi or swimming maintained persistence scores comparable to middle-aged cohorts.

Table 6 highlights significant PA disparities among female age groups, with declines linked to career and familial transitions. Mental toughness sub-dimensions remained stable, suggesting resilience buffers PA declines.

Table 7 reveals a stark PA drop (40%, *p = 0.003*) between males aged 18–20 and 27+. Cultural expectations in Türkiye prioritize career-building post-graduation, often at the expense of leisure PA (9).

Athletic achievement hinges on four pillars. Firstly, physical training factor including VO_2 max, muscle strength, and agility (6).Secondly, technical training factor including sport-specific skills (e.g., dribbling accuracy in soccer). Thirdly, tactical training factor including strategic adaptability during competition. Fourth, psychological training factor including mental toughness accounts for 50–82% of performance variance in high-pressure scenarios (20).

In the Case Study related to the wrestling, Gould et al. (21) analyzed 50 Olympic wrestlers, finding that mental toughness differentiated medalists from non-medalists. Medalists scored 35% higher in persistence and 28% higher in emotional control during critical matches.

Türkiye's unique sociocultural landscape shapes PA and mental health Dynamics as gender norms, academic stress and academic factors. In gender norms, gender norms, traditional gender roles limit female PA access (15). As academic Stressor, high-stakes exams correlate with sedentary behaviors (58). As a economic factor Lower-income students face barriers like costly gym memberships (34).

Contradictory Findings showed that as a positive association For example; light PA improves critical thinking (1). On the other hand, related to the negative association, Ölçücü et al. (41) reported paradoxical PA-depression links in females.

There are two measurement tools. First, Fourie & Potgieter (18) identified themes like "grace under fire." The other is quantitative tool in the study of Clough et al. (10) validated the MTQ48 scale (α = 0.89). There are also theoretical debates including trait vs. State (29, 55) and Cultural Validity of Liew et al. (36) advocate for culturally adaptive frameworks.

There are suitable many implications policy and practice toward education, workplace and agigng populations. It can be integrating mental toughness training into PE curricula in the field of education. Also it can be subsidizing to gym memberships and flexible hours. For aging populations, it can be offer low-impact PA programs (e.g., yoga). The nexus of age, gender, PA, and mental toughness is multifaceted, demanding interdisciplinary solutions. While PA enhances confidence and control, persistence requires holistic psychosocial interventions. Türkiye's cultural context further nuances these relationships, underscoring the need for tailored public health strategies. Future research should prioritize longitudinal designs and cross-cultural comparisons to refine our understanding of mental toughness as both a trait and a dynamic state.

Conclusions

Regular physical activity (PA) provides significant physical and psychological benefits, including reduced risks of chronic diseases, improved cognitive function, and enhanced mental resilience. However, adherence to PA guidelines remains low, even among sports sciences students. While men generally report higher PA levels and score higher in mental resilience subdimensions such as confidence and control, women demonstrate greater persistence. These differences are influenced by biological, social, and psychological factors. PA levels decline with age, but mental resilience remains relatively stable due to compensatory factors like experience and maturity. The finding that one-third of sports sciences students engage in low-intensity PA highlights the need to revise admission criteria (e.g., balance/coordination courses) to prioritize foundational motor skills. Positive correlations exist between PA and confidence, control, and overall mental resilience, but no significant link was found between PA and persistence. Türkiye's high number of sports sciences faculties and low national PA participation rates may impact study outcomes.

Recommendations:

Gender-Specific Programs: Design PA initiatives targeting confidence/control in women and persistence in men through goal-setting and stress management.

Mental Thoughness Training: Integrate mental taughness education into PA curricula.

Research: Conduct longitudinal studies to explore causal PA-mental thougkness relationships and investigate Türkiye's sociocultural barriers to PA.

Infrastructure: Improve university sports facilities and collaborate with public health agencies to promote PA benefits.

Holistic Training: Combine physical training with mindfulness and cognitive-behavioral strategies.

Collaboration: Foster partnerships among sports scientists, psychologists, and educators. These steps can enhance individual health outcomes and elevate the quality of sports sciences education.

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Effect of Self-Myofascial Release on Physical Performance in Young Basketball Players

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Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.

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Abstract

The aim of this study is to determine the effect of self-myofascial release (SMR) applied immediately after intense exercise on physical performance parameters such as joint range of motion (ROM), flexibility, agility, and balance. One of the popular methods today to reduce the negative effects on the body after fatigue is self-myofascial release. Myofascial release is a targeted, directional, low-load mechanical force application aimed at restoring optimum tissue length and improving function. The study involved 12 male basketball players (mean age 16,42±0,52 years) who actively played basketball and were randomly divided into two groups (SMR Group, n=6; CNT Group, n=6) The participants performed a self-myofascial release application for 30 seconds immediately after basketball training (3 days per week) for 8 weeks. The flexibility, agility, balance, and joint range of motion values of the participants were measured before and after the 8-week period (Pre Test and Post Test). The statistical analysis of within-group time differences and inter-group differences was performed using a mixed design (2x2) ANOVA test (SPSS 23). Significant results in favor of the SMR group were found only for hip adduction ROM values ($p<0,05$), while improvements in other ROM values, flexibility, and agility parameters were detected within the SMR groups, though not statistically significant between Pre Test and Post Test. As a result, it was not possible to establish evidence that SMR applications after training could significantly help in increasing joint range of motion, improving balance performance, enhancing muscle flexibility, or decreasing agility values in basketball players. However, improvements, albeit at low levels, in all parameters suggest that self-myofascial release may contribute to the recovery phase of athletes. Therefore, clinicians, sports scientists, coaches, and athletic performance specialists should provide athletes with the most appropriate recovery strategies for higher performance, readiness, and competition.

Keyword: Range of Motion, Balance, Flexibility, Agility, Myofascial Release.

Özet

Genç Basketbolcularda Kendi Kendine Miyofasyal Gevşemenin Fiziksel Performans Üzerine Etkisi

Bu çalışmanın amacı, yoğun bir egzersizin hemen sonrasında uygulanan köpük rulo ile kendi kendine miyofasyal gevşemenin, fiziksel performans parametrelerinden eklem hareket açıklığı, esneklik, çeviklik ve denge performansları üzerine etkisini belirlemektir. Yorgunluk sonrası vücutta oluşan olumsuzlukların azaltılmasına yönelik günümüz popüler yöntemlerden birisi kendi kendine myofasyal gevşemedir. Miyofasyal gevşeme, optimum doku uzunluğunu geri

kazandırmayı ve işlevi iyileştirmeyi amaçlayan hedefli, yönlü, düşük yüklemeli mekanik kuvvet içeren bir uygulamadır. Çalışmaya faal olarak basketbol oynayan ve rasgele yöntemle iki gruba ayrılan (SMR Grup, n=6; KNT Grup, n=6) 16,42± 0,52 yıl yaş ortalaması olan 12 erkek basketbolcu katılmıştır. Katılımcılara 8 hafta süren basketbol antrenmanlarının hemen sonrası (haftada 3 gün) 30 sn'lik sürelerle kendi kendine myofasyal gevşeme uygulaması yapılmıştır. Katılımcıların esneklik, çeviklik, denge ve eklem hareket açıklığı değerleri, 8 haftalık sürenin öncesinde ve sonrasında (Ön Test ve Son Test) ölçülmüştür. Grup içi zaman farklılıkları ve gruplar arası farklılıkların istatistiksel analizinde Karma Desen (2x2) ANOVA" testi (SPSS 23) kullanılmıştır. Gruplar arasında yalnızca kalça adduksiyon ROM değerlerinde SMR grubu lehine anlamlı sonuç ($p<0,05$) bulunurken, diğer ROM değerleri, esneklik ve çeviklik parametrelerinde sadece grup içi Ön Test ve Son Test ölçümleri arasında SMR gruplarında anlamlı düzeyde olmasa da iyileşmelerin olduğu tespit edilmiştir. Sonuç olarak, basketbolcularda antrenman sonrası SMR uygulamalarının eklem hareket açıklıklarının artırılmasında, denge performanslarının yükseltilmesinde, kas esneklik düzeyinin arttırılmasında ve çeviklik değerlerinin aşağı çekilmesinde yüksek düzeyde bir etkiye yardımcı olabileceği yönünde bir göstergeye ulaşılamamıştır. Fakat tüm parametrelerde düşük düzeyde de olsa iyileşmelerin görülmesi, oyuncuların toparlanma aşamasında katkılar sağlayabileceğini düşündürmektedir. Bu nedenle, klinisyenler, spor bilimciler, antrenörler ve atletik performansçılar sporcuların daha yüksek performans, hazır bulunuşluk ve rekabet için en uygun toparlanma stratejilerini sağlamalıdırlar.

Anahtar Kelimeler: Eklem hareket açıklığı, denge, esneklik, çeviklik, myofasyal gevşeme.

INTRODUCTION

It is very important for athlete performance to eliminate the effects such as fatigue and delayed onset muscle soreness (DOMS) that occur in athletes after exercise as soon as possible (1, 8, 15, 17). Failure to recover in a short period of time can also negatively affect players' performance and general well-being (19). Furthermore, players at all levels of competition are exposed to intense training and match programmes, which can lead to fatigue accumulation (12, 19). In order to determine effective strategies to eliminate these negative effects, various researches have been conducted and are still being conducted by many researchers. Post-exercise recovery strategies such as self-myofascial relaxation (SMR) applications (8, 16, 24, 26, 42) are common methods applied to reduce fatigue and muscle soreness. The main goal of SMR is to reduce the tension between the muscles and the surrounding fascia tissue and increase mobility. Fascial tissue is a structure whose presence is determined in every region and every part of the human body, wrapping the body like a spider web, and whose value and benefits are understood more and more every day. The fascial system penetrates and surrounds all organs, muscles, bones and nerve fibres; it gives the body a functional structure and provides an environment that allows all body systems to work in an integrated manner (2). The myofascial system and its physiological effects on the human body have been widely studied in the field of physical activity and sports strength and conditioning in the last decade (20, 28, 34, 50). Although scientific evidence is limited, 'myofascial release' (MFR) and 'self-myofascial release' (SMR) applications are quite common today in gyms and sports centres by individuals of all ages (4, 39) and are even used by athletes and coaches in the fields of sports performance and physiotherapy (8).

Myofascial release is a therapeutic intervention to loosen soft tissue from areas of abnormally tight fascia (36). Myofascial release therapy involves targeted, directional, low-loading mechanical forces aimed at restoring optimal tissue length and improving function (3). It is suggested that high or sustained pressure applied through myofascial release causes the golgi tendon organs to sense sensations of varying tension in the musculature and induce relaxation of muscle fibres (36). A popular approach to self-myofascial release (SMR) has emerged as a technique in which individuals apply pressurised rolling forces with a foam roller along the targeted musculature using their own body mass and follow the orientation of the mobilised muscle (41). SMR has become a popular method that affects muscle and myofascial structures by increasing fascia compliance and extensibility (37) and reducing passive muscle stiffness (38). The best known positive effect of SMR is the increase in ROM values (23, 32, 49). Beardsley and Scarabot (5) positively commented that myofascial release studies increased the range of motion by relaxing the fascia.

Studies examining the possible effects of SMR on the body mention that there may be fascial restrictions that may prevent normal muscle function after physical exertion (2, 45, 54). They state that this situation may affect the musculoskeletal system, which is the basis for sports performance (45) and the physical conditions (strength, speed, endurance, flexibility) arising from it (11). The idea that SMR exercises can be an alternative

to recovery methods for soft tissue regeneration attracts the attention of athletes, coaches, fitness participants and physiotherapists (32, 41). Despite its popularity, the physiological effects of many SMR tools on the body are still unclear. As a result, a consensus regarding the specific use of SMR in an optimal programme to enhance physical capacity, accelerate recovery processes and improve overall athletic performance has yet to be established (6, 22). Given that SMR is emerging as a trend in the field of physical conditioning (52), it is important to determine the conceptual meaning of the myofascial system in order to reach a broader understanding of the effects of SMR on the human body and how these effects can affect athletes' performance (34).

Considering that the effects of myofascial release on athletes are still unclear in the literature, an answer to the following question was sought. After an intense exercise session, does self-myofascial release with a foam roller accelerate muscle recovery, increase range of motion and improve balance, flexibility and agility performances that affect athletic performance?

METHOD

The study is a quantitative study and was carried out in experimental research type. The ethics committee approval for this experimental study was obtained from Selçuk University, Faculty of Sport Sciences, Non-interventional Clinical Research Ethics Committee (03.24.2023; 37).

Research Group: Twelve male basketball players aged 16-18 years actively playing basketball participated in the study. Before the study, participants were provided with a verbal explanation of the procedures and signed informed consent. All procedures were in accordance with the Declaration of Helsinki. Two groups were formed from the participants, the SMR group (6 athletes) and the CNT group (6 athletes). Descriptive information (Age, Body Weight (BW), Height, Body Fat Percentage (BFP), Lean Body Mass (LBM) and Body Mass Index (BMI) were measured/calculated and tabulated (see Table 1).

Data Collection

For body composition measurements of the participants, a scale (DESİS) with an accuracy of ±50 g, a stadiometer (SECA) with an accuracy of ±1 mm, and a skinfold caliper (HOLTAİN) with an accuracy of ±0.2 mm were used.

Agility measurements were performed with the Ilionis test. It was performed twice with 5 min intervals and the best test result was recorded.

Flexibility measurements were performed using a standard sit-stand test table and the higher value of the 2 measurements was recorded.

Balance measurements were performed using a multiaxial balance measurement device (BBS, Biodex Medical Systems Inc, Shirley, USA). With the balance measurements performed within 10 seconds with eyes open (GA), a total of 3 measurement results including swing limits, medial-lateral index, anterior-posterior index and overall stability index were obtained and recorded.

Range of Motion (ROM) was measured from 5 regions including shoulder (flexion, extension, abduction), hip (flexion, extension, abduction, adduction), knee (flexion), elbow (flexion) joints by means of HALO inc. (USA) digital goniometer (Correll et al 2018).

Figure 1. Range of Motion (ROM) Measurements of the Participants with Digital Goniometer.

Implementation Procedure

Type and Duration of Training; Both groups were ensured to continue their classical basketball training in their teams for 8 weeks and not to participate in any other physical activity. This process started with the 2nd half of the 2024-2025 season.

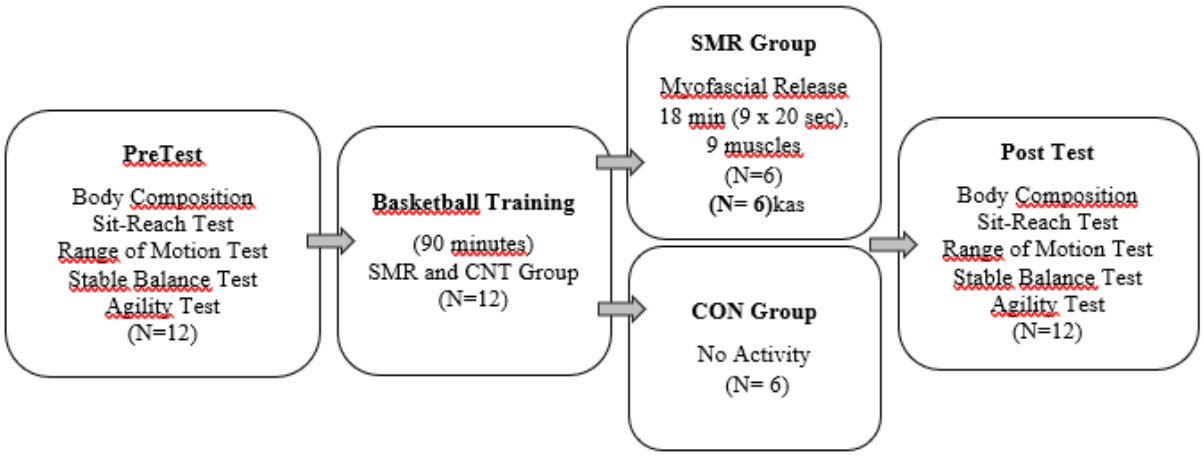

Figure 2. Study Design Diyagram

Content and duration of SMR applications; SMR application training was given by an expert trainer so that SMR applications could be performed by the athletes themselves. SMR application; Planter Facia, Gastrocneminius, Adductors, Tensor Fascia Latae, Hamstring, Gluteuses, Quadriceps, Priformis, Thoracic Spine, Latissimus Dorci, Pectoralis Major muscle groups were applied. In this study, a 90 cm long and 15 cm diameter high density (ACTIFOAM) foam cylinder with a smooth surface (without serrations) was used, and an 8 cm diameter ball of the same hardness (ACTIFOAM) was used for underfoot Planter Facia application.

SMR was applied by means of foam cylinders along the muscle fibres, from the proximal to the distal muscle insertion and vice versa, at a constant pressure and a speed of 2.5 cm/sec into the muscle tissue only. The participant was monitored by the researcher while applying the SMR technique, intervened when necessary and ensured that it was performed in the correct form. SMR was applied only to muscle tissue for an average of 20 seconds, avoiding pressure on bones, joints or tendons.

Figure 3. Self-Myofascial Release Practice and Foam Roller and Foam Ball Used.

Statistical Analysis

SPSS version 23.0.0 (SPSS Inc., Chicago IL, USA) was used in the analysis of all data and alpha levels were evaluated at 0.05 for significance. In data table presentations, values are expressed as mean (X) and standard deviation (SD). For the normal distribution analysis of the data, Skewnew-Kurtasis test and skewness and kurtosis values (51, 21) and then Shapiro-Wilk test values were taken into consideration. 'Box' test for the equality of Covariance Matrices and then "Levene" test results for the equality of Error Covariances were taken into consideration. 'Mauchly' test was performed for the sphericity condition, and in cases where the sphericity assumption was not met, the results were determined and used with Greenhouse-Geisser correction. 'Mixed Design (2x2) ANOVA' test was used in the pretest and posttest comparisons of the experimental and control groups of all the data obtained. The 'Eta Square (ηp2)' values were calculated and interpreted for the effect size of the significant differences obtained. Eta square (η2) values were considered as small effect size if equal to 0,01, medium effect size if equal to 0.05, and large effect size if equal to 0,14 (10).

FINDINGS

Table 1. Pretest Values Regarding Body Composition Parameters of Participants

N=12	Min.	Max.	$\bar{x}$	SD
Age (years)	16,00	17,00	16,42	0,52
Height (cm)	1,72	2,07	1,89	8,93
Body Weight (kg)	60,00	110,00	80,75	12,93
Body Fat Percentage (%)	9,43	20,15	13,86	3,16
Body Mass Index (kg/cm)	18,60	29,84	22,53	3,03

Table 2. Mixed Design Anova Test Results of Participants' Range of Motion (ROM) Values

	Groups	N	Pre Test $\bar{x}$ ± SD	Post Test	F Time	F Group	F GroupxTime
SHOULDER (flexion)	SMR Group	6	167,67±23,27	186,50±19,77	9,08*	0,01	1,19
	CNT Group	6	171,50±17,46	180,33±17,36			
	Total	12	169,58±19,71	183,42±18,03			
SHOULDER (extension)	SMR Group	6	46,83±12,23	50,50±13,90	0,95	0,76	0,01
	CNT Group	6	40,00±17,42	44,67±14,56			
	Total	12	43,42±14,71	47,58±13,91			
SHOULDER (abduction)	SMR Group	6	150,00±21,71	165,83±18,08	4,18	1,91	0,43
	CNT Group	6	141,50±16,83	149,67±16,91			
	Total	12	145,75±19,04	157,75±18,70			
HIP (flexion)	SMR Grubu	6	81,67±8,02	88,83±5,27	4,19	3,49	1,47
	SMR Group	6	71,00±11,82	72,83±5,27			
	CNT Group	12	76,33±11,12	80,83±16,77			
HIP (extension)	SMR Group	6	18,50±2,88	19,83±2,40	0,25	0,57	0,70
	CNT Group	6	19,67±2,94	19,33±3,56			
	Total	12	19,08±2,84	19,58±2,91			
HIP (adduction)	SMR Group	6	22,67±6,53	30,83±11,30	5,17*	0,44	5,17*
	CNT Group	6	29,67±8,29	29,67±5,47			
	Total	12	26,17±8,00	30,25±8,49			
HIP (abduction)	SMR Group	6	41,17±5,49	49,17±9,50	4,84*	3,99	1,59
	CNT Group	6	34,83±9,93	37,00±10,14			
	Total	12	38,00±8,33	43,08±11,32			
KNEE (flexion)	SMR Group	6	143,83±22,85	141,33±11,18	0,49	3,82	0,45
	CNT Group	6	126,67±21,40	122,00±15,96			
	Total	12	135,25±22,93	131,67±16,57			
ELBOW (flexion)	SMR Group	6	148,33±4,84	150,50±5,82	0,70	0,14	2,92
	CNT Group	6	153,33±7,15	147,00±3,63			
	Total	12	150,83±6,38	148,75±4,98			

*p=0,05

When the participants' Shoulder extension and abduction, Hıp flexion and extension, Knee flexion and Elbow flexion ROM values were examined, it was found that there were no significant differences in any of the time, group and group x time effect factors (p>0,05). It was observed that the effect of the time factor was statistically significant in Shoulder flexion (F(1,9)=9.08, p=0,01, η2=0,48) and Hip abduction ROM values (F(1,9)=4,84, p=0,05, η2=0,33). It was determined that there were significant differences in Hip adduction ROM values (F(1,9)=4,84, p=0,05, η2=0,33) in all effect factors, time (F(1,9)=5,17, p=0,04, η2=0,34), group (F(1,9)=0,44, p=0,05, η2=0,04) and group x time (F(1,9)=5,17, p=0,04, η2=0,34).

Table 3. Mixed Design Anova Test Results of Participants' Open Eye Balance Parameters

	Groups	N	Pre Test $\bar{x}$ ± SD	Post Test	F Time	F Group	F GroupxTime
Right Foot (Anterior-Posterior Index)	SMR Group	6	1,40±0,77	1,12±0,48	1,67	2,15	0,16
	CNT Group	6	1,87±0,73	1,72±0,76			
	Total	12	1,63±0,76	1,42±0,68			
Right Foot (Inner-Outer Index)	SMR Group	6	1,57±0,72	1,65±0,69	0,88	0,16	0,15
	CNT Group	6	1,38±0,42	1,58±0,57			
	Total	12	1,47±0,57	1,61±0,60			
Right Foot (Total Index)	SMR Group	6	2,33±1,06	2,28±0,97	1,32	1,11	0,62
	CNT Group	6	2,63±0,97	2,37±1,13			
	Total	12	2,48±0,98	2,33±1,00			
Left Foot (Anterior-Posterior Index)	SMR Group	6	1,58±0,55	1,45±0,61	2,38	0,19	0,14
	CNT Group	6	1,47±0,91	1,25±0,52			
	Total	12	1,53±0,72	1,35±0,55			
Left Foot (Inner-Outer Index)	SMR Group	6	1,47±0,87	1,48±0,0,83	0,15	0,75	0,23
	CNT Group	6	1,25±0,36	1,08±0,62			
	Total	12	1,36±0,65	1,28±0,73			
Left Foot (Total Index)	SMR Group	6	2,35±1,01	2,45±1,18	0,61	0,29	2,24
	CNT Group	6	2,25±1,05	1,93±0,79			
	Total	12	2,30±0,98	2,19±0,99			

*p=0,05

When the participants' right foot front-back, inside-outside and total index values and the left foot front-back, inside-outside and total index values were examined, it was determined that there were no significant differences in any of the time, group and group x time effect factors (p>0,05), (see table 3).

Table 4. Mixed Design Anova Test Results of Participants' Flexibility and Agility Values.

	Groups	N	Pre Test $\bar{x}$ ± SD	Post Test	F Time	F Group	F GroupxTime
FLEXIBILITY (cm)	SMR Group	6	11,06±5,12	16,02±5,16	12,16*	0,41	1,16
	CNT Group	6	10,43±6,44	13,05±3,89			
	Total	12	10,75±5,56	14,53±4,62			
AGILITY (sec)	SMR Group	6	17,78±1,24	17,51±1,07	7,09*	0,51	3,37
	CNT Group	6	18,84±1,87	17,41±0,63			
	Total	12	18,31±1,61	17,46±0,84			

When the flexibility values of the participants (see table 2) were examined, it was seen that the effect of the time factor (F(1,9)=12,16, p=0,04, η2=0,55) was statistically significant, while no significant difference was found in the group and group x time factor (p>0,05). In the flexibility parameter, it was determined that the Post-Test values of both the SMR and CNT groups were higher than the Pre-Test values. Although this increase in the SMR group was not statistically significant, it was higher than the CNT group. Although the significance in this increase was a significance of p=0,54 between the groups, it was observed that there was a low-level effect when the effect size (η2=0,04) value was taken into account. When the agility values of the participants (see table 4) were examined, it was seen that the effect of the time factor (F(1,9)=7,091, p=0,02, η2=0,42) was statistically significant, while no significant difference was found in the group and group x time factor (p>0,05). When the Pre-Test and Post-Test agility mean values of the SMR and CNT groups were examined, it was determined that there were decreases in the Post-Test agility values in both groups compared to the Pre-Test values.

DISCUSSION AND CONCLUSION

The aim of this study was to find an answer to the question whether self-myofascial release with a foam roller after an intensive exercise session helps to improve range of motion, balance, flexibility and agility performances which have effects on athletic performance.

When the findings of our study on active young basketball players were analysed, a significant difference between the groups (SMR and CNT) was found only in hip adduction ROM (see table 2) in favour of the SMR group. Significant differences were found in shoulder flexion and hip abduction ROM values in the intra-group time interaction, while no significant differences were found in other measured ROM values. However, improvements were observed in all ROM values in SMR groups compared to CNT groups.

It was determined that there were no significant differences between the groups in all parameters of balance measurements (see Table 3). On the other hand, in flexibility and agility variables, significant differences were found only between the pre-test and post-test values of the groups (SMR-CNT) (see table 4).

In all ROM values measured from nine regions in our study, increases were observed in both SMR and CNT groups in the pretest-posttest time parameters, but these increases were not significant in all except the hip adduction value. This significant increase in hip adduction value was 30.83 % in the SMR group and 29.67 % in the CNT group. Although we determined increases in all ROM values (between 2% and 15%), the lack of high level improvements in balance, flexibility and agility values suggested that the increases in ROM values were not sufficient to provide an increase in performance parameters. In a study conducted about 10 years before our study, Jay et al (25) applied SMR to one leg for 10 min after the stress they created in the hamstring muscles and did not determine a significant change in the ROM values of the leg with and without SMR as in our study.

Macdonald et al (33), who analysed post-exercise SMR application as in our study, reported that, contrary to the results of our study, there was an improvement in ROM values, muscle activation and vertical jump performance of the experimental groups compared to the control groups. In addition, in their systematic meta-analysis study on the use of SMR before and after exercise, Schroeder and Best (46) stated that increases in quadriceps and hamstring ROM values were detected depending on time factors, and as a result of their evaluation, they emphasised that foam roller SMR applications can be a valuable tool for exercising individuals and that individuals can eliminate the need for a massage therapist and allow individuals to self-treat themselves at a convenient time (immediately after exercise) and frequency (several times a day). Mauntel et al (35), in a review of 10 studies, Mauntel et al (35) found that a significant increase in ROM was observed in 8 of 10 studies and no significant changes in muscle function parameters were found in any of these 10 studies. Therefore, they recommended that clinicians use myofascial release applications before rehabilitation or physical activity.

The reason for this is that SMR applications effectively increase ROM without decreasing muscle function, and the increase in ROM increases the efficiency of movement and reduces the risk of injury. Martinez-Aranda et al (34), in their evaluation after a review of the literature on in-depth myofascial release involving a total of 25 articles and 517 athletes, stated that SMR applications are an effective and alternative application to improve the ROM values of the joints in both isolated and static and dynamic stretching without adversely affecting the athletes' performance in strength, speed and agility as well as muscle activities. They also emphasise that these improvements in ROM will provide higher performance in movement patterns and thus reduce the risk of skeletal muscle injuries. In addition to these explanations, they also stated that the most efficient and most appropriate SMR application time is approximately 1 minute 30 seconds.

In the limited literature studies in which the effects of SMR on static and dynamic balance were examined, there are studies in which improvements in balance performance were determined, as well as studies in which negative results were determined even if there was no improvement. The results of the study on the balance performance of SMR (23) and the subsequent studies (27, 53) and our study, in which we determined that SMR applied after basketball training did not have a positive effect on balance performance, are similar to these studies. In addition to these studies, Lee et al (30), one of the limited number of studies that determined the positive effects of SMR on balance performance, determined that foam rolling techniques showed an increase of 1.8% compared to static stretching techniques as a result of dynamic balance measurements with the Star

Balance Test (YDT) after 2 different foam roller rolling and static stretching applications applied to 30 male university students. In another study, Zhang et al (55) determined that the performance of the SMR group was better than the CON group in the anterior axis and lateral axis at the end of the SMR applications in the balance values determined with the Star Balance Test and stated that the balance values of the SMR group improved up to 8%. In our study, no significant differences were detected in both right and left foot balance measurements, in both anterior-posterior and lateral-medial oscillations and in total balance evaluation, neither between the groups nor within-group time factors (pretest-posttest). The lack of improvement in balance performances in the present study suggests that the lack of improvement in ROM values is also related to the lack of improvement in ROM values.

It is a known fact that basketball players should have appropriate back and hamstring flexibility in order to reduce the risk of knee and ankle injuries with muscle strain and to increase their performance. Although the differences between the SMR group and the CNT group were not significant (p= 0,54), we observed an improvement of 44,85% in the SMR group and 25,12% in the CNT group in the pretest and posttest values of the groups. While these findings are compatible with the results reported by Casanova et al (2018), they contradict the study by Macdonald et al (33) in which they found significant effects of SMR in reducing the loss of knee flexion and hip flexion flexibility 48 and 72 hours after exercise. In addition, in a study using the same measurement method as our study, Sullivan et al (49) found a 4.3% increase in flexibility measurements before (31,32) and after (32,68) SMR (p=0,00), although there was no significant difference between the groups (p=0,07). In addition to these results, Zhang et al (55) stated that SMR provided a significant ($p<0.001$) interaction between flexibility variables and that the scores in SLR (11 ± 7%), TTT (50 ± 40%) and WBLT (22 ± 17%) increased and improved flexibility performance in the SMR group.

As a result of their study aiming to reveal the effects of SMR in more detail, Beardsley and Škarabot (5) reported that SMR acutely increased flexibility and reduced muscle soreness without negatively affecting athletic performance. However, they emphasised that it should be noted that there is conflicting evidence as to whether SMR improves flexibility in the long term. When the literature studies on the improvement of flexibility by SMR are evaluated, there are studies with significant differences (48, 29) as well as studies that do not find significant. In the literature, when traditional stretching methods (passive / static or dynamic) are compared with other methods (foam roller, pilates ball / circle, foam ball, etc.), it is stated that there are not many differences between them (9, 14, 40, 41, 43, 53) close values are determined and not much improvements are determined.

It was also stated that all the methods applied did not produce any negative effects. In a recent meta-analysis (34), it was reported that although the underlying causes of improved flexibility in general remain unclear for a number of reasons, from a more positive perspective, these positive effects may be explained by a temporary decrease in the connection between fascial tissue and muscle tissue or plasticity deformation of connective tissue (e.g. fascia, tendon, capsule). On the positive side, Martinez-Aranda et al (34) stated that a temporary reduction in pain perception may also lead to an improvement in short-term flexibility. Therefore, studies focussing on the short-term effects of SMR have argued that knee and hip flexibility improved mainly immediately after the application, and that this effect disappeared after 24 hours, with no permanent improvement. As a result, according to short-term interventions, in accordance with the temporal improvements mentioned above, they stated that the effects on flexibility lasted less than 10 minutes.

In addition, short-term improvements in flexibility values are based on evidence, but there are no clear statements about why there is no improvement. Although no significant improvement was observed in our study, the fact that the rate of increase determined in the SMR group was higher than the CNT group suggests that SMR application may have an additional contribution to the flexibility value.

We consider anaerobic performance as a basic requirement for playing basketball due to the high number and intensity of sprints, changes of direction and jumps that basketball players must perform during the competition. For this reason, agility performance measurement, which is one of the anaerobic data, was included in our study and we sought an answer to the question of how foam roller application after intensive basketball training affects agility performance. In our current study, there was no significant difference between the SMR group and the CNT group in the agility values of SMR, but significant improvements were

observed between the Pre-Test and Post-Test values of both groups (time factor). This improvement was determined -1,52% in the SMR group and -7,59% in the CNT group, suggesting that the results were inconsistent. The fact that there was no difference between the groups in agility values, but that they differed over time in both groups, was interpreted as an indicator of a positive effect of 3 days of training and 1 day of competition per week on agility. Although there are massage-based applications on agility performance, the number of studies performed with normal foam rollers (without vibration, static/dynamic stretching) is limited. Rey et al. (42) examined the jump, sprint, flexibility, agility and recovery values as a result of SMR application after football training (n=18) and could not find a significant improvement in all parameters, but determined improvements in agility values in time ($\eta 2=0.27$) and time x group ($\eta 2=0.24$) values. The author commented on this result, stating that SMR has a positive effect in minimizing the decreases in agility test performance, providing a return close to pre-training values, and that this recovery mode can be one of the valuable aids for muscle recovery function in agility actions. Richman et al. (43) examined the effects of a 6-minute SMR protocol using a foam roller, combined with a general warm-up and sport-specific dynamic stretching (DS) session on flexibility and agility in a sample of 14 female university athletes, and reported that there were no significant differences between the groups, only improvements in flexibility values over time. When the studies that performed post-warm-up tests using vibrating foam roller and stretching applications were examined; studies that performed applications with different methods (vibrating foam roller, vibrating massage device and static/dynamic stretches) after warm-up training (not intense activity) (31, 9, 53) also determined significant differences in agility test results between the vibrating groups and the other groups, contrary to the results of the SMR study performed with a normal foam roller (our current study; Richman et al. (43)).

Since the use of different devices (vibration) and the implementation of the applications before exercise (after warming up) in these studies are different from our study method and their effects are thought to be different, it would be correct to evaluate such studies in different categories. Martinez-Aranda et al (34) stated that these inconsistencies determined in the literature can be explained by study designs, activities that induce fatigue, or differences between the samples. The low-value increase observed in agility performance after SMR application observed in our study, similar to what Martinez-Aranda at al (34) commented, may be due to decreased DOMS pain, increased voluntary activation, and decreased neural inhibition. Considering these different results in the literature, it is still unclear whether the use of SMR after training sessions will accelerate aerobic recovery and facilitate the improvement of repeated sprint performances. In order to transform this uncertainty into clear statements and to reveal the effect of SMR on recovery in every aspect, especially in team sports, more research needs to be done to definitely clarify the duration of SMR application and the intensity of pressure. It is also important that athletes are given meticulous training and reinforced with many repetitions so that they can apply SMR applications correctly.

The limitations of this study should definitely be taken into consideration when interpreting the results.

The first limitation is that the 8-week period during which SMR applications were performed in our study can be considered as a short period in terms of seeing improvements. When designed as a longitudinal application, it will facilitate the evaluation of the effectiveness of SMR on the level of fatigue that may occur after intense training and competition. In addition, SMR application is performed only once within the 24, 48 or 72 hours between two training sessions. SMR applications that can be repeated (more than once) between these training processes can facilitate fatigue level evaluations.

The second limitation is that the SMR trainings given to the athletes are created as a single repetition considering the time factor. Providing these trainings once before the study applications has ensured that the athletes cannot adjust the duration and intensity correctly, cannot clearly find the fascial trigger points or do not take the application seriously.

CONCLUSION AND RECOMMENDATIONS

In summary, the results of the current study did not show that SMR applications after training in basketball players could help to improve joint range of motion, increase balance performance, flexibility and agility performance at a high level. However, the fact that improvements were observed in all parameters, albeit at a low level, suggests that it may contribute to the recovery phase of the players. Therefore, clinicians,

sports scientists, coaches and athletic performers should provide the most appropriate recovery strategies for athletes for higher performance, readiness and competition.

This study aimed to ensure that the use of SMR in basketball players during the recovery phase after intensive training and competition is beneficial to athletic performance by increasing joint range of motion, increasing stable balance performance, increasing muscle flexibility level and decreasing agility values. Considering the importance of how players feel, it can be thought that any action taken to increase the perception of recovery after exercise can help basketball players to train adequately, perform the planned workload or reach the expected performance level. Therefore, to minimize the negative effects of basketball training, coaches and athletic performers of all age categories, both amateur and professional, may consider prescribing 20 to 30 minutes of SMR practice to help enhance recovery between training and competition loads.

Limitations of the Study

This study has some methodological limitations.

First, the study was conducted with only 12 male basketball players between the ages of 16-18. This situation limits the generalizability of the findings to different age groups, genders or sports branches. The low number of participants may reduce statistical power and make it difficult to transfer the results to a larger population.

Second, the application period was limited to eight weeks. The effects of long-term applications are outside the scope of this study. In addition, since SMR applications are based on the principle that athletes perform them on their own, application differences between individuals and technical errors are another factor that may affect the reliability of the results.

However, although the participants were only asked to continue their basketball training, their physical activities outside of training could not be completely controlled. This factor has the potential to increase the effect of external variables on the results.

Finally, psychological, motivational or environmental factors were not evaluated in the study; only physical performance parameters were measured. Since these individual factors may indirectly affect performance, they should be carefully considered when interpreting the results.

In line with these limitations, the findings obtained should be interpreted carefully and should be considered as a reference for future studies. When evaluated within this framework, the results of the study provide important findings regarding the effects of SMR applications on physical performance in young athletes.

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Sex-Based Differences and Associations in Muscle Stiffness and Reactive Strength Index Among Elite Male and Female Soccer Players

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Abstract

The aim of this study was to compare reactive strength index (RSI), muscle stiffness, and aerobic capacity between male and female soccer players, and to examine their relationships with physical performance. A total of 32 soccer players participated in the study, including 16 female players (age: 18.06 ± 3.21 years; height: 1.66 ± 0.09 m; body mass: 56.87 ± 7.51 kg; BMI: 20.78 ± 2.03 kg/m²; training experience: 7.09 ± 2.49 years) and 16 male players (age: 21.37 ± 3.86 years; height: 1.79 ± 0.06 m; body mass: 71.87 ± 8.93 kg; BMI: 22.51 ± 2.20 kg/m²; training experience: 11.37 ± 4.22 years). To compare performance characteristics between sexes, several key physical parameters were assessed, including linear sprint velocity, aerobic capacity (via the 30-15 Intermittent Fitness Test), maximal ball velocity, leg stiffness, and Reactive Strength Index (RSI). Group differences were assessed using independent t-tests or Mann–Whitney U tests, based on distribution characteristics. Within-group associations were analyzed through Pearson or Spearman correlation coefficients, as appropriate. Significant sex-based differences were found in sprint ($p = 0.000$, ES = 2.34), 30-15 IFT ($p = 0.005$, ES = 1.07), kicking velocity ($p = 0.000$, ES = 3.31), RSI ($p = 0.043$, ES = 0.75), and stiffness ($p = 0.007$, ES = 1.02). In females, stiffness was negatively correlated with kicking velocity ($p = 0.017$, ES = –8.34), while in males, RSI ($p = 0.013$, $r = 0.604$, ES = 2.47) and stiffness ($p = 0.028$, $r = 0.548$, ES = 1.82) were positively correlated with kicking velocity. Additionally, stiffness was positively related to 30-15 IFT performance in males ($p = 0.049$, $r = 0.499$, ES = 1.98). Male players showed higher RSI and stiffness values, which were more strongly associated with performance, while lower stiffness in females may support technical skills but increase injury risk. These findings highlight the importance of sex-specific training approaches that consider neuromechanical differences in performance and injury prevention. Future studies should include physiological variables such as muscle cross-sectional area to clarify sex-specific neuromechanical adaptations.

Keywords: Aerobic capacity, Injury risk, Kicking performance, Neuromechanical characteristics, Sprint.

Özet

Elit Erkek ve Kadın Futbol Oyuncuları Arasında Kas Sertliği ve Reaktif Güç Endeksindeki Cinsiyete Dayalı Farklılıklar ve İlişkiler

Bu çalışmanın amacı, erkek ve kadın futbolcular arasında reaktif kuvvet indeksi (RSI), kas sertliği ve aerobik kapasiteyi karşılaştırmak ve bu parametrelerin fiziksel performansla olan ilişkilerini incelemektir. Çalışmaya 32 futbolcu katılmıştır; bunların 16'sı kadın (yaş: 18.06 ± 3.21 yıl; boy: 1.66 ± 0.09 m; vücut ağırlığı: 56.87 ± 7.51 kg; BKİ: 20.78 ± 2.03 kg/m²; antrenman yaşı: 7.09 ± 2.49 yıl) ve 16'sı erkektir (yaş: 21.37 ± 3.86 yıl; boy: 1.79 ± 0.06 m; vücut ağırlığı: 71.87 ± 8.93 kg; BKİ: 22.51 ± 2.20 kg/m²; antrenman yaşı: 11.37 ± 4.22 yıl). Cinsiyete bağlı performans farklılıklarını karşılaştırmak amacıyla doğrusal sprint hızı, aerobik kapasite (30-15 Aralıklı Fitness Testi), maksimum şut hızı, bacak sertliği ve reaktif kuvvet indeksi gibi temel fiziksel parametreler değerlendirilmiştir. Gruplar arası farklar, dağılım özelliklerine bağlı olarak bağımsız örneklem t-testi veya Mann–Whitney U testi ile analiz edilmiştir. Grup içi ilişkiler ise uygunluğa göre Pearson veya Spearman korelasyon katsayıları ile değerlendirilmiştir. Sprint ($p = 0.000$, ES = 2.34), 30-15 IFT ($p = 0.005$, ES = 1.07), maksimum şut hızı ($p = 0.000$, ES = 3.31), RSI ($p = 0.043$, ES = 0.75) ve bacak sertliği ($p = 0.007$, ES = 1.02) performanslarında cinsiyetler arasında anlamlı farklar bulunmuştur. Kadın futbolcularda, bacak sertliği ile topa vurma hızı arasında negatif korelasyon saptanmıştır ($p = 0.017$, ES = –8.34); erkek futbolcularda ise RSI ($p = 0.013$, $r = 0.604$, ES = 2.47) ve sertlik ($p = 0.028$, $r = 0.548$, ES = 1.82) şut hızı ile pozitif ilişkili bulunmuştur. Ayrıca, erkeklerde sertlik, 30-15 IFT performansı ile anlamlı pozitif ilişki göstermiştir ($p = 0.049$, $r = 0.499$, ES = 1.98). Erkek futbolcular daha yüksek RSI ve sertlik değerlerine sahipken, bu parametreler performansla daha güçlü ilişkiler göstermiştir. Kadınlarda ise daha düşük kas sertliği teknik becerilere katkı sağlayabilirken, yaralanma riskini artırabileceği görülmüştür. Bu bulgular, performans ve sakatlanma riskine yönelik cinsiyete özgü antrenman yaklaşımlarının önemini ortaya koymaktadır. Gelecek çalışmalar, cinsiyete özgü nöromekanik uyumları daha iyi anlamak için kas kesit alanı gibi fizyolojik değişkenleri de içermelidir.

Anahtar Kelimeler: Aerobik kapasite, Yaralanma riski, Vuruş performansı, Nöromekanik özellikler, Sprint.

INTRODUCTION

Analyses of match-related performance indicators in both women's and men's soccer suggest a temporal advancement in technical, tactical, and physical aspects of team performance (4,16, 29). A comprehensive understanding of this evolutionary progression holds significant value for coaches and sports scientists alike, as the monitoring, assessment, and optimization of player performance rely heavily on the systematic analysis of such key performance indicators. Long-term performance development and its systematic monitoring have become one of the most emphasized and extensively studied topics in modern football, as they are considered crucial for enabling athletes to reach and maintain elite-level performance (2, 23, 26). Consequently, the integration of neuromechanical parameter monitoring into performance assessment has become a fundamental aspect of modern athlete monitoring systems, ensuring that training prescriptions are based on scientifically grounded evidence (7).

One of the fundamental neuromechanical mechanisms underlying football performance is the stretch-shortening cycle (SSC) (18). The SSC is typically defined as the ability of the musculotendinous unit to produce a rapid and forceful concentric contraction immediately following a fast eccentric action, and is effectively utilized in football-specific movements (15). This typically occurs during movements in which body segments are exposed to impact forces that induce a rapid stretch of the musculotendinous structures (11, 27). The magnitude of impact or stretch forces, task constraints, and the individual's capacity to tolerate such forces collectively determine the nature of the SSC−classified as either fast (≤ 250 ms) or slow (> 250 ms) (17). Reactive strength is a key parameter that reflects an athlete's ability to generate force rapidly. It becomes particularly prominent in sport-specific actions such as cutting, sprinting, and jumping, and is commonly associated with changes in muscle contraction velocity or force output. In sports where time-constrained actions are prevalent, the assessment of this quality provides valuable insights for exercise programming and athlete monitoring (15). Stiffness is an estimate of the resistance force a muscle exhibits in response to a given change in length. Mechanically, stiffness is defined as the ratio of change in force to change in length (stiffness [k] = Δ force / Δ length) (3). The primary source of resistance encountered during passive muscle elongation is attributed to the parallel elastic components of the muscle, including connective tissues such as the sarcolemma, endomysium, perimysium, and epimysium (17). A significant portion of passive muscle stiffness arises from the series elastic components, primarily tendons and the myofibrillar cross-bridge structures (25).

In contrast, active stiffness refers to the level of resistance a muscle exhibits against external forces during voluntary contraction, and is primarily determined by the number of cross-bridges formed in parallel within the muscle fibers (8).

Muscle stiffness and the Reactive Strength Index (RSI) are neuromechanical parameters closely associated with high-intensity actions in football, such as sprinting, jumping, and change of direction. Although these variables have received increasing attention in performance science in recent years, studies that directly compare male and female soccer players in terms of these parameters remain scarce. Nevertheless, to date, no studies have directly investigated the relationship between RSI and/or muscle stiffness with key performance components such as kicking velocity, sprint time, or aerobic capacity specifically in female athletes, highlighting the originality and relevance of the current research. This study aimed to provide a broader analysis of physical performance by evaluating not only neuromechanical characteristics but also aerobic capacity. In doing so, the relationships between variables such as RSI and stiffness and both anaerobic and aerobic performance indicators were examined in a sex-specific context. This research seeks to (i) compare RSI, muscle stiffness, and aerobic capacity between male and female soccer players, and (ii) investigate how these parameters relate to physical performance outcomes. The results aim to inform sex-specific training strategies and performance monitoring practices.

METHOD

Prior to the implementation of the study, the necessary approval was obtained from the Ethics Committee of Çukurova University, Faculty of Medicine (Decision No: 155; Date: 16.05.2025). Prior to the study, all athletes were informed about the measurement protocols and provided written consent in accordance with the Declaration of Helsinki.

Participants

A total of 32 soccer players voluntarily participated in this study, including 16 females (age = 18.06 ± 3.21 years, height = 1.66 ± 0.09 m, body mass = 56.87 ± 7.51 kg, BMI = 20.78 ± 2.03 kg/m², training experience = 7.09 ± 2.49 years) and 16 males (age = 21.37 ± 3.86 years, height = 1.79 ± 0.06 m, body mass = 71.87 ± 8.93 kg, BMI = 22.51 ± 2.20 kg/m², training experience = 11.37 ± 4.22 years). Inclusion criteria were: (i) being an active soccer player registered with a club or federation, (ii) having at least three years of systematic training history, (iii) participating in training regularly (minimum three sessions per week), and (iv) providing informed consent. Exclusion criteria included: (i) current musculoskeletal injury or pain affecting performance, (ii) any neurological, cardiovascular, or metabolic condition, and (iii) absence from training for more than two consecutive weeks in the past three months.

Procedure

The implemented protocol consisted of two separate testing sessions conducted on non-consecutive days, with a minimum 48-hour rest period between sessions to prevent fatigue-related effects. In the first session, sprint performance, maximum ball kicking velocity, and the 30-15 Intermittent Fitness Test (30-15 IFT) were conducted in that order. In the second session, the RSI and muscle stiffness measurements were carried out. Prior to each session, participants completed a standardized warm-up routine lasting approximately 10 minutes, which included self-selected dynamic stretching and submaximal trial efforts related to the upcoming tests (e.g., trial sprints or jumps). Additionally, 3 to 5-minute passive rest intervals were provided between each test within the sessions to ensure adequate recovery and minimize fatigue's influence on performance outcomes.

Linear Sprint Test

A 30-meter distance was precisely measured and marked, and necessary adjustments were made prior to the placement of electronic timing gates (TC Photogate; Brower Timing Systems LLC, Draper, UT, USA). The timing gates were positioned at the start of the 30-meter track, and each player began the sprint from a standing position 30 cm behind the first gate. Two plastic markers were placed 2 meters beyond the finish line to encourage players not to decelerate before crossing the line. Each participant performed three maximal-effort sprints, and the best time over the 30-meter distance was recorded for analysis (10).

30–15 Intermittent Fitness Test

The original 30–15 Intermittent Fitness Test was employed to assess participants' aerobic fitness levels. This protocol was selected due to its suitability for evaluating locomotor performance in soccer players. The test was conducted 48 hours after the participants' last official match, on a synthetic turf surface. Prior to the test, all participants completed a 5-minute self-paced running warm-up protocol. This test consists of alternating intervals of 30 seconds of high-intensity running and 15 seconds of active recovery. The running speed increases progressively at each stage. The initial speed was set at 8 km/h, and it was increased by 0.5 km/h every 30-second stage. The test was terminated when participants could no longer keep pace with the audio signal system. The primary outcome for aerobic performance was the velocity at the final completed stage (5).

Maximum Ball Kicking Velocity Test

Participants' ball kicking velocities were measured using a portable radar-based velocity measurement device (Bushnell 101911, Overland Park, KS, USA), which has previously demonstrated high validity (r = 0.88) (14). FIFA-approved size 5 footballs (circumference: 68–70 cm; weight: 420–445 g), specifically designed for the respective player category, were used for all attempts. Each participant performed three maximal-effort kicks from a distance of 11 meters, with a fixed 2-meter run-up. Regardless of shot accuracy, the highest ball velocity recorded among the three trials was used for analysis.

Leg Stiffness Test

Leg stiffness was assessed during a submaximal bilateral hopping test. The test was performed at a fixed hopping frequency of 2.5 Hz, selected to elicit movement patterns that resemble typical spring-mass model behavior (20). Participants were instructed to perform 20 consecutive bilateral hops on a mat. The hopping frequency was maintained using a quartz metronome (SQ-44, Seiko, Berkshire, UK). Leg stiffness (kNm^{-1}) was calculated using body mass, ground contact time, and flight time measurements (9) (Equation 1).

Kn=Mπ ⌈(Tf+Tc)⌉/T■(2@c)[(Tf+Tc/π)-(Tc/4)](Equ 1).

In the equation, K_n represents leg stiffness, M denotes body mass, Tc refers to ground contact time, and Tf indicates flight time.

Reactive Strength Index (RSI)

The RSI was calculated based on data obtained during a maximal vertical jump test. In this test, participants performed five consecutive bilateral maximal vertical jumps on a contact mat. They were instructed to minimize ground contact time while maximizing jump height (21). The first jump of each trial was excluded from analysis, and the mean value of the remaining four jumps was used in the RSI calculation (20). RSI was computed using the formula proposed by (11) (Equation 2).

RSI=Contact Time (ms)÷Jump Heigth (cm) (Equ 2).

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 20.0. For all variables, mean ($\bar{X}$) and standard deviation (SD) values were calculated. Following the assessment of normality, independent samples t-tests were used for variables meeting parametric assumptions, while the Mann–Whitney U test was applied for those that did not. Group comparisons were conducted to evaluate differences between male and female participants. Additionally, within-group relationships among variables were examined using correlation analyses (Pearson or Spearman, as appropriate). Effect sizes (Cohen's d) were calculated for all between-group comparisons, and interpreted using the following criteria: $d < 0.20$ = very small effect, $0.20 \leq d < 0.50$ = small effect, $0.50 \leq d < 0.80$ = moderate effect, and $d \geq 0.80$ = large effect (Cohen, 1988). The level of statistical significance was set at $p < 0.05$ for all analyses.

FINDINGS

Comparisons Between Female and Male Soccer Players

The mean, standard deviation, p-value, and effect size (Cohen's d) results for the 30 m sprint, 30-15 Intermittent Fitness Test (IFT), maximum kicking velocity, RSI, and stiffness tests of female and male soccer players were presented in Table 1. According to the statistical analysis, significant differences were found between female and male athletes in the 30 m sprint (p = 0.000, ES = 2.34, large), 30-15 IFT (p = 0.005, ES = 1.07, large), maximum kicking velocity (p = 0.000, ES = 3.31, large), RSI (p = 0.043, ES = 0.75, moderate), and stiffness (p = 0.007, ES = 1.02, large) performance levels.

Table 1. Comparative mean and standard deviation values of female and male athletes in physical performance tests.

Test	Female (Mean ± SD)	Male (Mean ± SD)	p-value	Cohen's d
RSI (ms / cm)	135.08 ± 36.61	162.81 ± 37.43*	0.043	0.75
Stiffness (kN·m^{-1})	23.41 ± 4.29	28.81 ± 6.12*	0.007	1.02
30m Sprint (s)	4.63 ± 0.30	4.09 ± 0.13*	0.000	-2.34
30-15 IFT (km/h)	17.31 ± 1.48	18.81 ± 1.33*	0.005	1.07
Maximal Kick (km/h)	74.94 ± 7.61	96.69 ± 5.34*	0.000	3.31

*Indicates statistical significance between the two groups (p < 0.05).

Correlations Within Female and Male Soccer Players

In the analyses conducted on data from female soccer players, a moderate but significant negative correlation was found between stiffness and maximum kicking velocity (p = 0.017, ES = –8.34, large). No significant relationships were observed between RSI and maximum kicking velocity (p = 0.226, ES = 2.27, large), RSI and sprint time (p = 0.853, ES = 5.04, large), RSI and 30-15 IFT (p = 0.464, ES = 4.54, large), stiffness and sprint time (p = 0.434, ES = 6.17, large), or stiffness and 30-15 IFT (p = 0.819, ES = 1.90, large) (Figure 1A and 1B).

According to the Pearson correlation analysis conducted on data from male soccer players, a significant and positive correlation was found between RSI and maximum kicking velocity (r = 0.604, p = 0.013, ES = 2.47, large). A significant and positive correlation was also observed between stiffness and kicking velocity (r = 0.548, p = 0.028, ES = 1.82, large). Additionally, stiffness showed a significant and positive relationship with 30-15 IFT performance (r = 0.499, p = 0.049, ES = 1.98, large). On the other hand, no significant relationships were found between RSI and sprint time (r = –0.250, p = 0.350, ES = 1.62) or between RSI and 30-15 IFT (r = 0.034, p = 0.901, ES = 0.86) (Figure 1A and 1B).

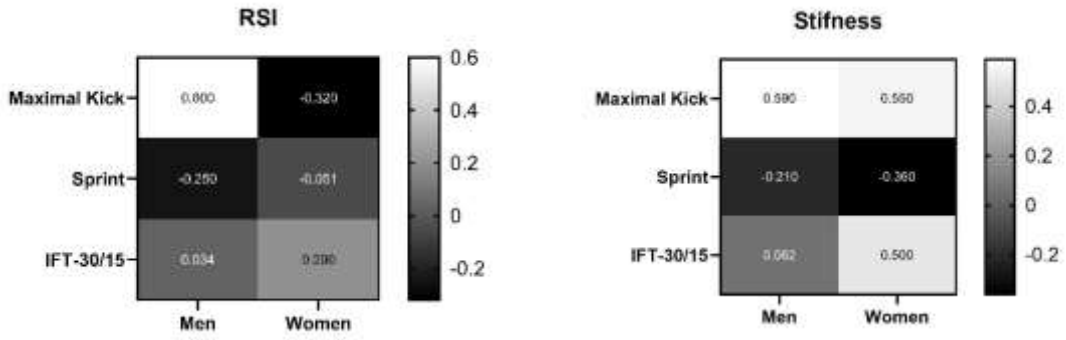

Figure 1. Correlation analysis of RSI and stiffness with performance variables based on gender.

DISCUSSION AND CONCLUSION

The primary objective of this study was to compare muscle stiffness and RSI between female and male soccer players and to investigate the associations between these neuromuscular variables and performance outcomes in a sex-specific context. The results demonstrated statistically significant differences between sexes in sprint, IFT 30/15, maximal kicking velocity, RSI, and muscle stiffness performance. Moreover, a significant negative relationship was identified between muscle stiffness and kicking velocity among female athletes, whereas in male athletes, both RSI and muscle stiffness exhibited significant positive correlations with maximal kicking velocity and aerobic capacity. These findings suggest that sex-based neuromuscular characteristics may differentially influence performance parameters in soccer.

In our study, male athletes demonstrated higher levels of muscle stiffness and reactive strength index (RSI) compared to their female counterparts. The literature investigating sex-based differences in these parameters remains limited. Lehnert et al. (19) reported that males aged 13–16 exhibited greater leg stiffness, with significant RSI differences observed only in the 15–16 age group. Similarly, Beckham et al. (6) found that male athletes showed higher RSI values than females, attributing these differences to physiological factors such as increased muscle mass, greater muscle–tendon unit stiffness, and enhanced neuromuscular control. These physiological advantages enable male athletes to utilize the stretch-shortening cycle (SSC) mechanism more effectively. Similarly, Granata et al. (13) reported that males exhibited greater leg stiffness than females during functional jumping tasks. In line with these findings, Padua et al. (24) observed higher leg stiffness in males compared to females during double-leg jumping, suggesting that this difference might be due to limited hamstring contribution in females despite higher quadriceps and soleus activation levels measured via surface EMG. Consistent with these observations, Zhang et al. (30) found that female athletes demonstrated lower leg and knee stiffness during single-leg landings compared to their male counterparts, which may compromise knee joint stability and increase the risk of anterior cruciate ligament (ACL) injuries. The findings indicate that sex-related differences in muscle–tendon architecture are associated not only with performance outcomes but also with injury risk. Another key result of the study was that male athletes exhibited significantly superior performance compared to female athletes in sprint time, maximal kicking velocity, and aerobic endurance tests. This highlights the importance of neuromechanical characteristics such as RSI and muscle stiffness in lower limb functionality and rapid force production. Effective utilization of the stretch-shortening cycle (SSC) contributes to reduced ground contact time and enables greater force generation by exploiting the elastic properties of the muscle–tendon unit (22). This mechanism provides a distinct advantage, particularly in sprint performance (28). Indeed, the ability to generate high force in a short ground contact phase is a fundamental determinant of the reactive strength index, reflecting the efficiency of SSC utilization (12).

Comparative analyses between sexes reveal that the relationships between neuromuscular and mechanical properties and field-based performance tests operate through different dynamics in male and female athletes. Notably, the significant positive associations observed between RSI and muscle stiffness with performance outcomes such as kicking velocity and aerobic endurance in male athletes suggest that these parameters may serve as key performance determinants in this population. These findings are supported by previous literature. For instance, Başkaya et al. (1), in their study on young male soccer players, reported significant positive correlations between RSI, leg strength, and eccentric utilization ratio, yet found no significant relationships between RSI and field-based performance tests such as sprint time, acceleration, or change of direction. Similarly, in the present study, no significant correlation was found between RSI and sprint time. Nevertheless, existing literature also includes studies reporting strong associations between RSI and sprint performance, indicating that the nature of this relationship may be context-dependent and influenced by factors such as age, training background, or test methodology. Indeed, Ciacci et al. (7) reported strong negative correlations between RSI—calculated using ground reaction force data during sprinting—and 100-meter sprint times ($r = –0.90$ to $–0.96$). These discrepancies suggest that the relationship between RSI and field-based performance may vary depending on factors such as the athlete's competitive level, the specific testing protocol, and the method used to assess RSI. Supporting this, a meta-analysis conducted by Jarvis et al. (15) demonstrated that RSI is significantly and moderately correlated with both strength ($r = 0.356$) and endurance ($r = 0.401$) performance.

These associations are thought to be underpinned by physiological mechanisms: in strength-related performance, muscle–tendon stiffness and explosive force capacity play a critical role, whereas in endurance performance, elastic energy reutilization and mechanical efficiency are key contributors. To date, no studies have directly examined the relationship between RSI, stiffness, and kicking velocity. This study offers a novel contribution by addressing these associations. Notably, a significant negative correlation was identified between muscle stiffness and kicking velocity in female athletes, whereas no statistically significant associations were observed between RSI and any performance variables in the same group. The negative association between muscle stiffness and kicking velocity among female players may suggest that more compliant muscle–tendon structures could favor technical performance outcomes. On the other hand, the lack of significant relationships between RSI and performance parameters may imply that the role of explosive strength in determining performance could be limited in female athletes.

Limitations and Future Directions

This study has certain limitations, including a relatively small sample size, a cross-sectional design, and the exclusion of other biomechanical and physiological variables such as muscle cross-sectional area or hormonal status. These factors may limit the generalizability and causal interpretation of the findings. Future research should include larger, more diverse samples, incorporate physiological measures (e.g., muscle architecture, hormonal profiles), and adopt longitudinal designs to better understand sex-specific adaptations in neuromechanical performance.

CONCLUSION

In conclusion, male soccer players demonstrated higher levels of RSI and muscle stiffness compared to female players, and these parameters exhibited stronger associations with performance outcomes in males. While force-based performance advantages were more prominent among male athletes, lower muscle stiffness in females appeared to contribute positively to technical skills, albeit potentially increasing injury risk. In this study, dynamic muscle stiffness was evaluated, and it is suggested that although lower stiffness may be advantageous for executing technical movements, it could also impair effective force transmission during sudden loads, thereby elevating the risk of injury. The absence of significant associations between RSI and performance variables in female athletes may reflect the limited role of explosive strength in determining performance within this population. To date, no studies have directly examined the relationships between RSI and/or muscle stiffness and performance components such as sprint time, kicking velocity, or aerobic capacity specifically in female athletes. Therefore, the present study offers a novel contribution by addressing this gap and highlighting the influence of sex-specific neuromechanical differences on sport performance.

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Ruthless Victory: Determining the Game-Related Characteristics That Affect Winning and Losing in EuroLeague Basketball Games Decided by 1 and 2 Points

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Abstract

To win a basketball game, it is necessary to fight until the last second of the game. This study aimed to determine the game-related characteristics that directly affect winning or losing in men's basketball games decided by 1 and 2 points. The data consisted of 664 games played in the European Basketball League (Euroleague) between 2001 and 2023, covering 22 years and were tested with logistic regression analysis to find the most significant characteristics of such games. In the games decided by 1 point, fewer characteristics (points off turnover p:0.001/β -0.114, fastbreak points p:0.000/β -0.214, fouls committed p:0.002/β 0.081, fouls received p:0.007/β -0.068, points by bench p:0.014/β -0.054) were identified, while in those decided by 2 points, more characteristics (points off turnovers p:0.000/β -0.205, 2 field points percents p:0.000/β -0.081, 3 field points percents p:0.000/β -0.049, rebounds offensive p:0.017/β -0.070, rebounds defensive p:0.000/β -0.135, steals p:0.002/β -0.082, turnovers p:0.000/β -0.107, fastbreak points p:0.000/β 0.193, assists p:0.024/β 0.075) were prominent. In the games won by 1 point, more fastbreak points and fouls committed/received for home teams had the most significant impact on winning the game, while the visitors teams 3 Field points, points off turnover, points by bench and fastbreak points had the most significant impact on winning the game. Also in the games won by 2 point, more 2 field points, rebounds offensive/defensive, steals, turnovers, fastbreak points and points off turnovers for home teams had the most significant impact on winning the game, while the visitors teams 2 field points, 3 field points, rebounds defensive, assists, turnovers, fastbreak points and points off turnover had the most significant impact on winning the game. This study has helped us understand how basketball teams win games in the EuroLeague. It was observed that in closely contested games with small margins, the required game-related characteristics varied significantly for all winning teams. While there were fewer distinguishing parameters in games decided by a 1-point difference, the number of parameters increased in games decided by a 2-point difference.

Keywords**:** EuroLeague, game-related characteristics, loser, winner, points difference

Özet

Acımasız Zafer: EuroLeague'de 1 ve 2 Sayı ile Sonuçlanan Basketbol Maçlarında Kazanma ve Kaybetmeyi Etkileyen Oyunla İlgili Özelliklerin Belirlenmesi

Bir basketbol maçını kazanmak için oyunun son saniyesine kadar mücadele etmek gerekir. Bu çalışmanın amacı, 1 ve 2 sayı farkla sonuçlanan erkek basketbol maçlarında kazanmayı veya kaybetmeyi doğrudan etkileyen oyunla ilgili özellikleri belirlemektir. Veriler, 2001-2023 yılları arasında Avrupa Basketbol Ligi'nde (Euroleague) oynanan ve 22 yılı kapsayan 664 maçtan oluşmaktadır ve bu tür maçların en önemli özelliklerini bulmak için lojistik regresyon analizi ile test edilmiştir. 1 sayı fark ile biten maçlarda daha az basketbol karakteristik özelliğinin (top kaybından sayı p:0.001/β -0.114, fastbreak sayıları p:0.000/β -0.214, yapılan fauller p:0.002/β 0.081, alınan fauller p:0.007/β -0.068, benchten gelen sayılar p:0.014/β -0.054) etkili olduğu tespit edilirken, 2 sayı fark ile biten maçlarda daha fazla özellik (top kaybından sayı p:0. 000/β -0.205, 2 saha sayısı yüzdesi p:0.000/β -0.081, 3 saha sayısı yüzdesi p:0.000/β -0.049, hücum ribauntları p:0.017/β -0.070, savunma ribauntları p:0. 000/β -0.135, top çalma p:0.002/β -0.082, top kaybı p:0.000/β -0.107, fastbreak sayıları p:0.000/β 0.193, asist p:0.024/β 0.075) öne çıkmıştır. Bir sayı farkla kazanılan maçlarda, ev sahibi takımlar için daha fazla fastbreak sayısı ve yapılan/alınan fauller maçın kazanılmasında en önemli etkiye sahipken, deplasman takımları için 3 sayılık atış sayısı, top kaybından elde edilen sayılar, benchten gelen oyuncuların aldığı sayılar ve fastbreak sayıları maçın kazanılmasında en önemli etkiye sahip olmuştur. Ayrıca 2 sayı farkla kazanılan maçlarda, daha fazla 2 sayılık atışlar, hücum/defans ribauntları ve top çalma özelliklerinin etkili olduğu bulunmuştur.

Anahtar kelimeler: Euro Lig, oyun karakteristikleri, kaybeden, kazanan, puan farkı

INTRODUCTION

Basketball is a popular cooperative sport in which the winner is often decided in the last minutes of the game, and it is necessary to make an effort until the last moment in order to win in games decided by a small point difference (1). Sport psychologists state that basketball players are highly vulnerable to psychological pressure in the last five minutes of the game and their performance decreases, with an even higher likelihood of performance deterioration in the final minute of the last period (2, 3, 4). Although the literature attempts to explain how and why changes in performance occur under pressure from a psychological perspective, it does not provide information about which game parameters have a greater effect on winning or losing in the last minutes of the game (5, 6).

Basketball players are expected to perform game-specific technical movements according to certain tactics (7, 8). These are technical moves used in offense and defense to score points or prevent the opponent team from scoring, such as throwing, free throws, offensive rebounds, defensive rebounds, steals, turnovers, and assists (9, 10, 11). Coaches should develop new strategies by adapting these technical moves to the style of play in order to win the game (10). This is because there are several characteristic behavioral patterns for each period or even each minute during the whole playing time (12).

Modern coaches conduct performance and match analysis of their players and teams to prepare the training process and to analyze the opposing team (13, 14, 15). It is important for coaches to identify the technical movements used by their own and opponent players during their performances that affect the outcome of the match and much research has been conducted on this subject (16, 17, 18). These studies use many statistical analysis methods to determine the characteristic movements that most affect winning and losing the game by using end-of-game outputs (19, 20, 21).

EuroLeague is one of the most popular professional basketball leagues in the world. The champion teams are known as European Champions. This study examined the results of games decided by small margins in EuroLeague seasons and tried to identify the game characteristics that affect the outcome of games. This study has different characteristics from other studies in the field because it (1) considers all games played since the beginning of the EuroLeague (5,207 games), (2) tests variables with logistic regression analysis (LRA) for the first time, and (3) analyzes game performances of home and visitor teams separately.

METHOD

Data extraction and processing

The data were collected from the boxscore, graphic stats, and shooting chart pages published after each game on the EuroLeague website (www.euroleaguebasketball.net). The study analyzed all seasons played under the name of EuroLeague after the status change (Table 1). A total of 5,252 games were played over 23 seasons, but the results of 5 games were not available. The 2019–20 season could not be completed due to the COVID-19 pandemic. In the 2021-22 season, due to the Russia-Ukraine war, some teams (CSKA Moscow, UNICS Kazan, and Zenit St Petersburg) were banned from the EuroLeague by FIBA and many games could not be played. For the purpose of this study, a total of 664 games were analyzed, including 361 games won by the home teams and 303 games won by the visitor teams.

Table 1. EuroLeauge Games Decided by 1 and 2 Points between 2001 and 2023

Seasons	Matches	Points difference			Home			Visitor		
		1	2	Total	1	2	Total	1	2	Total
2001-2023	5,252	290	374	664	161	200	361	129	174	303

Note. Matches=matches played by seasons; Points difference=matches ending based on points difference; Home=matches won by home teams; Visitors=matches won by visitor teams.

In this study, 15 game characteristics were determined as variables of the study: 2 field points percent, 3 field points percent, free throws percent, rebounds (offensive), rebounds (defensive), assists, steals, turnovers, blocks, fouls (committed), fouls (received), points by bench, fastbreak points, points off turnovers, second chance points.

Statistical analysis

The study used LRA to analyze the data and the Hosmer-Lemeshow test to measure the goodness of fit of the test model. The Nagelkerke R^2 value evaluated the explanatory power of the model, considering a confidence interval 95% value. In LRA, the dependent variable is a binary variable and is used to calculate the probability of a binary outcome on one or more independent variables. Variables can be continuous, ordinal, or categorical. When creating a multivariate model, the presence of a high degree of correlation between independent variables is examined (22). The study conducted the Hosmer-Lemeshow test, which is used in risk prediction models, to test the goodness of fit in logistic regression models. The test evaluates the matching of observed and expected event rates in subgroups of the model sample. The models are referred to as the expected and observed event rates of similar subgroups (23) and a good model requires a "sig" value greater than 0.05 (24).

FINDINGS

Table 2.1 and Table 2.2. shows the differences between the winning and losing team averages according to the game characteristics used in the study for 664 EuroLeague games decided by 1 and 2 points between 2001 and 2023.

Table 2.1. Averages of Winning and Losing Teams in Games Decided by 1 and 2 Points According to Basketball Game Characteristics

		2 Field Points Percent	*3 Field Points Percent*	*Free Throws Percent*	*Rebounds (Offensive)*	*Rebounds (Defensive)*	*Assists*	*Steals*	*Turnovers*
1 Points	Winner	51.98	36.46	74.55	10.03	23.36	14.60	7.16	12.73
	Loser	51.13	35.49	74.30	10.43	23.11	14.34	7.19	12.79
	Difference	0.84	0.97	0.25	-0.40	0.24	0.26	-0.02	-0.06
2 Points	Winner	52.88	36.88	73.08	10.00	23.51	14.79	7.41	12.84
	Loser	50.87	35.12	74.77	10.08	22.65	14.09	7.10	13.05
	Difference	**2.01**	1.76	-1.69	-0.08	0.86	0.70	0.31	-0.21

Table 2.2 Averages of Winning and Losing Teams in Games Decided by 1 and 2 Points According to Basketball Game Characteristics

		Blocks	*Fouls (Committed)*	*Fouls (Received)*	*Points by Bench*	*Fastbreak Points*	*Points Off Turnovers*	*Second Chance Points*
1 Points	Winner	2.65	21.75	22.01	30.93	5.92	13.30	10.86
	Loser	2.52	22.35	21.35	29.50	5.10	14.06	11.09
	Difference	0.13	-0.60	0.66	**1.43**	0.82	-0.76	-0.23
2 Points	Winner	2.70	21.96	22.04	30.93	5.26	14.47	10.35
	Loser	2.52	22.20	21.80	29.57	6.04	13.43	10.08
	Difference	0.18	-0.24	0.23	1.36	-0.78	1.05	0.27

The positive averages for the teams winning the match by a 1-point difference compared with the losing teams are as follows: 2 field points percent 0.84, 3 field points percent 0.97, free throws percent 0.25, rebounds (defensive) 0.24, assists 0.26, blocks 0.13, fouls (received) 0.66, points by bench 1.43, fastbreak points 0.82. 9 mean positively differentiated and the largest average points by bench is 1.43.

The positive averages for the teams winning the match by a 2-point difference compared with the losing teams are as follows: 2 field points percent 2.01, 3 field points percent 1.76, rebounds (defensive) 0.86, assists 0.70, steals 0.31, blocks 0.18, fouls (received) 0.23, points by bench 1.36, points off turnovers 1.05, second chance points 0.27. 10 mean positively differentiated and the largest average 2 field points percent is 2.01.

InLRA, winning team values were taken as the reference point of the dependent variable (winner 0, loser 1). According to the omnibus test, when 10 parameters were taken into consideration, the chi-square value for the model coefficient was 151.038 and the *p*-value was 0.000 ($p < 0.05$). A *p*-value less than 0.05 indicates that the model is significant and good. Looking at the model summary, it can be observed that the model is relatively small based on -2 Log likelihood (2179.322), and the R^2 value (0.115) explains 11% of the variance. According to the Hosmer-Lemeshow goodness-of-fit test values, the chi-square value was 8.090 and the *p*-value was 0.425. The *p*-value being $p > 0.05$ and close to 1 indicates a good fit. Table 3 shows the statistically significant game characteristics and LRA results of all games decided and won by a 1-point difference, winning home teams and winning visitor teams.

Table 3. Game Characteristics and LRA of All Games Decided by 1 Point, Winning Home Teams and Winning Visitor Teams

	Characteristic variables	β	— *SE*	**Wald**	***df***	***p***	**Exp(β)**	**95% C.I.for EXP(β)**	
								Lower	**Upper**
All Matches	2 Field points percent	-.020	.016	1.670	1	.196	.980	.951	1.010
	3 Field points percent	-.012	.012	.990	1	.320	.988	.966	1.011
	Free throws percent	.005	.009	.255	1	.613	1.005	.987	1.023
	Rebounds (offensive)	.023	.033	.518	1	.472	1.024	.960	1.091
	Rebounds (defensive)	-.005	.027	.039	1	.843	.995	.944	1.048
	Assists	.003	.023	.012	1	.913	1.003	.957	1.050
	Steals	-.012	.028	.171	1	.679	.988	.935	1.045
	Turnovers	-.005	.028	.036	1	.849	.995	.942	1.051
	Blocks	-.061	.053	1.306	1	.253	.941	.847	1.045
	Fouls (committed)	.081	.027	9.290	1	.002	1.085	1.030	1.143
	Fouls (received)	-.068	.025	7.287	1	.007	.934	.890	.982
	Points by bench	-.022	.012	3.640	1	.056	.978	.956	1.001
	Fastbreak points	-.214	.049	18.832	1	.000	.807	.733	.889
	Points off turnovers	.114	.035	10.666	1	.001	1.121	1.047	1.201
	Second chance points	.025	.039	.395	1	.529	1.025	.949	1.106
	Constant	.946	1.898	.249	1	.618	2.576		
Home	2 Field points percent	-.028	.022	1.590	1	.207	.972	.930	1.016
	3 Field points percent	.016	.017	.839	1	.360	1.016	.982	1.050
	Free throws percent	.002	.013	.029	1	.865	1.002	.977	1.028
	Rebounds (offensive)	.017	.046	.130	1	.718	1.017	.929	1.113
	Rebounds (defensive)	.005	.038	.017	1	.896	1.005	.932	1.083
	Assists	-.030	.030	.997	1	.318	.970	.914	1.030

	Steals	-.043	.039	1.254	1	.263	.958	.888	1.033
	Turnovers	.016	.041	.154	1	.695	1.016	.938	1.101
	Blocks	-.134	.075	3.161	1	.075	.875	.755	1.014
	Fouls (committed)	.140	.038	13.698	1	.000	1.150	1.068	1.239
	Fouls (received)	-.121	.037	10.673	1	.001	.886	.824	.953
	Points by bench	-.003	.015	.044	1	.835	.997	.968	1.027
	Fastbreak points	-.141	.062	5.160	1	.023	.868	.769	.981
	Points off turnovers	.088	.045	3.821	1	.051	1.092	1.000	1.193
	Second chance points	-.030	.053	.324	1	.569	.970	.874	1.077
	Constant	.653	2.767	.056	1	.814	1.920		
Visitor	2 Field points percent	-.011	.025	.194	1	.659	.989	.942	1.039
	3 Field points Percent	-.046	.019	5.846	1	.016	.955	.921	.991
	Free throws percent	-.003	.014	.037	1	.848	.997	.969	1.026
	Rebounds (offensive)	.030	.053	.307	1	.580	1.030	.928	1.144
	Rebounds (defensive)	-.024	.044	.300	1	.584	.976	.896	1.064
	Assists	.051	.045	1.311	1	.252	1.053	.964	1.149
	Steals	.032	.051	.402	1	.526	1.033	.935	1.141
	Turnovers	-.027	.045	.377	1	.539	.973	.892	1.062
	Blocks	.018	.087	.043	1	.835	1.018	.858	1.209
	Fouls (committed)	.020	.042	.226	1	.635	1.020	.939	1.109
	Fouls (received)	-.024	.034	.497	1	.481	.976	.914	1.043
	Points by bench	-.054	.022	6.045	1	.014	.947	.907	.989
	Fastbreak points	-.284	.086	10.823	1	.001	.753	.635	.891
	Points off turnovers	.167	.065	6.481	1	.011	1.181	1.039	1.343
	Second chance points	.101	.067	2.307	1	.129	1.106	.971	1.261
	Constant	2.017	2.987	.456	1	.499	7.515		

Note. $p < 0.05$; Home=matches won by home teams; Visitor=matches won by visitor teams; β=estimated coefficient; *SE*=standard error of the estimate; Wald=wald value; *df*=degree of freedom; *p*=significance value; Exp(β)=exponentiated b/odds ratio; C.I. for Exp(β)=confidence interval for Exponentiated β /odds ratio.

In Table 3, based on the LRA results, where all games won by one point are examined together, the positive values in the β column, such as fouls (committed) and points off turnovers, indicate their influence on winning the game (since the winning team values are taken as the reference point). Conversely, the negative values, such as fouls (received) and fastbreak points, indicate their influence on losing the game. Specifically, having one unit more of fouls (committed) increases the probability of winning the game by a factor of 1.085, and having one unit more of points off turnovers increases the probability of winning the game by a factor of 1.121. Conversely, having one unit less of fouls (received) decreases the probability of losing the game by a factor of 1.07 (1/0.934), and having one unit less of fastbreak points decreases the probability of losing the game by a factor of 1.23 (1/0.807).

Considering all games of the winning home teams, three variables stand out: fouls (committed), fouls (received), and fastbreak points. Having one unit more of fouls (committed) increases the probability of winning the game by a factor of 1.150. Conversely, having one unit less of fouls (received) increases the probability of losing the game by a factor of 1.128 (1/0.886), and having one unit less of fastbreak points decreases the probability of losing the game by a factor of 1.15 (1/0.868).

Considering the games won by the visitor teams, four variables stand out: 3 field points percent, points by bench, fastbreak points, and points off turnovers. Having one unit more of points off turnovers increases the probability of winning the game by a factor of 1.181, while having one unit less of 3 field points percent increases the probability of losing the game by a factor of 1.047 (1/0.955). Similarly, having one unit less of points by bench increases the probability of losing the game by a factor of 1.055 (1/0.947), and having one unit less of fastbreak points increases the probability of losing the game by a factor of 1.328 (1/0.753).

Table 4 shows the statistically significant game characteristics and LRA results of all games decided and won by a 2-point difference, winning home teams and winning visitor teams.

Table 4. Game Characteristics and LRA of All Games Decided by 2 Points, Winning Home Teams and Winning Visitor Teams

	Characteristic variables	β	*SE*	Wald	*df*	*p*	Exp(β)	95% C.I.for EXP(β)	
								Lower	Upper
All Matches	2 Field points Percent	-.081	.014	31.428	1	.000	.922	.897	.949
	3 Field points Percent	-.049	.010	21.998	1	.000	.952	.933	.972
	Free throws percent	.009	.007	1.419	1	.234	1.009	.994	1.024
	Rebounds (offensive)	-.070	.030	5.671	1	.017	.932	.880	.988
	Rebounds (defensive)	-.135	.023	33.905	1	.000	.874	.835	.914
	Assists	.025	.022	1.336	1	.248	1.026	.982	1.071
	Steals	-.082	.026	9.826	1	.002	.921	.875	.970
	Turnovers	.107	.026	17.117	1	.000	1.113	1.058	1.171
	Blocks	-.043	.047	.812	1	.368	.958	.873	1.051
	Fouls (committed)	.027	.023	1.330	1	.249	1.027	.982	1.074
	Fouls (received)	-.021	.023	.816	1	.366	.979	.935	1.025
	Points by bench	.001	.009	.012	1	.914	1.001	.983	1.020
	Fastbreak points	.193	.038	26.008	1	.000	1.213	1.126	1.306
	Points off Turnovers	-.205	.035	35.172	1	.000	.815	.761	.872
	Second chance Points	-.031	.036	.780	1	.377	.969	.904	1.039
	Constant	9.835	1.625	36.630	1	.000	18671.912		
Home	2 Field points Percent	-.070	.021	11.058	1	.001	.932	.895	.972
	3 Field points percent	-.024	.015	2.611	1	.106	.976	.948	1.005
	Free throws percent	.002	.011	.043	1	.836	1.002	.981	1.024
	Rebounds (offensive)	-.128	.042	9.117	1	.003	.880	.809	.956
	Rebounds (defensive)	-.119	.034	12.452	1	.000	.888	.831	.949
	Assists	-.031	.032	.948	1	.330	.969	.910	1.032
	Steals	-.092	.038	5.875	1	.015	.913	.847	.983
	Turnovers	.112	.038	8.888	1	.003	1.119	1.039	1.205
	Blocks	-.078	.073	1.140	1	.286	.925	.803	1.067
	Fouls (committed)	.042	.033	1.631	1	.202	1.043	.978	1.111
	Fouls (received)	-.057	.033	2.917	1	.088	.945	.885	1.008
	Points by bench	.015	.015	.971	1	.325	1.015	.986	1.045
	Fastbreak points	.302	.072	17.585	1	.000	1.352	1.174	1.557
	Points off Turnovers	-.386	.074	27.565	1	.000	.680	.588	.785
	Second chance Points	-.039	.055	.494	1	.482	.962	.863	1.072
	Constant	11.629	2.489	21.824	1	.000	112353.471		
Visitor	2 Field points Percent	-.100	.022	19.945	1	.000	.905	.866	.946
	3 Field points Percent	-.080	.017	21.945	1	.000	.923	.893	.955
	Free throws percent	.017	.011	2.283	1	.131	1.017	.995	1.040
	Rebounds (offensive)	.000	.047	.000	1	.992	1.000	.912	1.096
	Rebounds (defensive)	-.146	.035	17.019	1	.000	.864	.806	.926
	Assists	.075	.033	5.076	1	.024	1.078	1.010	1.152
	Steals	-.078	.042	3.538	1	.060	.925	.852	1.003
	Turnovers	.101	.040	6.328	1	.012	1.106	1.023	1.197
	Blocks	.011	.068	.028	1	.868	1.011	.885	1.156
	Fouls (committed)	.004	.036	.012	1	.911	1.004	.936	1.077
	Fouls (received)	.022	.036	.355	1	.551	1.022	.952	1.097
	Points by bench	-.016	.014	1.325	1	.250	.984	.958	1.011
	Fastbreak points	.146	.048	9.081	1	.003	1.157	1.052	1.272
	Points off Turnovers	-.131	.042	9.738	1	.002	.877	.808	.953
	Second chance Points	-.053	.050	1.116	1	.291	.948	.859	1.047
	Constant	10.032	2.424	17.126	1	.000	22733.256		

Note. $p < 0.05$; Home=matches won by home teams; Visitor=matches won by visitor teams; β=estimated coefficient; *SE*=standard error of the estimate; Wald=wald value; *df*=degree of freedom; *p*=significance value; Exp(β)=exponentiated b/odds ratio; C.I. for Exp(β)=confidence interval for Exponentiated β /odds ratio.

In Table 4, based on the LRA results, where all games won by two points are examined together, the number of significant game characteristics increases. The variables turnovers and fastbreak points were effective for winning with significant positive results, while the variables 2 field points percent, 3 field points

percent, rebounds (offensive), rebounds (defensive), steals, and points off turnovers had significant negative results, indicating their effectiveness in losing.

Therefore, having one unit more of turnovers increases the probability of winning the game by a factor of 1.113, and having one unit more of fastbreak points increases the probability of winning the game by a factor of 1.213. Similarly, having one unit less of 2 field points percent decreases the probability of losing the game by a factor of 1.084 (1/0.922), having one unit less of 3 field points percent decreases the probability of losing the game by a factor of 1.050 (1/0.952), having one unit less of rebounds (offensive) decreases the probability of losing the game by a factor of 1.072 (1/0.932), and having one unit less of rebounds (defensive) decreases the probability of losing the game by a factor of 1.144 (1/0.874). In addition, having one unit less of steals decreases the probability of losing the game by a factor of 1.085 (1/0.921), and having one unit less of points off turnovers decreases the probability of losing the game by a factor of 1.226 (1/0.815).

Considering all games of the winning home teams, seven game characteristics were found to be significant. Having one unit more of turnovers increases the probability of winning the game by a factor of 1.119, and having one unit more of fastbreak points increases the probability of winning the game by a factor of 1.352. Similarly, having one unit less of 2 field points percent decreases the probability of losing the game by a factor of 1.072 (1/0.932), having one unit less of rebounds (offensive) decreases the probability of losing the game by a factor of 1.113 (1/0.880), having one unit less of rebounds (defensive) decreases the probability of losing the game by a factor of 1.126 (1/0.888), having one unit less of steals decreases the probability of losing the game by a factor of 1.095 (1/0.913), and having one unit less of points off turnovers decreases the probability of losing the game by a factor of 1.470 (1/0.680).

Considering all games of the winning visitor teams, seven game characteristics were found to be significant. Having one unit more of assists increases the probability of winning the game by a factor of 1.078, having one unit more of turnovers increases the probability of winning the game by a factor of 1.106, and having one unit more of fastbreak points increases the probability of winning the game by a factor of 1.157. Similarly, having one unit less of 2 field points percent decreases the probability of losing the game by a factor of 1.104 (1/0.905), having one unit less of 3 field points percent decreases the probability of losing the game by a factor of 1.083 (1/0.923), having one unit less of rebounds (defensive) decreases the probability of losing the game by a factor of 1.157 (1/0.864), and having one unit less of points off turnovers decreases the probability of losing the game by a factor of 1.140 (1/0.877).

Table 5. Game Characteristics That Affect the Winning of Home and Visitor Teams in Games Decided by 1 and 2 Points

1 point		2 points	
All matches	Fouls (committed)	**All matches**	2 Field points
	Fouls (received)		3 Field points
	Fastbreak points		Rebounds (offensive)
	Points off turnover		Rebounds (defensive)
Home	Fouls (committed)		Steals
	Fouls (received)		Turnovers
	Fastbreak points		Fastbreak points
Visitor	3 Field points		Points off turnover
	Points off turnover	**Home**	2 Field points
	Points by bench		Rebounds (offensive)
	Fastbreak points		Rebounds (defensive)
			Steals
			Turnovers
			Fastbreak points
			Points off turnover
		Visitor	2 Field points
			3 Field points
			Rebounds (defensive)
			Assists
			Turnovers
			Fastbreak points
			Points off turnover

DISCUSSION AND CONCLUSION

The most significant factor that ensures victory is the ability to perform the fundamental techniques (game characteristics) specific to each sports branch within the game. Basketball has many game characteristics specific to itself. In games where one of the teams is significantly superior, it is known that the winning team performs the fundamental game characteristics perfectly. However, in games where the teams have similar strengths and the results are very close, it is not known which fundamental game characteristics affect winning the game. This study examined 15 fundamental basketball techniques and investigated which fundamental techniques would have a greater impact on winning the game in games decided by a 1-point and 2-point difference.

In the games decided by a 1-point difference, four parameters stand out, among which fastbreak points parameter affects both the whole game and winning the game for both home and visitor teams. For the winning home teams, both fouls committed and fouls received were differentiated, while for the winning visitor teams, points by bench, 3 field points, and points off turnovers were also important parameters. It is understood that visiting teams try to accelerate the game, while home teams try to slow down and control the offense.

In the games decided by a 2-point difference, the number of differentiated parameters increased. Thus, it can be considered that the parameters will increase as the point difference increases. Considering the results of both winning home and visitor teams in all games, game-related characteristics such as points off turnovers and fastbreak points were the most important parameters in winning the game, while the rebounds (defensive) parameter also had a significant impact on visitor teams winning the game. Moreover, the assist parameter had also differentiated for the first time when visitor teams won the game.

In a research study conducted on NCAA Division I men's basketball games, it was found that winning teams played with a higher 3-point shooting percentage, defensive rebounds, and steals, while losing teams attempted more 3-point shots and committed more personal fouls (8). In U-16 games involving teams with similar strengths, it was emphasized that turnovers and assists are more important, and due to less ball possession time, a faster-paced and higher-tempo game is played, with an emphasis on 2-point shots and defensive rebounds (11). This result explains the importance of the fastbreak points parameter suggested in our study. Another study states that the variables that best distinguish winners from losers are defensive rebounds and assists (26); a different study suggests that having a greater number of players who can secure rebounds directly affects the outcome of the game (27). In a separate study conducted to determine the factors that differentiate winners from losers, assists, defensive rebounds, and successful 2-point and 3-point shooting were highlighted in regular season games for winning teams, while in playoff games, winning teams established dominance with more defensive rebounds (28).

It has been found that free throws play a crucial role in determining the outcome of the game in the last minutes of games where the score difference was less than 3 points and in games played in overtime. Similarly, in NBA games decided by a 1-point difference, players tend to miss more free throws (16, 25). However, according to the results of the present study, game-related characteristics used throughout the entire game have a greater impact on winning the game, and free throws used only in the final stages of the game are not sufficient to secure a win. Considering that the free throws used throughout the game are caused by fouls, it can be said that the results of our study will directly affect winning.

Looking at player performances in the final moments of close-scoring games with high game pressure, it has been found that when a player is choking in one part of the game, this can affect other actions such as dribbling, passing, or ball handling (29). As players make more mistakes and fouls during choking phases of the game, free throws, which are considered to change the outcome of the game, also increase. The results of the present study showed that the number of fouls committed and received might affect the outcome of the match.

It is very unlikely for any basketball team to win a game without rotating its starters. Player rotation is more frequent in the EuroLeague compared with the NBA, allowing different players' skills to be utilized for scoring (30). Teams tend to have better scoring performance after player substitutions, and especially player substitutions made in the first and third quarters have a higher impact on the score, while in the fourth

quarter, the impact is lower (31). According to the results of this study, in the games between teams of equal strength, the visitor team needs more contribution from players coming off the bench to win.

Coaches tend to choose players who have fewer turnovers during the game (32). While some studies indicate that turnovers do not have a significant impact on winning (20), a study comparing experienced and inexperienced players suggested that turnovers do have a direct impact on the outcome, with experienced players committing fewer turnovers (33). In a research study that examined offensive and defensive performance as determinants of winning, possession of the ball and the turnover rate were identified as the third most important criteria (34). In games where teams have similar defensive rebounds, turnovers have the most significant impact on winning (32). One clear result from this study is that points off turnovers are the most significant determinant of winning.

This study has helped us understand how basketball teams win games in the EuroLeague. It was observed that in closely contested games with small margins, the required game-related characteristics varied significantly for all winning teams. While there were fewer distinguishing parameters in games decided by a 1-point difference, the number of parameters increased in games decided by a 2-point difference. Coaches can use these distinguishing variables as reference points in their training and matches based on the characteristics and difficulty level of their opponents.

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Examination of the Effects of a Chronic Exercise Program on Body Composition and Selected Biochemical Parameters in Children with Down Syndrome*

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Abstract

This study aims to examine the effect of an 8-week chronic exercise program on body composition and some biochemical parameters in individuals with Down Syndrome. Individuals with Down Syndrome were included in the study and divided into two groups experimental and control groups. The experimental group participated in a chronic exercise program lasting 75 minutes per session, conducted 4 days a week over 8 weeks. Before and after exercise, body composition and some biochemical parameters were obtained from both experimental and control groups. For statistical analysis of the data, SPSS 25 package program was used. Since the data were normally distributed, parametric tests were used in statistical analyses. For intra-group comparisons, Paired Samples T Test and for inter-group comparisons, Independent Samples T Test were applied. Comparison of the pre-test and post-test values of the experimental and control groups revealed no statistically significant difference (P>.05) in BMI, FP, WC, WHR, preperitoneal adipose tissue, subcutaneous adipose tissue, glucose, HDL, LDL, triglycerides, AST and ALT values of the experimental group. In the control group, only a significant increase was observed in triglyceride value (P<0.05). There was no statistically significant difference in any of the measured parameters as a result of intergroup comparison (P>0.05). Consequently, the 8-week chronic exercise program did not have statistically significant results in body composition and some biochemical parameters of individuals with Down Syndrome.
Keywords: Biochemical Parameters, Down Syndrome, Exercise, Body Composition.

Özet

Down Sendromlu Çocuklarda Uygulanan Kronik Egzersiz Programının Vücut Kompozisyonu ve Bazı Biyokimyasal Parametreler Üzerine Etkilerinin İncelenmesi

Bu çalışmanın amacı Down Sendromlu bireylere uygulanan 8 haftalık kronik egzersiz programının vücut kompozisyonu ve bazı biyokimyasal parametrelere etkisinin incelenmesidir. Çalışmaya Down Sendromlu bireyler dahil edilmiş, deney ve kontrol grubu olarak ikiye ayrılmıştır. Deney grubuna 8 hafta boyunca haftada 4 gün 75'er dakikalık kronik egzersiz programı uygulanmıştır. Egzersiz öncesi ve sonrası hem deney hem de kontrol gruplarından vücut kompozisyonu ve bazı biyokimyasal parametreler alınmıştır. Verilerin istatiksel analizinde SPSS 25 paket programı kullanılmıştır. Verilerin normal dağılım göstermesinden dolayı istatiksel analizlerde parametrik testler kullanılmıştır. Grup içi karşılaştırmalar için Paired Samples T Testi, gruplar arası karşılaştırmalar için de Independent Samples T Testi uygulanmıştır. Deney ve kontrol grubunun ön test son test değerleri

karşılaştırıldığında deney grubunun vücut kompozisyonu parametrelerinden VKİ, YY, BÇ, BKO, preperitonal yağ dokusu ve subkutan yağ dokusu, biyokimyasal parametrelerden glukoz, HDL, LDL, trigliserid, AST ve ALT değerlerinde istatiksel olarak anlamlı farklılık bulunamamıştır (P>,05). Kontrol grubunda ise sadece trigliserid değerinde anlamlı bir artış görülmüştür (P<0,05). Gruplar arası karşılaştırma sonucunda ise ölçülen parametrelerin hiçbirinde istatiksel olarak anlamlı farklılık görülmemiştir (P>0,05). Sonuç olarak 8 haftalık kronik egzersiz programının Down Sendromlu bireylerin vücut kompozisyonunda ve bazı biyokimyasal parametrelerinde istatiksel olarak anlamlı sonuca ulaşılamamıştır.

Anahtar Kelimeler: Biyokimyasal Parametreler, Down Sendromu, Egzersiz, Vücut Kompozisyonu.

INTRODUCTION

Down Syndrome (DS), first described by John Langdon Down in 1887, affects roughly 1 in every 700 live births. Nevertheless, the rate changes with the age of the mother, increasing to one in 30 live births for mothers aged 45 and over. DS is caused by the presence of an extra copy on chromosome 21 (1, 2).

Body composition is an important indicator of health at all ages, especially in childhood and adolescence. It is observed that individuals with DS have an unhealthy body composition with high-fat mass and low lean mass compared to their mentally disabled or normal peers (3, 4). One reason for being overweight in individuals with DS is low activity levels (5) and given that 45% of men and 56% of women with DS are overweight, children with DS must meet the minimum recommended activity guidelines (6). The most common health problems of individuals with DS are sleep apnea and obesity. Both of these problems hurt their lives. Moreover, it has been reported that individuals with DS have lower physical work capacity than their peers with intellectual disabilities (7).

Although preperitoneal adipose tissue is not classified as visceral adipose tissue, it shows a strong correlation with intra-abdominal visceral adipose tissue thickness and has been linked to an increased risk of cardiovascular disease (CVD) (8). A study on obese children found that preperitoneal adipose tissue exhibited a stronger association with hyperinsulinemia compared to visceral and subcutaneous adipose tissue (9). Subcutaneous adipose tissue thickness is associated with dyslipidemia in a few studies and is also associated with serum leptin levels (10). Besides, another study concluded that increased preperitoneal fat accumulation in non-insulin-dependent diabetic patients was closely associated with obesity, hypertension, and hyperinsulinemia (11).

Regular exercise has benefits that include being protective alongside calorie restriction and increasing lean muscle mass. It is particularly effective in reducing visceral adipose tissue and waist circumference, thereby providing a protective effect against cardiometabolic risk factors. When lifestyle changes lead to a negative energy balance in the body, visceral fat stores are easily mobilized and exert a beneficial effect (12).

Effects of chronic exercise on biochemical parameters may vary depending on individual characteristics, physical fitness, duration and intensity of exercise, and different lipid values. It has been reported that triglyceride levels are lower in individuals who engage in different types of exercise over long periods compared to sedentary individuals (13).

In this context, the aim of this study is to examine the effect of an 8-week chronic exercise program applied to individuals with Down Syndrome on body composition and certain biochemical parameters.

METHOD

Participants

Nineteen students with DS aged 12-15 years with moderate intellectual disabilities attending Batman Special Education Application Center (I., II., and III. Level) participated in the study. In the study, a pre-test post-test control group quasi-experimental design was used. Individuals with DS were divided into two groups experimental group (n=10) and control group (n=9) according to exercise participation and health status. However, 5 individuals with DS (3 experimental and 2 control) were excluded from the study because their measurements could not be taken. Statistical data were evaluated as 7 experimental groups and 7 control groups. Before the study, participants were informed not to take any medication or engage in strenuous

exercise. The Ethics Committee Report was obtained from the Selçuk University Faculty of Sport Sciences Ethics Committee. Before the study, parents were informed and a signed parental consent form was obtained. Necessary permissions were also obtained from the Batman Provincial Directorate of National Education for the study to be conducted in the relevant school.

Exercise Protocol

The exercise program spanned 8 weeks, consisting of 75-minute sessions conducted 4 days per week. Each unit study consists of a 10-minute warm-up, a 60-minute main study, and a 5-minute cool-down period. Animal imitations, strength exercises with their own body weight, step exercises, medicine ball exercises, track work, and games were included in the main work section. During the implementation of each training unit, care was taken to ensure that the training was fun and playful. In addition, 3 assistant trainers were present in the study area to help the students perform the movements correctly.

Height, Body weight, BMI, Body Fat Percentage Measurement

The height of the individuals with DS participating in the study was measured in an anatomical posture, barefoot, using a tape measure with 0.01 cm precision. The values obtained were recorded in cm. TANITA BC-418 (Japan) Segmental Bioelectrical Impedance analyzer was used to determine body composition. Before each measurement, the height, age, gender, athletic, and sedentary status of the experimental and control groups were entered into the screen of the analyzer. The weight of 0.5 kg of clothing was deducted by paying attention to the light weight of the clothes of the individual to be measured. During the measurement, it was ensured that the individuals did not have any metal objects on them and that they stood on the platform of the analyzer with bare feet. Body composition measurement was completed by holding the arms of the device with the right and left hands (14).

Waist Circumference and Waist-to-Hip Ratio Measurement

For waist circumference measurement, the thinnest point between the iliac cristae and the end of the costume was measured. The hip was also measured at the widest part of the hip. In these measurements, an inelastic tape measure was used and the tape measure was kept parallel to the ground. The measurement taken while the individuals were standing upright was recorded in cm. The waist-hip ratio was obtained by dividing the waist circumference by the hip circumference (15).

Sonographic Measurements

Ultrasound measurements were performed by a specialist physician at Batman Training and Research Hospital. The GE P5 Logiq system was utilized to measure the thickness of subcutaneous and preperitoneal fat. The thickness of subcutaneous fat is defined as the distance between the anterior aspect of the linea alba and the fat-skin barrier. Preperitoneal fat extends from the anterior aspect of the liver (left lobe) to the posterior aspect of the linea alba (8).

During the measurement, students lying on a flat surface were asked to take a deep breath. All measurements were performed after a quiet exhalation with minimal pressure without affecting fat thickness. The thinnest subcutaneous adipose tissue thickness between the skin and the linea alba and the thickest preperitoneal adipose tissue thickness between the linea alba and the liver were measured between the xiphoid and the navel, approximately 5 cm from the navel.

Measurement of Biochemical Parameters

Blood samples were taken from the elbow vein twice from all subjects before and after the 8-week exercise program. Blood samples of individuals with DS were collected and analyzed at Batman Training and Research Hospital. The blood samples were centrifuged at 4000 rpm in an Elektromag centrifuge and the serum samples were analyzed in a Beckman Coulter autoanalyzer.

Statistical Analysis

In the statistical analysis of the data, arithmetic averages and standard deviations of all data were calculated using the SPSS 25 package program. The distribution of the data was assessed using the Shapiro-Wilk test, and the skewness and kurtosis values of the two datasets that did not initially show normal distribution were examined, confirming that they followed a normal distribution. Therefore, parametric tests were used in the analyses. Paired Samples T Test was used to determine the differences in dependent groups and Independent Samples T Test was used for intergroup comparisons.

FINDINGS

Table 1. Descriptive statistics of the experimental and control groups participating in the study.

Variables	Time	N	Mean	SD
Age (years)	**Experimental**	7	13.86	0.50
	Control	7	13.29	0.60
BW (kg)	**Experimental**	7	58.65	13.58
	Control	7	49.62	15.30
Height (cm)	**Experimental**	7	144.42	3.73
	Control	7	143.14	8.57

Table 1 shows the descriptive statistics of the individuals with DS who participated in the study. The mean age of the experimental group was 13.86±0.50 years, body weight was 58.65±13.58 kg, and height was 144.42±3.73 cm. The mean age of the control group was 13.29±0.60 years, body weight was 49.62±15.30 kg and height was 143.14±8.57 cm.

Table 2. Comparison of in-group body composition values of experimental and control groups.

Variables	Time	Pre-Test Mean±SD	Post-test Mean±SD	P
BW (kg)	**Experimental**	58.65±13.58	58.37±12.37	.703
	Control	49.62±15.30	50.10±14.34	.646
BMI (kg/m²)	**Experimental**	28.21±7.09	28.07±6.55	.680
	Control	23.85±5.95	24.14±5.72	.594
Fat Percentage (%)	**Experimental**	26.32±9.60	25.28±9.07	.225
	Control	21.81±5.39	22.05±5.11	.370
Waist circumference (cm)	**Experimental**	89.28±11.01	88.00±10.47	.27
	Control	81.71±11.27	82.00±11.13	.68
Waist - Hip Ratio	**Experimental**	0.90±0.02	0.91±0.03	.225
	Control	0.92±0.01	0.92±0.01	1.000
Preperitoneal Fat Tissue (mm)	**Experimental**	10.84±4.07	10.52±3.77	.386
	Control	11.04±3.91	10.48±4.20	.170
Subcutaneous Fat Tissue (mm)	**Experimental**	10.88±3.88	10.94±4.49	.862
	Control	11.22±4.34	11.47±4.15	.447

Table 2 shows the pre-test - post-test comparisons of body weight, BMI, fat percentage, waist circumference, waist-hip ratio, preperitoneal adipose tissue, and subcutaneous adipose tissue values of the experimental and control groups. According to the findings, there was no statistically significant difference between the pre-test and post-test values of the experimental group (P>0.05). There was no statistically significant difference when the values of the control group were compared (P>0.05).

Table 3. Comparison of in-group biochemical values of experimental and control groups.

Variables	Time	Pre-Test Mean±SD	Post-test Mean±SD	P
Glucose (mg/dL)	**Experimental**	98.85±8.13	96.57±7.18	.649
	Control	96.00±8.71	99.14±16.20	.709
HDL (mg/dL)	**Experimental**	50.85±4.18	44.85±9.28	.078
	Control	50.71±7.97	48.57±8.92	.115
LDL (mg/dL)	**Experimental**	63.28±13.13	68.57±12.60	.412
	Control	80.14±30.82	85.42±18.91	.504
Triglycerides (mg/dL)	**Experimental**	104.14±58.30	126.28±61.64	.206
	Control	124.85±28.36	173.71±61.74	**.038***
AST (U/L)	**Experimental**	24.71±5.58	23.85±3.23	.771
	Control	27.28±6.57	26.28±3.90	.774
ALT (U/L)	**Experimental**	21.71±6.65	27.14±9.92	.225
	Control	23.14±5.11	21.71±3.35	.529

P<0.05

Table 3 shows the pre-test - post-test comparisons of in-group glucose, HDL, LDL, triglyceride, AST, and ALT values of the experimental and control groups. According to the findings, there was no statistically significant difference between the pre-test and post-test values of the experimental group (P>0.05). As a result of the pre-test and post-test comparisons of the control group, a significant increase was observed only in the triglyceride value (P<0.05), while no statistical difference was observed in other variables (P>0.05).

Table 4. Comparison of inter-group body composition values of experimental and control groups.

Variables	Time	Experimental Mean±SD	Control Mean±SD	P
BW (kg)	**Pre-Test**	58.65±13.58	49.62±15.30	.266
	Post-test	58.37±12.37	50.10±14.34	.270
BMI (kg/m²)	**Pre-Test**	28.21±7.09	23.85±5.95	.237
	Post-test	28.07±6.55	24.14±5.72	.256
Fat Percentage (%)	**Pre-Test**	26.32±9.60	21.81±5.39	.300
	Post-test	25.28±9.07	22.05±5.11	.428
Waist circumference (cm)	**Pre-Test**	89.28±11.01	81.71±11.27	.228
	Post-test	88.00±10.47	82.00±11.13	.320
Waist - Hip Ratio	**Pre-Test**	0.90±0.02	0.92±0.01	.062
	Post-test	0.91±0.03	0.92±0.01	.349
Preperitoneal Fat Tissue (mm)	**Pre-Test**	10.84±4.07	11.04±3.91	.927
	Post-test	10.52±3.77	10.48±4.20	.984
Subcutaneous Fat Tissue (mm)	**Pre-Test**	10.88±3.88	11.22±4.34	.879
	Post-test	10.94±4.49	11.47±4.15	.823

Table 4 shows the pre-test and post-test comparisons of body weight, BMI, fat percentage, waist circumference, waist-to-hip ratio, preperitoneal adipose tissue, and subcutaneous adipose tissue values between the groups. According to the findings, there was no statistically significant difference between the groups in both pre-test and post-test values (P>0.05).

Table 5. Comparison of intergroup biochemical values of experimental and control groups.

Variables	Time	Experimental Mean±SD	Control Mean±SD	P
Glucose (mg/dL)	**Pre-Test**	98.85±8.13	96.00±8.71	.538
	Post-test	96.57±7.18	99.14±16.20	.708
HDL (mg/dL)	**Pre-Test**	50.85±4.18	50.71±7.97	.967
	Post-test	44.85±9.28	48.57±8.92	.460
LDL (mg/dL)	**Pre-Test**	63.28±13.13	80.14±30.82	.208
	Post-test	68.57±12.60	85.42±18.91	.073
Triglyceride (mg/dL)	**Pre-Test**	104.14±58.30	124.85±28.36	.415
	Post-test	126.28±61.64	173.71±61.74	.176
AST (U/L)	**Pre-Test**	24.71±5.58	27.28±6.57	.446
	Post-test	23.85±3.23	26.28±3.90	.229
ALT (U/L)	**Pre-Test**	21.71±6.65	23.14±5.11	.660
	Post-test	27.14±9.92	21.71±3.35	.195

Table 5 shows the pretest-posttest comparisons of glucose, HDL, LDL, triglyceride, AST, and ALT values between the groups. According to the findings, there was no statistically significant difference between the groups in both pre-test and post-test values (P>0.05).

DISCUSSION AND CONCLUSION

In this study, 8-week exercise practice was performed, and measurements of body composition and blood parameters were taken before and after the exercise. As a result of the calculations, there were no significant changes in body weight, BMI, fat percentage, waist circumference, waist-to-hip ratio, preperitoneal adipose tissue, subcutaneous adipose tissue, glucose, HDL, LDL, triglyceride, AST and ALT values of the individuals with DS in the experimental and control groups (P>0.05), while there was a significant increase in triglyceride value only in the control group (P<0.05). When the values between the groups were compared, no significant difference was observed (P>0.05).

The results showed that body weight and BMI values were maintained in the experimental group, while there was a non-significant decrease in body fat percentage. However, there was a non-significant increase in body weight, BMI, and body fat percentage values of the control group. The reason for this is thought to be the sedentary lifestyle and diet in the control group. Similarly, Ordonez et al (16) did not observe any difference in the body mass index of the experimental (n=11) and control (n=9) groups in their study of 20 obese women with DS. In many studies, no significant difference was observed in body weight, BMI, and body fat percentage of individuals with DS (17, 18, 19, 20, 21). In contrast to our study, Ulrich et al., (22), Lin and Wuang, (23), Seron et al., (24), Ordonez et al., (25), Erol, (26), found that there were significant decreases in body weight, BMI, and body fat percentage as a result of exercise and training programs they applied.

Individuals with DS tend to gain weight due to hypotonia, metabolic diseases, or slow metabolism. Furthermore, individuals with DS have unhealthy eating habits and medications that contribute to excessive weight gain (27). Overweight gain and obesity are associated with an increased risk of hypertension, type 2 diabetes, and cardiovascular disease (28). This is why nutrition and exercise are important to have a healthy body composition in individuals with DS (29, 30). Considering the nutritional status of individuals with DS, it has been reported that their carbohydrate and protein consumption is above the recommended levels. This causes the energy intake to be more than needed. It was also found that sodium consumption was much higher than recommended due to the high consumption of ready-to-eat foods in this population. It has been reported that individuals with DS prefer chocolate, biscuits, and chips in snacks (31). Since we aimed to achieve a positive change in the body composition of individuals with DS, individuals with DS and their families were informed about a diet rich in fiber and low in calories and fat. It was observed that individuals with DS who participated in our study had a fondness for unhealthy diets and did not follow nutritional recommendations sufficiently.

The results showed that the waist circumference of the experimental group decreased while the waist circumference of the control group increased. Similarly, Cai and Beak (32) did not find a significant difference in the waist-hip ratio in the experimental and control groups after a 24-week exercise program. In the study

by Seron et al (24), no significant difference was found in the waist circumference of adolescents with DS in the resistance group and the control group. Calders et al (20) found no significant difference in waist circumference in the combined training group, resistance training group, and control group in their study on children with intellectual disabilities.

In contrast to these studies, Suarez-Villadat et al (33) examined the effect of the swimming program on body composition in adolescents with DS. After 36 weeks of swimming exercise, significant decreases in waist circumference and waist-to-hip ratio were observed in the experimental group, while significant increases were observed in the control group. Küçükyetgin (34) conducted a study on overweight and obese individuals without DS and found significant decreases in waist-hip ratio and waist circumference in the resistance group. Again, in a study conducted on 40 obese women without DS, Sabir et al (35) obtained similar results by detecting decreases in waist-hip ratio and waist circumference.

A literature review did not reveal any studies on preperitoneal and subcutaneous adipose tissues in groups with DS. Donnelly et al (36) did not find a significant difference in subcutaneous adipose tissue in women in their 16-month exercise study on overweight men and women. Irving et al (37) performed computed tomography measurements of 27 obese women divided into a high-intensity exercise group, low-intensity exercise group, and control group and found no significant difference in subcutaneous adipose tissue in the low-intensity exercise group and the control group. Although there was no statistical significance in our study, it can be said that if a decrease can be achieved with exercise and diet, the risk of diabetes, insulin resistance, hyperinsulinemia, leptin, and metabolic diseases will be reduced.

Sabir et al. (35) compared the pre- and post-diet results in their study on 40 obese women and observed significant reductions in subcutaneous and preperitoneal fat tissue. Tsuzuku et al (38) exercised elderly people (aged 65-87 years) with their body weight for 12 weeks and found significant reductions in both preperitoneal and subcutaneous adipose tissue in the exercise group. Nishiwaki et al (39) examined the effects of 8 weeks of exercise under mild hypoxic conditions on body composition and circulating adiponectin levels in postmenopausal women and found no significant change in the values measured in the normoxic group after exercise.

Body fat distribution is an important factor in the treatment of obesity and its complications (38). This observation has been confirmed by many studies (41, 42, 43), which have shown that increased blood pressure is related to the distribution of body fat rather than the absolute amount of body fat. Preperitoneal fat, although not part of the visceral fat, is in anatomical contact with the peritoneum. Therefore, it is thought that preperitoneal fat may share some physiologic properties with visceral fat (44). There are also studies showing that diabetic patients have high levels of preperitoneal fat. It has been reported that high leptin levels in female patients are due to increased subcutaneous fat accumulation rather than preperitoneal fat accumulation (11). Previous studies have shown that hyperinsulinemia elicits leptin release from adipose tissues (45, 45). Increased preperitoneal fat deposition is closely associated with insulin resistance or hyperinsulinemia (47). In studies examining the relationship between body fat distribution and metabolic disorders in obesity, there is a need for methods to evaluate and monitor the ratio between intra-abdominal fat (visceral and preperitoneal) and extra-abdominal (subcutaneous) fat (35).

In our study, no significant difference was observed in glucose values when the experimental and control groups were compared ($P>0.05$). Again, no significant difference was found in HDL, LDL, and triglyceride values in the experimental group as a result of pre-test and post-test measurements ($P>0.05$). It is thought that this may be related to the duration and intensity of the exercise. On the other hand, no significant difference was found in HDL and LDL in the control group as a result of pre-test and post-test measurements, while there was a significant increase in triglyceride value ($P<0.05$). In the pre-test measurements, the triglyceride value, which was within the normal limits, exceeded the normal limit in the post-test measurement. This is thought to be due to the sedentary life and nutritional status in the control group.

Erol (26) divided two people with DS as exercise and control in his study. It was found that the pre-exercise HDL value of the individual participating in the exercise was 32 mg/dL and the post-exercise value was 40.3 mg/dL. The HDL value of the individual with DS selected as control was reported to be 46.8 mg/dL before exercise and 37 mg/dL after exercise. In addition, it was reported that the HDL value of the exercised

individual, which was lower than normal before exercise, increased after exercise and was in the normal value range. The pre-exercise LDL value of 114 mg/dL and triglyceride value of 313 mg/dL were reported as 79 mg/dL and triglyceride value of 256 mg/dL after exercise. The pre-exercise LDL value was 77 mg/dL and the triglyceride value was 106 mg/dL, while the post-exercise LDL value was 90 mg/dL and the triglyceride value was 173 mg/dL in a non-exercised individual.

The changes that occur in the organism due to exercise vary according to the intensity and severity of the activity. It was reported that exercise performed at an optimum level causes an increase in plasma glucose levels. While glucose is derived from glycogen breakdown and amino acids in the liver during rest, plasma glucose concentration increases with the aid of catecholamines during physical activity. The glucose level in blood plasma is influenced by the intensity and duration of exercise (48). In our study, no significant changes were observed in the ALT and AST values following pre-test and post-test measurements in the experimental and control groups with DS. A literature review revealed only one study measuring liver enzymes in individuals with DS. De Gonzalo-Calvo et al. (49) included 248 adults with DS and 84 adults in the control group in their study to examine the biochemical and hematological findings of adults with DS and compare these values to the control population. The mean AST and ALT values in individuals with DS were reported as 21.0 U/L and 20.0 U/L, respectively. In the control group, these values were reported as 19.0 U/L and 19.0 U/L, respectively.

The effects of 8-week chronic exercise training on body composition and some biochemical parameters of individuals with DS were investigated in this study. As a result, the 8-week chronic exercise program did not cause significant differences in body weight, BMI, body fat percentage, waist circumference, waist-to-hip ratio, preperitoneal adipose tissue, subcutaneous adipose tissue, glucose, HDL, LDL, triglyceride, AST and ALT values of individuals with DS.

According to the results of the study, although there was no significant difference between the groups, body fat percentage showed a non-significant decrease in the experimental group and a non-significant increase in the control group during this process. In addition, the triglyceride value of the control group increased significantly in the final test, exceeding normal limits. This situation shows that a sedentary lifestyle can negatively affect the body composition and some biochemical parameters of individuals with DS. Therefore, future studies may be planned for longer periods.

The experimental and control groups included in our study consist solely of individuals with DS. In similar studies, individuals with DS can be compared with individuals with typical development and individuals with intellectual disabilities.

The reason why the training sessions are not effective may be related to the duration and intensity of the training. Therefore, training programs with different frequencies, durations, and intensities can be created for similar exercises.

In our study, only subcutaneous and preperitoneal fat tissue were measured in relation to abdominal fat. However, these two values are not sufficient for total abdominal fat. Therefore, in similar studies, visceral fat tissue can also be measured along with subcutaneous and preperitoneal fat tissue.

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The Effects of Proprioceptive Exercises on Vertical Jump and Balance Performance in Individuals with Different Somatotype Characteristics Engaged in Regular Fitness Training

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Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.

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Abstract

This study aimed to investigate the effects of proprioceptive exercises on vertical jump and balance performance in individuals with different somatotype characteristics. A total of 67 male volunteers were included in the study and classified into endomorph (n=22), mesomorph (n=22), and ectomorph (n=23) groups. Participants engaged in an six-week proprioceptive exercise program performed twice weekly. The exercise protocol included movements selected for stable and unstable surfaces. Vertical jump performance was assessed using the Smart Jump Mat, while postural stability and balance skills were evaluated with the Sigma Balance Platform under botheyes-open and eyes-closed conditions. Balance performance was analyzedbased on parameters such as center of pressure (COP) swayarea and balance speed. To examine the effects of somatotype (between-subjectfactor: endomorph, mesomorph, ectomorph) and time (within-subjectfactor: pre-test and post-test) on vertical jump and balance parameters, a 3×2 mixed (Mixed ANOVA) design was applied. Prior to the analysis, normality and homogeneity of variances a ssumptions were assessed using the Shapiro-Wilk and Levene tests, respectively. The significance level was set at $p < 0.05$. A significant time effect was observed only for vertical jump performance ($p<0.001$). In the between-group comparisons, a significant difference was found solely in balance speed ($p=0.016$), favoring mesomorph individuals over ectomorphs. While no significant differences were detected in other balance parameters, a moderate improvement trend was observed in the mesomorph group. Proprioceptive exercises may effectively support explosive power development in the short term. However, their impact on balance performance appears to vary depending on somatotype characteristics. Mesomorph individuals demonstrated a more favorable response to proprioceptive stimuli, where as improvements were limited in ectomorph individuals.

Keywords: Proprioceptive Exercise; Balance; Vertical Jump; Somatotype; Postural Stability

Özet

Düzenli Fitness Egzersizleri Yapan Farklı Somatotip Özelliklere Sahip Bireylere Uygulanan Proprioseptif Egzersizlerin Dikey Sıçrama ve Denge Performanslarına Etkisi

Bu çalışmanın amacı, proprioseptif egzersizlerin farklı somatotipe sahip bireylerde dikey sıçrama ve denge performansı üzerindeki etkilerini incelemektir. Araştırmaya, endomorf (n=22), mezomorf (n=22) ve ektomorf (n=23) olmak üzere toplam 67 gönüllü erkek katılımcı dâhil edilmiştir. Katılımcılar, altı hafta boyunca haftada iki gün uygulanan proprioseptif egzersiz programına katılmıştır. Egzersiz programının içeriği stabil ve stabil olmayan Zemin üzerinde uygun olan hareketlerden seçilmiştir. Dikey sıçrama performansı Smart Jump Mat ile değerlendirilirken; postüralstabilite ve denge becerileri, Sigma Balance Platform kullanılarak, gözler açık ve kapalı koşullarda uygulanmış ve COP (Center of Pressure) salınımalanı ile denge hızı gibi parametrelerle analiz edilmiştir. Verilerin analizinde Somatotip (gruplararasıf aktör: endomorf, mezomorf, ektomorf) ve zaman (grup içi faktör: ön test ve son test) değişkenlerinin dikey sıçrama ve denge parametreleri üzerindeki etkilerini incelemek amacıyla 3×2 karma (Mixed) ANOVA analizi uygulanmıştır. Analiz öncesinde normallik varsayımı Shapiro-Wilk testi ve varyans homojenliği Levene testi ile control edilmiştir. Anlamlılık düzeyi $p < 0.05$ olarak kabul edilmiştir. Zaman etkisi açısından yalnızca dikey sıçrama performansında anlamlı bir gelişim tespit edilmiştir ($p<0.001$). Gruplararası karşılaştırmada ise yalnızca denge hızı parametresinde anlamlı farklılık bulunmuştur ($p=0.016$); bu fark mezomorf bireylerin ektomorflara göre daha iyi performans göstermesinden kaynaklanmıştır. Diğer denge parametrelerinde istatistiksel anlamlılık gözlenmemekle birlikte, mezomorf grupta orta düzeyde gelişim eğilimi saptanmıştır. Proprioseptif egzersizler kısa vadede patlayıcı kuvvet gelişimini desteklemekte etkili olabilir. Denge performansı üzerindeki etkiler ise somatotip özelliklerine bağlı olarak farklılık göstermektedir. Mezomorf bireylerin proprioseptif uyaranlara daha olumlu yanıt verdiği, ektomorf bireylerde ise gelişimin sınırlı kaldığı gözlemlenmiştir.

Anahtar Kelimeler: Proprioseptif Egzersiz; Denge; Dikey Sıçrama; Somatotip; Postüral Stabilite

INTRODUCTION

Studies conducted at the general population level have revealed that regular exercise has positive effects on physical fitness. These effects include critical health-related gains such as improved capacity for maintaining an active lifestyle, increased aerobic endurance, and enhanced muscular strength (1). Among individuals who are not athletes but engage in regular physical activity, the content of the exercise programs plays a determining role in their motor performance gains. In this context, proprioceptive exercises aimed at improving balance, coordination, and muscle control can lead to significant improvements not only in athletes but also in regularly exercising individuals (2).

Proprioceptive exercises, as one such program, enhance balance and motor control mechanisms by enabling the central nervous system to perceive feedback related to body position, movement, and muscle tension levels (3). Previous studies have shown that these exercises improve dynamic balance, postural control, and reaction time in both sedentary individuals and those who engage in regular physical activity (2).

Individuals' physical structures can influence their physiological and biomechanical responses to exercise. At this point, somatotype emerges as a significant variable, representing a classification system that reflects an individual's genetic and morphological structure, and which affects both body composition and motor performance. These classifications are defined as ectomorph, mesomorph, and endomorph (4).

Somatotypes are categorized into three main types: endomorph (characterized by dominant adipose tissue), mesomorph (characterized by dominant muscularity), and ectomorph (characterized by a slim, linear build) (5). These structural differences are reported to affect individuals' strength production, balance mechanisms, and proprioceptive responses differently. Furthermore, it has been noted that somatotype characteristics in physically active individuals may lead to significant differences in motor performance-related parameters (6).

Mesomorphic individuals are generally more successful in explosive strength and vertical jump tests, whereas ectomorphic individuals may have an advantage in balance tests due to their lower body mass (5). These distinctions underscore the necessity of individualizing exercise programs and highlight the importance of physiologically-based approaches.

Exercise specialists and athletic trainers are responsible for designing physical exercise programs with the aim of prescribing exercise, promoting regular physical activity, or achieving fitness and performance goals (7). In this context, it has been emphasized that, in order to provide appropriate doses of exercise-induced stress stimuli, exercise specialists and personal trainers should consider individuals' genetic characteristics, developmental status, morphological structure, demographic factors, and environmental conditions, as well as their adaptive responses to these variables (8).

In light of this information, investigating the effects of a six-week proprioceptive exercise program applied according to different somatotype characteristics—on selected motor performance parameters in individuals who engage in regular fitness exercise is considered important. Such investigation may contribute both to enhancing the effectiveness of personalized exercise programs and to better understanding somatotype-based differences in practical applications.

METHOD

Research Design

This study employed a quasi-experimental design with a pre-test–post-test comparison and without a control group. The quasi-experimental research model is a method used to examine the effect of a specific variable and to evaluate the relationship between this variable and the outcomes within a cause-effect framework. In this model, the data obtained are analyzed comparatively to reach measurable results (9). The present study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Study Group

A total of 67 male participants aged between 19 and 26 years who regularly engaged in fitness exercise voluntarily took part in the study. Participants were classified according to their body types using the Heath-Carter anthropometric somatotype method and grouped as follows: Endomorph (n=22), Mesomorph (n=22), and Ectomorph (n=23). All participants underwent a proprioceptive exercise program for six weeks, performed twice a week for approximately 45 minutes per session. The exercises were conducted using balance boards, Swiss balls, BOSU balls, and unstable surfaces in single-leg stances, and were planned with progressively increasing difficulty (Table 1).

Table 1. Six-Week Proprioceptive Training Program

Warm Up	**Method**	**Sets x Reps**	**Tempo/Time**	**Rest**
Calf stretch, Hamstring stretch, Quadriceps stretch, IT-Band stretch	Dynamic	1 x 10 (R-L)		
Chest stretch,Back stretch (child pose)	Static	1	30 sec	
Balance	**Method**	**Sets x Reps**	**Tempo/Time**	**Rest**
1-3. Weeks				
Single-leg balance reach (Sagittal-frontal plane)	Unilateral	2x12 (R-L)		30 sec
Bosu ball single-leg balance with throw and catch	Unilateral	2 (R-L)	30 sec	30 sec
Wobble board squat	Bilateral	2x12		30 sec
Two hands hold stick on single leg on bosu ball	Unilateral	2 (R-L)	30 sec	30 sec
Elbow to hands plank on bosu ball	Bilateral	2	30 sec	30 sec
4-6. Weeks				
Single-leg balance reach (Touch the target-multiplane)	Unilateral	2 (R-L)	30 sec	30 sec
(Pair) Bosu ball single-leg balance (Touch the target with hands)	Unilateral	2 (R-L)	30 sec	30 sec
(Pair) Wobble board squat (Touch the target with hands)	Bilateral	2	30 sec	30 sec
(Pair) One hand hold stick, the other touch the target, single-leg	Unilateral	2 (R-L)	30 sec	30 sec
(Pair) Plank on bosu ball (Touch the target)	Bilateral	2	30 sec	30 sec
Cool Down	**Method**	**Sets x Reps**	**Tempo/Time**	**Rest**
Calf stretch, Hamstring stretch, Quadriceps stretch, IT-Band stretch, Chest stretch, Back stretch (child pose)	Static	1	30 sec	

Data Collection Tools

Height and Body Weight Measurement

Participants' height was measuredusing a Secastadiometer, with participants standing barefoot in an anatomicalposture. Body weight was alsomeasuredusing the same device, with measurements taken in the morningwhile participants were fasting and after they had used the restroom.

Body Mass Index (BMI)

BMI was calculatedbydividing body weight (kg) by the square of height in meters (m^2) (kg/m^2).

Somatotype Classification Method

An anthropometric method developed for somatotype classification was used (10). This method evaluates the endomorph (fatness), mesomorph (muscular and skeletaldevelopment), and ectomorph (linearity) components of individuals. Required body measurements were obtained using a skinfoldcaliper (11).

Body Composition Measurement

Body fatpercentage was estimatedthroughskinfold measurements taken with a skinfoldcaliper. Measurements were obtained from the triceps, subscapular, suprailiac, abdominal, thigh, and calfregions. The collected values were thencalculatedusing a specificformula (12).

Vertical Jump Performance Measurement

Lower limbexplosivepower was assessedusing the Fusion Smart Jump Mat. Participants were asked to perform a maximalvertical jump with their hands on their hips. The devicecalculated jump height based on groundcontact time and flight time (13).

Balance Performance Measurement

Postural stability and balance ability were evaluatedusing the Sigma Balance Platform. Participants stood on the platform and performed tests thatrequiredmaintaining balance with eyesopen and closed. The platform quantitativelyanalyzed balance performance using parameters such as center of pressure (COP) swayarea and velocity (14).

Statistical Analysis

Before analyzing the data obtained in the study, normalitydistribution was assessedusing the Shapiro-Wilk test, and homogeneity of variances was evaluatedusingLevene's test. Since the data met parametricassumptions, a 3×2 Mixed ANOVA was applied to analyze the effects of somatotype and time on vertical jump and balance performance. In cases of significantinteraction, Bonferroni-corrected post-hoc tests were conducted to determine pairwise differences. Partialetasquared (η^2) values were used to interpret effect sizes, and Cohen's*d*coefficients were used to evaluate within-groupchanges. Percentagechanges in performance parameters before and after the exercise program were calculatedusing the followingformula (15): % Change = [(Post-test – Pre-test) / Pre-test] × 100

Additionally, a power analysis was conducted using the G*Power 3.1 software to determine whether the sample size was statisticallysufficient. In this analysis, a medium effect size (f = 0.25), a significancelevel (α = 0.05), and a statisticalpower of 95% (1 – β = 0.95) were considered. A RepeatedMeasures ANOVA (within–betweeninteraction) was selected in accordance with the study design, which includedthreegroups and two time points.

Ethical Approval and Institutional Permission

This study was approved by the Ethics Committee of Istanbul Gelisim University in accordance with ethical principles, under the session dated 16.08.2024 (Meeting No: 2024-12, Decision No: 2024-12-07).

FINDINGS

Table 2. Descriptive Characteristics of Participants by Somatotype

Group	Variable	N	Min.	Max.	Mean ± SD
Endomorph	Age (year)	22	19	26	21,23 ± 1,82
	Height (m)	22	1,65	2,03	1,79 ± 0,09
	Body Weight (kg)	22	63	107	78,85 ±10,96
	BMI (kg/m²)	22	21,80	28,00	24,52 ± 1,59
Mesomorph	Age (year)	22	20	23	21,32 ± 1,25
	Height (m)	22	1,67	2,05	1,78 ± 0,07
	Body Weight (kg)	22	68	108	79,84 ± 9,54
	BMI (kg/m²)	22	21,30	31,90	25,18 ± 2,46
Ectomorph	Age (year)	23	19	24	21,26 ± 1,45
	Height (m)	23	1,66	1,97	1,78 ± 0,08
	Body Weight (kg)	23	53	95	67,81 ±11,02
	BMI (kg/m²)	23	17,70	31,50	21,31 ± 3,19

When Table 2 is examined, the mean age of participants in the endomorph group was 21.23 ± 1.82 years, with a mean height of 1.79 ± 0.09 meters, body weight of 78.85 ± 10.96 kg, and a BMI of 24.52 ± 1.59 kg/m². In the mesomorph group, the mean age was 21.32 ± 1.25 years, height 1.78 ± 0.07 meters, body weight 79.84 ± 9.54 kg, and BMI 25.18 ± 2.46 kg/m². For the ectomorph group, participants had a mean age of 21.26 ± 1.45 years, height of 1.78 ± 0.08 meters, body weight of 67.81 ± 11.02 kg, and BMI of 21.31 ± 3.19 kg/m².

Tablo 3. Time, Time × Group Interaction, and Between-Group Differences in Pre- and Post-Exercise Measurements

Variables	Time Effect			Time x Group Interaction			Group Effect			Significiant Difference
	F	p	η^2	F	p	η^2	F	p	η^2	-
Vertical Jump	51,301	**,000****	,445	1,885	,160	,56	1,214	,304	,037	-
Balance Deviation	,010	,921	,000	,825	,443	,025	1,297	,281	,039	
Balance Velocity	1,528	,221	,023	1,310	,227	,039	4,450	**,016***	,122	**Mesomorph> Ectomorph**
Balance Path Length	,909	,344	,014	1,861	,164	,055	2,920	,061	,084	-

*p < .05 = *, p < .001 = *; η^2 = *Partial Eta Squared (Effect Size)*

When Table 3 is examined, the analysis revealed a statistically significant main effect of time only for the vertical jump parameter (F = 51.301; p < .001; η^2 = .445), indicating a notable improvement in vertical jump performance from pre- to post-test across all groups.There was no significant Time × Group interaction for any of the variables (p > .05), suggesting that the change over time did not differ significantly among the somatotype groups.Regarding the main effect of group, a statistically significant difference was observed only in balance velocity (F = 4.450; p = .016; η^2 = .122). Post-hoc comparisons indicated that this difference favored the Mesomorph group over the Ectomorph group(p = .013). No other significant between-group differences were found in the remaining parameters (p > .05).

Table 4. Pre-Test and Post-Test Mean Values, Percentage Changes, and Effect Sizes (Cohen's *d*) by Group

Group	Variables	Pre Test	Post Test	Change (%)	Effect Size (*d*)
Endomorph	Vertical Jump	35,43±3,78	38,10±3,46	%7,53	Medium
	Balance Deviation	,07±,10	,05±,09	-%25,0	Small
	Balance Velocity	,54±,16	,56±,16	%3,70	Small
	Balance Path Length	15,23±4,39	15,36±4,33	%0,85	None
Mesomorph	Vertical Jump	34,78±5,87	39,09±5,77	%12,39	None
	Balance Deviation	,01±,08	,03±,07	%200,0	Small
	Balance Velocity	,57±,17	,67±,22	%17,54	Medium
	Balance Path Length	15,48±4,59	18,28±6,28	%18,06	Medium
Ectomorph	Vertical Jump	37,35±3,53	39,74±4,56	%6,40	Medium
	Balance Deviation	,05±,08	,05±,08	%0,00	None
	Balance Velocity	,51±,19	,50±,13	-%1,96	None
	Balance Path Length	14,61±5,40	13,90±3,61	-%4,86	Small

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

E.S. = Effect Size. Effect size levels based on partial eta squared (η^2):

η^2< 0.01 = None, 0.01 ≤ η^2 < 0.06 = Small, 0.06 ≤ η^2 < 0.14 = Medium, η^2 ≥ 0.14 = Large.

When Table 4 is examineda moderate level of improvement in vertical jump performance across participants. In addition, mesomorphic individuals exhibited moderate effect sizes in both balance velocityandbalance path lengthparameters. However, among the endomorphic and ectomorphic groups, no significant improvement was observed in balance-related parameters.

DISCUSSION AND CONCLUSION

In this study, the effects of an eight-week proprioceptive exercise program on vertical jump and balance performance were examined in individuals with different somatotype characteristics. According to the findings, a statistically significant effect of time was observed only in the vertical jump parameter, while no significant time effect or time × group interaction was found in the balance parameters. On the other hand, between-group comparisons revealed that mesomorphic individuals exhibited significantly superior performance in the balance speed parameter compared to ectomorphic individuals. These findings suggest that proprioceptive exercises may support the development of explosive strength in the short term, whereas their effects on balance may vary depending on individuals' morphological characteristics.

In the literature, proprioceptive training has been reported to enhance rapid for coproduction through early and synchronize deactivation of motor units (16). In this context, our study observed improvements in vertical jump performance across all groups, ranging from 6% to 12%, with a particularly notable increase of 12.39% in the mesomorphic group. Moreover, it has been suggested that mesomorphic individual spossess higher muscle mass and an athletic morphology (17,10), which may enhance their capacity to respond more rapidly to proprioceptive stimuli and confer an advantage in motor control mechanisms (18,19).Similar short-term enhancements in vertical jump performance have been reported following proprioceptive training, with improvements observed in explosive power and agility (20, 30).

A meta-analysis has demonstrated that proprioceptive training significantly contributes to the development of explosive strength, particularly when combined with plyometric exercises (21). Although the program implemented in our study consisted solely of proprioceptive exercises, the significant improvement observed in vertical jump performance ($p < .001$) suggests the possibility of favorable changes in the contraction-relaxation capacity of the muscle-tendon unit. This indicates that proprioceptive exercises may indirectly support explosive force production by enhancing neuromuscular coordination (22,23). A recent study demonstrated that proprioceptive mat training significantly improved countermovement jump performance in volleyball players (24). Similarly, a related study reported that proprioceptive training enhances explosive strength by increasing the rapid and efficient activation of motor units (25). This finding is consistent with the improvement observed in vertical jump performance in our study.

On the other hand, the absence of a statistically significant time effect in the balance parameters may be attributed to factors such as the short duration of the intervention, the difficulty level of the exercises, or the sensitivity of the measurement instruments. Another study has indicated that a minimum intervention period of 12 weeks is necessary to achieve significant improvements in balance performance (26), emphasizing that shorter interventions may yield limited effects (27,28). For instance, an 8-week proprioceptive training program was reported to significantly improve static and dynamic balance in adolescent soccer players, though younger populations may exhibit faster neuromuscular adaptations compared to adults (29). However, unlike adolescent athletes who may demonstrate heightened neuromuscular plasticity, individuals engaged in recreational fitness may require longer or more intensive interventions to achieve similar balance-related adaptations. In this regard, the eight-week duration applied in our study may have been insufficient for eliciting meaningful improvements in balance.

In our study, although moderate effect sizes were observed in the mesomorphic group for both balance speed (17.54%) and balance path (18.06%) variables, these differences did not reach statistical significance. This highlights the importance of distinguishing between statistical significance and practical significance. A systematic review reported that proprioceptive training positively contributes to athletic performance components such as balance, explosive strength, and postural stability (30). These findings support the notion that mesomorphic individuals may respond more favorably to proprioceptive exercises (31,32).Additionally, one study demonstrated that mesomorphic athletes exhibited significantly better dynamic balance control compared to both endomorphic and ectomorphic groups, even though static balance remained similar across somatotypes underscoring the relevance of morphological characteristics in dynamic postural tasks (33). Other studies have also shown that proprioceptive exercises can enhance postural stability (34,35). In this context, it may be suggested that mesomorphic individuals are able to process proprioceptive signals more efficiently. On the other hand, the changes observed in balance parameters within the ectomorphic group were quite limited; in particular, a declining trend was noted in the balance speed and balance path variables. Although proprioceptive training is generally reported to have positive effects on balance and postural control, it is important to note that these effects may vary depending on somatotype (30). Furthermore, other studies have also shown that proprioceptive exercises can enhance postural stability (33,34). In this context, it may be suggested that mesomorphic individuals are able to process propri On the other hand, the changes observed in balance parameters within the ectomorphic group were quite limited; in particular, a declining trend was noted in the balance speed and balance path variables. Although proprioceptive training is generally reported to have positive effects on balance and postural control, it is important to note that these effects may vary depending on somatotype (30).

Structural disadvantages of ectomorphic individuals such as low muscle mass and poor trunk stabilization may limit the benefits gained from proprioceptive training (37,38). Therefore, it can be suggested that proprioceptive performance is influenced not only by the applied exercise protocol but also by the individual's morphological characteristics proceptive signals more efficiently, thereby developing postural control more rapidly.

In the endomorphic group, although a notable 25% reduction was observed in balance deviation, this difference did not reach statistical significance due to the initially low baseline values and the limited sample size (5). Another study has indicated that endomorphic individuals may exhibit lower balance performance compared to other body types due to higher fat mass and lower muscle tone. This relationship is supported by Peterson et al., who found that greater fat mass negatively impacts neuromuscular control and physical performance, while lean body mass is positively associated with strength and balance (39).Similarly, it has been emphasized that postural control may be limited in endomorphic individuals and that such morphological features may act as structural barriers to balance development (34).Furthermore, endomorphic participants demonstrated greater postural sway in dynamic conditions than mesomorphs and ectomorphs, likely a result of the combined effect of higher body mass and reduced muscle torque (30).In this context, the limited improvements observed in endomorphic individuals in our study appear to be consistent with the existing literature.

This study has several limitations. The inclusion of only young male participants limits the generalizability of the findings. The exercise duration, restricted to eight weeks, may have been insufficient, particularly in terms of balance development. Furthermore, applying the same exercise program to all participants may have overlooked individual differences. The absence of neurological measurements such as muscle activation, as well as the lack of control over factors like nutrition and sleep, also represent additional limitations of the study.

CONCLUSION AND RECOMMENDATIONS

This study examined the effects of an eight-week proprioceptive exercise program on vertical jump and balance performance in individuals with different somatotype characteristics. Based on the findings, the implemented exercise program improved vertical jump performance across all groups, with the most pronounced gains observed in mesomorphic individuals. On the other hand, no significant time effect or time × group interaction was found for the balance parameters. However, between-group comparisons revealed that mesomorphic individuals performed better in balance speed compared to ectomorphic individuals. These results suggest that proprioceptive exercises particularly support the development of explosive strength in the short term, while their effects on balance performance may vary depending on an individual's morphological characteristics. The limited benefits observed in ectomorphic individuals with low muscle mass indicate that somatotype is a significant variable in determining responses to exercise.

According to the findings of the present study, proprioceptive exercises may be effective for the development of explosive strength in mesomorphic individuals and can be prioritized in training programs for this group.For ectomorphic and endomorphic individuals, the duration of training should be extended and supported with fundamental strength exercises to enhance balance development. Future studies with longer intervention periods may more clearly reveal the impact of somatotype on balance improvement.Theeffects of proprioceptive exercises should also be evaluated in conjunction with variables such as surface type, loading method, and psychological factors.

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