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Investigation of the Relationship Between Mental Training and Sports Injury Anxiety

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Abstract

The aim of the study was to determine the sport injury anxiety and mental training level of the athletes. The relationship between mental training and sport injury anxiety was also investigated. A total of 179 (78 males, 101 females) athletes, aged $\bar{x}$= 20.57±1.80 years, licensed for at least 1 year in a team or individual sports branches, voluntarily participated. "The Sport Mental Training Questionnaire" adapted to Turkish by Yarayan and İlhan (31) and "The Sports Injury Anxiety Scale" adapted to Turkish by Caz et al. (8) were applied to the athletes. According to gender and branch variables, injury anxiety and mental training status were analyzed using t-test. Pearson's correlation analysis was used for the relationship between injury anxiety and mental training in sports. The study findings examination according to the gender variable in the sport injury anxiety scale showed a statistically significant difference found in favor of female athletes in the sub-dimensions "Loss of Social Support" (p=.024); "Being Perceived as Weak" (p=.045); "Experiencing Pain" (p=.012) and in the total scale point (p=.037). According to the branch variable, there is no statistically significant difference observed in the sub-dimensions of the injury anxiety scale and in the total scale (p>.05). According to the gender variable, a statistically significant difference in favor of women was observed in the self-talk sub-dimension of the sport mental training questionnaire (p = .048). However, it was concluded that mental training status did not make a statistically significant difference between athletes interested in team or individual sports branches. As a result, male athletes have higher injury anxiety levels than female. Self-talk is more commonly practiced by female athletes during mental training. There is no relationship between mental training and sports injury anxiety.

Key Words: Mental Training, Injury Anxiety, Athletes

Zihinsel Antrenman ve Spor Yaralanma Kaygısı Arasındaki İlişkinin İncelenmesi

Özet

Çalışmanın amacı, sporcuların yaralanma kaygılarını ve zihinsel antrenman yapma düzeylerini belirlemektir. Ayrıca zihinsel antrenman ve spor yaralanma kaygısı arasındaki ilişki incelenmiştir. Çalışmaya, takım ya da bireysel spor dallarında en az 1 yıl boyunca lisanslı, yaşları $\bar{x}$=20.57±1.80 yıl olan toplam 179 (78 erkek ve 101 kadın) sporcu gönüllü olarak katılmıştır. Gönüllü olarak katılan sporculara; araştırmacı tarafından hazırlanan kişisel bilgi formu, Yarayan ve İlhan (31) tarafından Türkçeye uyarlanan sporda "Zihinsel Antrenman Envanteri" ve Caz ve ark., (8) tarafından Türkçeye uyarlanan "Spor Yaralanması Kaygı Ölçeği" uygulanmıştır. Cinsiyet ve branş değişkenlerine göre yaralanma kaygısı ve zihinsel antrenman durumları t-testi kullanılarak analiz edilmiştir. Sporda yaralanma kaygısı ve zihinsel antrenman arasındaki ilişki için Pearson korelasyon analizi kullanılmıştır. Çalışma bulguları incelendiğinde, yaralanma kaygısı ölçeğinde cinsiyet değişkenine göre; sosyal desteği kaybetme kaygısı (p=.024); zayıf algılanma kaygısı (p=.045); acı çekme kaygısı (p=.012) ve yeniden yaralanma kaygısı (p=.045) alt boyutları ile ölçek toplam skorunda (p=.037) kadın sporcular lehine istatiksel olarak anlamlı fark tespit edilmiştir (p>.05). Cinsiyet değişkenine göre sporda zihinsel antrenman yapma envanterinin kendinle konuşma alt boyutunda kadınların lehine istatistiksel olarak anlamlı farklılık gözlenmiştir (p=.048). Ancak, takım veya bireysel spor branşlarıyla ilgilenen sporcular arasında zihinsel antrenman yapma durumlarının istatiksel olarak anlamlı fark yaratmadığı sonucuna varılmıştır. Sonuç olarak, erkek sporcuların yaralanma kaygı düzeyleri kadın sporculara göre daha yüksektir. Zihinsel antrenman durumlarında ise kendi kendine konuşma kadın sporcular tarafından daha fazla uygulanmaktadır. Zihinsel antrenman ile spor yaralanma kaygısı arasında ilişki yoktur.

Anahtar Kelimeler: Zihinsel Antrenman, Yaralanma Kaygısı, Sporcu

INTRODUCTION

Traditionally, if sports performance is considered as a concept, it includes the regular practice of sports and participation in activities related to competition, as well as the performance in activities related to prevention of sports injuries, rehabilitation, and return to sports (6). One of the most important points that affect individuals' athletic lives is injuries. Athletes are exposed to minor and major injuries during training or competitions. These injuries to themselves or other athletes can have psychological effects as well as physical effects.

Sport and exercise-related injury can negatively affect one in many ways. This can lead to negative mood states, re-injury anxiety, withdrawal from sports, re-injury, and physical inactivity (30). After the treatment process is over, the anxiety of athletes increases due to the possibility of returning to sports life. Thoughts such as the joy of getting rid of the injury and the possibility of re-injury that occur after the treatment of athletes can often cause the emergence (2). A lot of research has been devoted to understanding how anxiety can affect sports performance, both in practice and in competitive settings.

Stress and sport-related injury suggest that when athletes are finding themselves in a stressful sportive position, they are going to do cognitive appraisals of the situation requirements, their usable resources, and the results of the possible outcomes. Those assessments, called the stress response, are supposed to interact in two directions with physiological/attentional aspects, which lead to greater muscle tension, a reduced field of vision, and higher distractibility. Based on the stress response, a person can increase or decrease their potential risk of encountering sport injury. In relation to the stress response, an athlete will raise or reduce the chances to have an athletic injury (3, 32). Avoiding injury anxiety of athletes; It is an important point that will eliminate the negative effects caused by anxiety in sportive performance and increase the success in performance.

Usually, the sport has concentrated mainly on physical training. It changed with time, and nowadays psychological training took an important place for improving sportive performance. Mental training includes for the sportive to learn psychological techniques which aim to ameliorate their performances and well-being (13, 29). To use scientific knowledge in sport is essential for the athlete to progress. Indeed, besides enhancing physical skill, improving the mental factors will be beneficial highly as well to the sportive and increase his chances of success. Observation in professional and amateur sports showed that coupling high physical and psychological conditions leads to success (1). There is a strong consideration for tools aiming at psychological skills and strategies in sport since they allow to make the distinction between successful and unsuccessful athletes and bring evidence that the mental trainings are effective (18).

The distinction between mental skills and mental techniques is conceptually important. While a mental skill is the ability to learn a specific training task (goal), increase attention level; the mental technique is a special process used to achieve its goals (mental animation, speaking to yourself) (31). In this context, athletes and coaches should set some goals and contribute to the athlete's optimal efficiency by using effective techniques to achieve these goals. In addition, it will be appropriate to make applications to improve the mental skills of the athlete.

Many studies on injury anxiety (21, 25, 7, 17, 28) and mental training status (12, 14, 27, 11) of athletes stand out in the literature. It has been observed in the studies that injury anxiety and mental training situations were examined separately. No study has been found that investigated injury anxiety and mental training conditions together. In this context, the purpose of this study is to determine the injury anxiety and mental training status of athletes. In addition, the relationship between mental training and sports injury anxiety was investigated.

MATERIAL

Research model

In this study, the relational survey model was carried out. The purpose of this model is to reveal whether the relationship has changed or not, and if so, to what extent it has changed (20).

Participants

A total of 179 (78 males, 101 females) athletes, aged $\bar{x}$= 20.57±1.80 years, who have been licensed for at least 1 year in either teams or individual sports branches participated in this study voluntarily.

Data Collection Tools

As a data collection tool; Personal Information Form, The Sport Mental Training Questionnaire (SMTQ) and Sport Injury Anxiety Scale (SIAS) were used.

Personal Information Form

"Personal Information Form" were used which was developed by the researcher and included information about the gender, age, branch of the athletes included in the research.

The Sport Mental Training Questionnaire (SMTQ)

The Sport Mental Training Questionnaire developed by Behnke et. al. (5) based on the Vealey (29) model, is a comprehensive mental training inventory that explains the distinction between mental skills and mental techniques. The scale was adapted to Turkish by Yarayan and İlhan (31). The Sport Mental Training Questionnaire consists of 5 sub-dimensions. Mental Fundamental Skills (4 items), Mental Performance Skills (6 items), Interpersonal Skills (4 items), Self-talk (3 items), Mental İmagery (3 items) and total 20 items. The 5-point Likert-type inventory is scored as 1 "Totally Disagree" and 5 "Totally Agree". The lowest score that can be obtained from the inventory is 20 and the highest score is 100. Cronbach α coefficients of the sub-scales and total were calculated as: Mental Fundamental Skills .82, Mental Performance Skills .85, Interpersonal Skills .85, Self-Talk .91, Mental Imagery .82 and total .91 in the adaptation study of the inventory to Turkish. In the present study, the Cronbach's alpha coefficient was, Mental Fundamental Skills .66, Mental Performance Skills .74, Interpersonal Skills .80, Self-Talk .75, Mental Imagery .75 and total .91.

Sport Injury Anxiety Scale (SIAS)

Sport Injury Anxiety Scale was developed by Rex and Metzler (23) to measure the level of injury anxiety of athletes. The scale was adapted to Turkish by Caz et. al. (8). The Sport Injury Anxiety Scale consists of 6 sub-dimensions. Letting Down Important Others (3 items), Loss of Social Support (3 items), Being perceived as weak (3 items), Loss of Athleticism (3 items), Experiencing Pain (3 items), Reinjury (4 items). The 5-point Likert-type inventory is scored as 1 "Totally Disagree" and 5 "Totally Agree". The Cronbach's alpha coefficient of the original was found Being Perceived as Weak .64, Experiencing Pain.78, Letting Down Important Others .87, Loss of Social Support.81, Loss of Athleticism .72, Reinjury .60 and total .87. In the present study, the Cronbach's alpha coefficient was; Being Perceived as Weak .62 Experiencing Pain .62, Letting Down Important Others.78, Loss of Social Support .76, Loss of Athleticism.70, Reinjury .64 and total .85.

Data Analysis

SPSS statistics program was used in the analysis of the data. Normality test was performed using skewness and kurtosis analysis and it was determined that the data were normally distributed. The t-test was used according to the variables of the participants' gender and sports branch. The relationship between mental training and injury anxiety was analyzed using Pearson correlation analysis. A value of $p < 0.05$ was accepted as the statistical significance limit. In addition, Cohen d analysis was performed to determine the effect size. SSpooled = $\sqrt{(SS2\ grupA + SS2\ grupB) / 2}$

RESULTS

In this part of the study are presented the findings of the statically analyzed data obtained by survey.

Table 1. Sports Injury Anxiety Scale (SIAS) T Test Results by Gender Variable

SIAS	Gender	N	Mean ± Sd.	t	p	d
LDIO	*F*	101	7.51 ± 2.82	1.563	.120	.23
	M	78	8.20 ± 3.05			
LSS	*F*	101	6.72 ± 3.11	2.283	.024*	.34
	M	78	7.82 ± 3.28			
BPW	*F*	101	7.00 ± 2.60	2.023	.045*	.30
	M	78	7.88 ± 3.10			
LA	*F*	101	7.56 ± 2.61	.341	.734	.05
	M	78	7.71 ± 3.25			
EP	*F*	101	6.86 ± 2.44	2.542	.012*	.37
	M	78	7.88 ± 2.93			
R	*F*	101	9.01 ± 2.96	2.024	.045*	.31
	M	78	10.11 ± 4.00			
Total	*F*	101	44.68 ±13.91	2.099	.037*	.31
	M	78	49.62 ± 17.60			

*p <0.05

LDIO: Letting Down Important Others; LSS: Loss of Social Support; BPW: Being Perceived as Weak; LA:Loss of Athleticism; EP: Experiencing Pain; R: Reinjury

In Table 1, a statistically significant difference in favor of women was observed in Loss of Social Support, Being Perceived as Weak, Experiencing Pain, Re-injury and the total scale. Cohen's d value was found as .34 for Loss of Social Support, .30 for Being Perceived as Weak, .37 for Experiencing Pain, .31 for Re-injury and .31 for the total scale.

Table 2. Sports Injury Anxiety Scale (SIAS) T Test Results by Sports Branch Variable

SIAS	Sports Branch	N	Mean ± Sd.	t	p	d
LDIO	Individual	79	7.72 ± 2.86	-.379	.705	.05
	Team	100	7.89 ± 3.01			
LSS	Individual	79	7.10 ± 2.98	-.367	.714	.05
	Team	100	7.28 ± 3.42			
BPW	Individual	79	7.45 ± 2.86	.291	.771	.04
	Team	100	7.33 ± 2.87			
LA	Individual	79	7.69 ± 2.80	.265	.791	.03
	Team	100	7.58 ± 2.98			
EP	Individual	79	7.21 ± 2.69	-.403	.687	.06
	Team	100	7.38 ± 2.73			
R	Individual	79	9.46 ± 3.51	-.098	.922	.01
	Team	100	9.52 ± 3.49			
Total	Individual	79	46.65 ± 15.10	-.135	.893	.02
	Team	100	46.98 ±16.35			

LDIO: Letting Down Important Others; LSS: Loss of Social Support; BPW: Being Perceived as Weak; LA:Loss of Athleticism; EP: Experiencing Pain; R: Reinjury

Table 2 shows the difference injury anxiety of athletes involved in individual and team sports. The present finding shows that there is no significant difference between individual and team athletes in anxiety of injury point (p> 0.05).

Table 3. The Sport Mental Training Questionnaire (SMTQ) T Test Results by Gender Variable

SMTQ	Gender	N	Mean ± Sd.	t	p	d
MFS	F	101	15.66 ± 3.05			
	M	78	15.62 ± 2.70	-.080	.936	.01
MPS	F	101	21.60 ± 4.13			
	M	78	22.57 ± 4.25	1.543	.125	.23
IS	F	101	16.87 ± 2.85			
	M	78	16.76 ± 2.91	-.235	.814	.03
ST	F	101	11.97 ± 2.38			
	M	78	11.23 ± 2.56	-1.989	.048*	.29
MI	F	101	12.13 ± 2.45			
	M	78	12.08 ± 2.35	-.134	.893	.02
Total	F	101	78.24 ± 12.54			
	M	78	78.29 ± 12.25	.025	.980	.00

*p <0.05

MFS: Mental Fundamental Skills; MPS: Mental Performance Skills; IP: Interpersonal Skills; ST: Self Talk; MI: Mental Imagery

In Table 3, a statistically significant difference was observed in favor of women in the sub-dimension of self talk (p = .048). Cohen's d value was found to be .29 for the self talk sub-dimension.

Table 4. The Sport Mental Training Questionnaire (SMTQ) T Test Results by Sport Branch Variable

SMTQ	Branch	N	Mean ± Sd.	t	p	d
MFS	Individual	79	15.82 ± 2.96			
	Team	100	15.51 ± 2.84	.717	.475	.10
MPS	Individual	79	22.08 ± 4.50			
	Team	100	21.98 ± 3.96	.171	.864	.02
IS	Individual	79	16.54 ± 3.10			
	Team	100	17.05 ± 2.66	-1.171	.243	.17
ST	Individual	79	11.50 ± 2.65			
	Team	100	11.76 ± 2.34	-.677	.500	.10
MI	Individual	79	12.05 ± 2.51			
	Team	100	12.17 ± 2.33	-.329	.743	.04
Total	Individual	79	78.01 ± 13.50	- .245	.807	
	Team	100	78.47 ± 11.49			.03

MFS: Mental Fundamental Skills; MPS: Mental Performance Skills; IP: Interpersonal Skills; ST: Self Talk; MI: Mental Imagery

The effect of the branch on mental training was examined and the results obtained are shown in table 4. Considering the findings, it is understood that the branch has no significant effect on mental training (p> 0.05).

Table 5. The Relationship Between The Sport Mental Training Questionnaire and Sports İnjury Anxiety Scale

		The Sport Mental Training Questionnaire	Sport Injury Anxiety Scale
The Sport Mental Training Questionnaire	**r**	1	-.035
	n	179	
Sport Injury Anxiety Scale	**r**	-.035	1
	n	179	

Table 5 shows the relationship between mental training and injury anxiety. The current finding shows that there is no significant relationship between both mental training and injury anxiety.

DISCUSSION

The aim of the study was to determine the sport injury anxiety and mental training level of the athletes and also the relationship between mental training and sport injury anxiety status.

When analyzed in terms of gender variable, it is seen that there is a significant difference in injury anxiety between male and female athletes (see table 1). In the current study, it was concluded that injury anxiety of male athletes is higher than female athletes. The reason why male athletes have higher injury anxiety may be that men are more actively involved in sports that require physical contact. Tanyeri (25), concluded that male athletes 'injury anxiety was higher than female athletes in their study, which examined athletes' anxiety of injury. It concluded that male athletes may have high levels of physical violence against their opponents in sports branches that require physical contact, in terms of high levels of injury anxiety. This result supports our study findings.

Coping with injury is important for sports performance. The literature has shown that athletes who can cope well with injuries are among the most important factors that distinguish them from those who fail. Arvinen-Barrow et al. (4) study results show that physiotherapists have the practical experience and an awareness of the psychological aspects of injuries and acknowledge the importance of treating a range of psychological conditions. Houston et al. (19) study results show that following acute musculoskeletal injury, the injury-related fear scores decrease as the athletes' condition improves.

However, a significant difference was observed in favor of women only in the sub-dimension of self-talk in the mental training status of athletes (see table 3). The results of the study examining mental training situations in the literature differ according to the gender variable. In the study of Erdoğan and Gülşen (14), no significant differences were found in mental training skills according to the gender variable. Turgut and Yaşar (26) found a statistically significant difference in the Mental Performance Skills sub-dimension in favor of male participants in the study in which they determined whether there was a significant difference between the mental training levels of male and female participants. Çelik and Güngör (10) study results show that male participants are more successful than female participants in the mental performance skills sub-dimension. But also there is no difference between male and female athletes according to their SMTQ average scores.

It is seen that there is no significant difference between individual and team athletes in both anxiety of injury and mental training. This finding shows that athletes who are interested in sports as a team or individually show similar tendency at the point of mental training. It was also determined that athletes experienced similar levels of injury anxiety. When the literature is examined, injury researches mostly involve contact and collision sports, researches related to non-contact sports branches are less (24). However, it is possible to come across some studies examining the level of injury anxiety in team and individual sports branches. Tanyeri (25) study shows that the injury anxiety is not meaningful among athletes who are interested in individual or team sports, as well as the results of the study in which athletes in different sports branches examine injury anxiety. In addition, Erdoğan and Gülşen (14) did not detect significant differences in mental training skills according to the branch variable in their study. This result supports our study findings. However, Çelik and Güngör (10) stated that male participants who are interested in individual sports are more likely to use their mental performance skills than team sports. In the present study, male and female athletes interested in team and individual sports were evaluated together. However, Çelik and Güngör (10) stated that there was no difference between individual sports participants and team sports participants according to their total SMTQ average scores.

Today, a lot of research has been done to understand how anxiety can affect sports performance. It is well known that sports has a high potential for stress and anxiety, and the application and use of various psychological strategies can be beneficial in the management of anxiety (15). However, no relationship was found between the two conditions in the present study. Although there is no statistical significance between the two conditions in the present study, the direction of the expected relationship is similar to the studies examined. In addition, studies on relationship are mostly about whether mental training practice affects anxiety levels or not. In the literature, it is possible to come across many studies that use mental training methods and show that these methods bring anxiety processes to an optimal level. Reese et al. (22) compilation study of "Effectiveness of psychological intervention in sports injuries"

supports the effectiveness of psychological intervention in reducing psychological outcomes after injury and improving psychological coping skills during rehabilitation. Fortes et al. (16) study results showed that mental training is effective in reducing cognitive and somatic anxiety and increasing self-confidence of swimmers.

As a conclusion, male athletes' anxiety of injury is higher than female athletes. Self-talk is used more by female athletes in mental training situations. There is no relationship between mental training and sports injury anxiety scale. Considering that injury anxiety affects performance, it may be useful to include psychological support processes in training. Especially during the training and competition days when the athlete is injured, getting psychological support can prevent the negative effects of anxiety.

In the present study, the mental training status of the athletes was examined using the questionnaire. It is thought that the implementation of mental training programs and determination of injury anxiety levels in future studies will contribute to the literature. Also the researchers can repeat this study with professional athletes.

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Examination of Psychological Ability Levels of Middle School Students Towards Sports (Sample of Konya City)

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Abstract

The main purpose of this study, to find out the ability of athlete students who study at the secondary school level to cope with psychological difficulties. The research was carried out in a descriptive screening model. The sample of the study consists of 237 participants, who are athlete student studying in secondary schools within Konya Provincial Directorate of National Education in Konya. Research data were collected on September, October and November in 2019. The statistical software program was used to analyse the research data. For the study, the arithmetic mean and standard deviation values were determined. Moreover, T-test and one-way variance analysis (ANOVA) test were applied to determine the differentiation status of the scores related to variables. To determinate, the difference between the selected groups, Scheffe and LSD tested were applied.As a result of the research, according to ''athletic coping skills inventory'' the ability of athlete student to deal with sports problems was found in moderate level furthermore the levels of psychological attitude for sports differed significantly in terms of gender and grade variables. Lastly, in terms of the parent's educational status and family monthly income variables, there are no significant differences detected.

Keywords: Middle School, Student, Psychology, Skill

Ortaokul Öğrencilerinin Spora Yönelik Psikolojik Yetenek Düzeyleri (Konya İli Örneklemi)

Özet

Bu araştırmada ortaokul düzeyinde öğrenim gören sporcu öğrencilerin psikolojik yetenek düzeylerini incelemek amaçlanmıştır. Araştırma betimsel tarama modelinde gerçekleştirilmiştir. Araştırmanın örneklemini Konya İl Milli Eğitim Müdürlüğü'nün merkez ilçeleri bünyesinde bulunan ortaokullarda öğrenim gören sporcu öğrencilerden oluşan 237 katılımcı oluşturmaktadır. Veriler 2019 yılı eylül, ekim, kasım aylarında toplanmıştır. Araştırmanın verileri istatistik yazılım programı kullanılarak analiz edilmiştir. Veri analizi için aritmetik ortalama ve standart sapma değerleri belirlenmiş, değişkenlere ilişkin alınan puanların farklılaşma durumlarını belirlemede t-Testi ve Tek Yönlü Varyans Analizi (ANOVA) testinden yararlanılmıştır. Farkın hangi gruplar arasından kaynaklandığını belirlemek için ise Scheffe ve LSD testi yapılmıştır. Araştırma sonucunda; sportif sorunlarla başa çıkma becerileri envanterine göre sporcu öğrencilerin sportif sorunlarla başa çıkma becerilerinin orta düzeyde olduğu; spora yönelik psikolojik yetenek düzeylerinin cinsiyet ve sınıf değişkenleri bakımından anlamlı bir biçimde farklılaştığı belirlenmiştir. Baba eğitim durumu, anne eğitim durumu ve aile aylık geliri değişkenleri bakımından ise anlamlı farklılıklar tespit edilmemiştir.

Anahtar Kelimeler: Ortaokul, Öğrenci, Psikolojik, Yetenek

INTRODUCTION

Sports have a comprehensive effect on many aspects of people life and society. It is a fact that in sportive activities as part of individual or group will bring many positive contributions, such as improving the physical health of the individual, mental endurance and increases the sense of well-being. (15). Activities that students participate during education can improve their social ability in the community and help them avoid criminal and anti-social behaviours of their students' life (3).

Talent is important for people to obtain gains and being successful in life. Talent provides many benefits to individuals in every field of life, not only in sports. The ability, which is a complex characteristic, is determined heritably, has a complex structure and also affected by environmental conditions (18). Harsányi (1997) considers sports ability to be a trait of the individual whose hereditary such as physical, psychological, anthropometric, motor and social and he sees these abilities as a characteristic of individuals who can achieve a high level of success in the future at the appropriate stage of development processes. (17)

Athletes are a bio-psycho-social entity (8). They may face many positive and negative situation on their way to success so that athletes should know how to get rid of these situations when they come across and try to cope with these issues (23). Skills are key to solve such a problem. Physical skills are trainable and developable, psychological skills are also trainable and developable. (25). Sports psychology, is scientific and professional assistance that provides to the athlete better communication in sports, Especially, in recent years, psychology in sports has become an important speciality that increases productivity and maintains optimal levels for athletes who tend to show significant developments. (6). Sports psychologists constantly examine the factors that distinguish top performers from those who are average or below average. (16). Most researchers emphasize that psychological traits are important determinants of the athlete's success (2). Moreover; many researchers found that the psychological conditions greatly impact competitive performance which is occurred as anxiety and stress-related issues during the competition (10). Therefore; sports psychologists make psychological skills training program to improve athletes 'sporting performance. For many years, sports psychologists have been studying what psychological characteristics elite athletes should possess to be more succesfull in competition level (5, 12). Individuals who are actively doing sports in a sports club, school or a private company should know how to deal with any sporting problems they may encounter during their sports life. The concept of coping has been described by Lazarus and Folkman (21) as “ever-changing cognitive and behavioural efforts to manage certain external and/or internal demands that are considered to be taxing or exceeding one's resources (20). Problem-oriented strategies refer to cognitive and behavioural efforts such as problem solving, knowledge acquisition, planning, learning new skills, trying to cope with stress (9). However, research on coping with sports problems is limited due to the problem of measurement. In this study, it is aimed to measure the ability to cope with the psychological difficulties of athlete students who study at the secondary school level and valuating those coping skills according to gender, income and family education level variables.

MATERIALS AND METHODS

The research is a quantitative study and carried out in a descriptive screening model. In this study, it was aimed to determine whether secondary school students' psychological ability levels for sports differ in some demographic variables.

Population and Sample

Students who study in secondary schools in the central districts of Konya Provincial Directorate of National Education constitute is the universe of this research. In the research, athlete students randomly selected from secondary schools are the sample of the research. 237 available data were evaluated from the scales filled by the students, with the help of physical education teachers. 48.5% (n=115) participants included in the research sample were female and 51.5% (n=122) of were male respondents.

From the paticipants; 5. grade 24, % 24.1’i (n=57) ,6. grade 27.8% (n=66) 7.grade 24.5% (n=58) is 8th in grade. Father education status participants 37.6% (n=89) are elementary-middle school graduates, 33.8% (n=80) are high school graduates, 4.6% (N=11) are associate degree graduates, 24.1% (N = 57) are graduates-post graduates. In terms of mother education status; 45.6% (N=108) are elementary-middle school graduates, 29.5% (N=70) are high school graduates, 5.9% (N=14) are associate

graduates, 19% (N=45) are graduate post-graduates. Participants' family monthly income status; 30.4% (n=72) have income of TRY 0-2500, 30% (N=71) have income of TRY 2501-4000, 16% (n=38) have income of TRY 4001-5000, and 23.6% (n = 56) have income of TRY 5000 and above.

Data Collection Tools

Athletic Coping Skills Inventory (ACSI)

The scale developed by Smith et al.,(26) aimed at measuring athletes 'ability to cope with difficulty psychologically. The ACSI-28 inventory is a personal evaluation form that has been developed by performing explanatory and confirmatory factor analysis. The DFA was applied to assess whether the 28-item structure of the scale had been verified. Substances with a statistically significant non-t value were studied in the first DFA (detrended fluctuation analysis) applied. According to the examination, it has a non-meaningful t value of 9. and 12. matter removed from the scale. The remaining 26 items were re-analysed. On the scale developed in the Likert-type form of 4, participants were asked to specify how often they experienced their experiences (almost never= 0, sometimes= 1, often= 2, almost always= 3). The alpha reliability coefficient specified for the overall scale was designated 86. In this study, the Cronbach Alpha coefficient for the overall scale was found to be 89.

Statistical Analysis of Data

All the data were analyzed using the Statistical Package of Social Sciences (SPSS) program software version. To determine the tests to be used in the research, the skew coefficient method (2) examined whether the scores obtained showed normal distribution. Skewness values obtained from the analysis are for the overall scale of the Athletic Coping Skills Inventory''calculated as 212. It is assumed that the value is in the range of +1 to -1 and that the distribution is normal. After this stage, the arithmetic mean and standard deviation values determined for data analysis, the views of the participant to determine the status differentiation in terms of demographic variables t-test and one-way analysis of variance (ANOVA) test for significant F values Scheffe and LSD test was used in determining the difference in group works

FINDINGS

Table 1. The arithmetic mean of the inventory of participants ' ability to deal with Athletic Coping Skills Inventory and their differentiation according to demographic variables are given below tables

Scale	Factor	N	Min-Max	$\overline{X}$	SS
ACSI Athletic Coping Skill	**ACSI General**	237	1-4	2.81	.53

Above table shows that the arithmetic average of the participants Athletic Coping Skills Inventory is moderate level.

Findings comparing participants ''athletic coping skills inventory'' according to demographic variables

Table 2. Gender Variable T-Test Findings of participants Athletic Coping Skills Inventory

Scale	Factors/Variable		N	$\overline{X}$	SS	sd	t	p
ACSI Athletic Coping Skill	Gender	Female	115	2,71	0,46	235	-2,89	0,004*
		Male	122	2,90	0,57			

***(p<0,05)**

According to table 2, there was a statistically significant difference in the gender of the participants in terms of the variable t (235)=-2.89; p<0.05. In comparison, female participants ability to cope with sportive problems (Xfemale = 2.71, Ssfemale=.46) found to be significantly lowered than the male participants' level of ability to deal with sportive problems(Xmale=2.90,SSmale=.57).

Table 3. According to ANOVA test findings, grade, paternal educational status and maternal educational status and income levels of family variables of participants.

Scale	Factors/Variable		N	$\overline{X}$	SS	F	p	Grpups in differ (Scheffe test)
ACSI Athletic Coping Skill	**Grade**	5. Grade (a)	57	2,71	0,50	4,29	0,006*	c –a, b, d
		6. Grade (b)	56	2,80	0,46			
		7. Grade (c)	66	2,99	0,62			
		8. Grade (d)	58	2,70	0,43			
	Paternal educational status	Primary-Middle sc (a)	89	2,77	0,45	,508	0,677	-
		High school (b)	80	2,87	0,55			
		Associate degree (b)	11	2,81	0,44			
		Graduated-Post (b)	57	2,80	0,61			
	Maternal educational status	Primary-Middle sc (a)	108	2,76	0,46	0,569	0,636	-
		High school (b)	70	2,84	0,59			
		Associate degree (b)	14	2,80	0,60			
		Graduated-Post Gr(b)	45	2,87	0,55			
	Income level of family	0-2500 TRY (a)	72	2,71	0,48	2,37	0,72	-
		2501-4000 TRY (b)	71	2,89	0,49			
		4001-5000 TRY (c)	38	2,72	0,57			
		5000 TRY and above (d)	56	2,90	0,56			

***p<.05**

DISCUSSION AND RESULT

The concept of talent is a decisive factor in minimizing the negative impact that may occur due to internal and external factors in sports. Theorists often describe sportive abilities based on sporting achievements and results. Major approaches focus on talent in sports is a prerequisite for achieving future sports achievements. (7,24). Our research concluded that the arithmetic mean of the inventory of participants' ability to deal with sportive problems was moderate. This indicated that students have a clear idea in solving problems but are not well equipped to handle such sportive problems, properly.

In terms of gender variables, it was revealed that female participants levels of coping skills with sportive problems were lower than male participants levels of coping skills with sportive problems. It can be interpreted as the fact that female students ' interest in sports is less than male students and female students who are tend to keen on more daily life and feminine activities than men's during that age period. For example, aesthetic and beauty may become more important and first priority for female students. Similar to Peter and et al., (22) found that males could use higher levels of problem-focused compared to female in his study on athletes performance related to stress. Furthermore; Geczi et al., (13) found significant differences between gender and coping skills among hockey, soccer, water polo, and soccer athletes.

When we evaluated the grade; there was a significant difference between the grades of students. It was concluded that the athletes' students who study at the 7th-grade level had higher skills to deal with sports problems than the athletes at the 5th, 6th and 8th grades. According to these results; students at 5. and 6. grade are unfamiliar with the school because they are new students at the school and they're still in the orientation phase. The students in the 8. class will take the entrance exam to high school therefore, exam anxiety may be the dominant factor here. However, athlete students studying at class level 7 are psychologically more comfortable than other classes for instance 5 and 6. class level students to deal with sportive problems so their ASCI scores can be expected to be higher.

In the final findings; there were no statistically significant differences in paternal educational status, maternal educational variables. There are some studies in the literature that have similar to our findings. Gökalp (14) Fırat et al.(11), Duman (7), Kale (19) in their study, found no significant difference between the education status of the mothers and fathers of the students in the general score of ASCI as well as their sub-scale mean scores. In terms of family income level; there is no statistically significant found in our findings. Similar to the studies performed by Cengiz et al. (4), Altundağ'ın (1) did not find a significant difference between the students 'families' monthly income status and their coping styles scale. In literature; a few studies indicate the significant difference

between ASCI and family income in particular sub-scales of ASCI. Generally, it is accepted that the average scores of the candidates with moderate and good family income levels were significantly higher than the candidates with family low-income levels because students feel the support of families on their back and the economic situation is an always strong motivating and driving force.

In summary; secondary school is a period in which systematic education stands. For this reason, it is an important period in determining the talent choices of the students, realizing their strengths and skills that direct them to the right sports branch. During this period; middle-class college student-athletes may face a various physiological or stress-related problem if not well managed, could become a source of personality issues such as lack of self-confidence, discouragement and may prevent them from using their abilities effectively in achieving sportive success. Overall, the ACSI instrument provided us with the ability of athlete student to deal with sports problems at a moderate level. Furthermore, there is a significant difference in participants' ability to cope with sports problems with gender and grade variables. Lastly, parental educational status and income levels have not impact on middle school students dealing with sportive problems. The small sample size is the main limitation of this study, in the future, such studies can be applied to more group of students not only from middle school but also high school or college level students to make a better comparison and deeper analysis. In addition, psychological education should be an integral part of an athlete's holistic training process, which is carried out with other educational elements and this can only be achieved through coordinated work between a good coach, sports psychologist and athlete; In this context, conducting scientific workshops and seminars on talent determination and coping with sportive problems will contribute significantly to this process.

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From Fitness Tracking to Augmented Shopping Experience: Perceptions and Use of Mobile Payment among Runners Using Wearable Devices

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Abstract

Regularly exercising users of sports wearables (e.g., smartwatches) comprise an overlooked group in the literature on mobile payment despite their frequent use of such high-tech devices that allow making mobile payments. Payment-capable wearables could lead to a more health-conscious shopping experience through push notifications that make customised suggestions—say, for fluid/food intake based on dehydration/calories burnt, since they track exercise (e.g., steps), health (e.g., pulse), and well-being data (e.g., sleep cycles). Accordingly, this study aims to explore the perceptions and use of mobile payment technology among a sample of runners, who track their exercise metrics using sports wearables. A typical runner that we captured data from was an educated, employed, and adult female user of high-tech sports wearables, who makes nearly 9 kilometres on each of her four runs in a week, but taps her smartphone—not her wearable—to make payments for necessity goods (e.g., food, apparel) and services (e.g., bills, bookings) through either Alipay or Apple Pay. Mobile payment was among the top three preferred methods of payments; however, only 4% were using their wearable device for that purpose. Runners had a positive perception of the mobile payment technology, which was homogeneous across the categories of their socio-demographic characteristics and exercise metrics. These results indicate that mobile payment use on a smartphone is common among the physically active, but the convergence of that technology with high-tech wearable devices is yet to find acceptance.

Keywords: High-tech sports wearables, Health-conscious shopping, Mobile payment, Perceptions and use, Runners

INTRODUCTION

High-tech sports wearables (e.g., GPS-enabled fitness bracelets) help motivate physically active users to exercise more and effectively by providing them with, for instance, real-time metrics (e.g., interval-based workouts, pace by splits) comparable to past performances or the performances of others on their social fitness circles (e.g., Fitbit Community, clubs on Strava). The pioneers of the latest generation of wearables converge smartphone technology into wearable devices so that they can run software applications (also known as 'apps') within networks over the Internet. Among that software are payment apps (e.g., Google Pay) that enable users to make purchases with their wearables, such as Suunto—the Finnish smartwatch brand, and Glass—Google's smart spectacles.

Unlike hand-held smartphones, users fasten wearables to their bodies to observe a range of health and wellbeing data such as sleep/stress patterns, and physical (e.g., exercise intensity), physiological (e.g., heart rate) and chemical performance (e.g., calories burnt). Aside from allowing safer multitasking on the go (e.g., as Google Glass does), the new generation of wearables could increase mobile payment use among not just exercising but also recreationally active users by providing them with customised purchase suggestions based on their health and wellbeing data as traced by their smart devices (1). However, smartphone-user biasing or sedentary samples in

earlier works on the perceptions and use of mobile payment have overlooked the exercising users of sports wearables.

The consumer line of the relevant literature provides insights into two main domains. One that focuses on people's adoption of mobile payment technology has unearthed that the more the positive users' emotions about mobile payment are, the higher (lower) the technology's perceived usefulness (risk) gets (2). Perceived usefulness stimulates people's intention to use mobile payment services (3, 4) through attitude formation (5). Perceived risk [e.g., of system security and privacy issues (6–8)], on the other hand, reportedly exerts a negative influence on the adoption of mobile payment technology (9). The second domain has revealed the frequently purchased items through mobile payment, which mainly comprise clothing and footwear (10), food, tickets and parking (11), bill/invoice payments (12), hotel bookings (13), and public transportation services (14–16).

Whether these findings from studies that mainly employ samples pursuing sedentary-abiding lifestyles hold for exercising individuals notwithstanding, research on mobile payment among the users of sports wearables has been sparse. The next generation of sports wearables that enable mobile payment provides not just an augmented shopping experience for exercising individuals based on their quantified selves [(17) e.g., push notifications about suggestions for the replacement of fluids lost through sweat when exercising] but also an opportunity for the socially responsible businesses to personalise their customer relationship management towards building a more health-consciousness society. Accordingly, we surveyed a sample of runners using fitness wearables for their current perceptions and future intentions related to using mobile payment.

Next, we provide the methodological details of our study. Then, we report our test results. A discussion on the findings and contemplations of their possible implications conclude the paper.

MATERIAL AND METHOD

Design and Procedures

We invited the members of a New Zealand-based running club on a social fitness network to participate in our descriptive study in mid-2019. A link in our recruitment post took volunteers to the welcoming page of the online survey that we created in Google Forms. The landing page explained subjects about the research and its terms. A click to proceed with the survey questions obtained participants' informed consents. Before data analysis, we excluded 75 submissions that contained missing values. We also checked for extremities that fall outside the 95% confidence interval by converting the scores on the 20-item device (see 'instrument') into z scores and excluded 12 such cases. We computed the average variance expected (AVE), composite reliability (CR), and Cronbach's alpha values [following the same procedures explained in Zhou (18)] for a comparison of the inter-item reliability of each dimension.

Table 1. Comparison of the present and benchmark[a] studies by standardised item loadings, AVE, CR, and Cronbach's α[b]

		Standardised loadings		AVE (CR)		Cronbach's α	
Factor	*Item*	*Present*	*Benchmark*	*Present*	*Benchmark*	*Present*	*Benchmark*
Trust in mobile payment (TMP)	TMP1	.749	.869	.626 (.833)	.65 (.85)	.751	.84
	TMP2	.743	.848				
	TMP3	.874	.692				
System quality (SYS)	SYS1	.675	.744	.635 (.874)	.51 (.81)	.878	.80
	SYS2	.837	.667				
	SYS3	.785	.746				
	SYS4	.877	.704				
Information quality (INF)	INF1	.922	.826	.696 (.900)	.62 (.83)	.904	.82
	INF2	.853	—[c]				
	INF3	.856	.877				
	INF4	.687	.650				
Performance expectancy (PE)	PE1	.662	.867	.590 (.810)	.62 (.83)	.735	.82
	PE2	.767	.771				
	PE3	.862	.713				
Flow (FLOW)	FLOW1	.771	.654	.544 (.774)	.55 (.79)	.682	.78
	FLOW2	.874	.783				
	FLOW3	.522	.789				
Usage continuance (USE)	USE1	.530	.765	.302 (.560)[d]	.60 (.82)	.524[d]	.81
	USE2	.651	.691				
	USE3	.450	.862				

Notes: Sample size in present (benchmark) study = 336 (226). See benchmark study for item statements. Measurement on 5-point scale.
[a]Zhou (18). [b]The benchmark study reports factor loadings in three decimal points and AVE, CR, and alpha figures in two decimal points. [c]The benchmark study drops item INF2 due to its high correlation with the error variances of other items [see p. 942 in Zhou (18)]. [d]We interpreted the weak effect that AVE = .302 indicates as sufficient validity within the context of its square root, which is higher than all factor correlation coefficients (see Table 2). This interpretation is in line with Borsboom, Mellenbergh, and Van Heerden's ontological approach in their 2004 paper entitled "The concept of validity" published in Psychological Review, 111(4):1061-107. We followed the guidelines Field (19, p. 675) provides for interpreting alpha and considered α = .524 as reliable in context as the average correlation between the items comprising the USE dimension was a respectable .48.
Abbreviations: AVE = average variance extracted, CR = composite reliability

Sample

Four-hundred and twenty-three (of 617) volunteering runners passed through the filter (see 'instrument'), 194 (31%) of them did not fit for what we want to study for using either no device or a non-high-tech wearable (e.g., regular watch) or a smartphone while exercising. After the afore-mentioned exclusions remained 336 runners in the sample (55% female). Subjects were running 2 ≤ M = 3.8 (SD = 1.1) ≤ 6 times a week and travelling 2 ≤ M = 8.7 (SD = 5.7) ≤ 31.8 kilometres per run. These figures were homogeneous among gender groups: t (334) runs/week = .486, p = .314 and t (334) km/run = –.285, p = .338. By age, three-quarters were in their 30s [38%, running M (SD) = 4.8 (.87) times/week, travelling 6.8 (5.3) km/run] and 40s [37%, running M (SD) = 3.5 (.56) times/week, travelling 9.2 (5.4) km/run]. The remainder were either in their 50s [19%, running M (SD) = 2.6 (.63) times/week, travelling 12.8 (5.3) km/run,] or 20s [6%, running M (SD) = 2.9 (.88) times/week, travelling 5.51 (2.37) km/run; F (3, 332) runs/week = 146.753, and F (3, 332) km/run = 21.565, ps < .001]. The runners in the sample were educated (73% had a degree, 19% post-degree, 8% pre-degree). More than four-fifths were economically active (i.e., 68% employed plus 15% self-employed), the rest were either students (8%) or unemployed (1%; 8% did not prefer to answer).

Instrument

A filter question distinguished fitness wearable users from non-users. Then, a self-administered quadripartite questionnaire asked each participating runner a set of 31 questions. The opener contained six descriptive items (reported in 'sample'). The two scaled items in the second section asked about frequently used payment methods (1 = hardly ever, 5 = almost always) and the extent to which each payment method was found frustrating due to security, difficulty or complexity (1 = not frustrating at all, 5 = very much frustrating). The third part had three structured questions exploring mobile payment use (i.e., items purchased, non-bank app/s used, and choice of payment). The 20-item 5-point scale in the last section that we adapted from Zhou (18) determined the runners' perceptions of and intentions to continue using mobile payment technology (1 = strongly disagree, 5 = strongly agree).

Validity Checks

The sample size was sufficiently large (orthogonal rotation, KMO = .967, Bartlett's p < .001) and allowed us to compare the factorial structure of the 20-item device that conceptualises the mobile payment usage to Zhou (18)—the source we benchmarked. Prelim to data analysis, six components emerged after seven iterations, explaining together 84% of the total variance. The structure was similar to Zhou (18)'s; therefore, we named the components identically as the source (see table 1). The emerged factors were statistically heterogeneous, indicating that the 6-factor structure also had good discriminant validity (20, p. 1525). We replicated Zhou (18)'s procedures for discriminant validity and compared the square root of AVE values to the factor correlation coefficients. For each factor, the square root of AVE was higher than the factor correlation coefficients; thus, confirming validity (see table 2).

Table 2. Comparison of factor correlation coefficients and the square root of AVE values for discriminant validity

Factors	*1*	*2*	*3*	*4*	*5*	*6*
1. TMP	***.7910***					
2. SYS	.6084	***.7971***				
3. INF	.5005	.6109	***.8340***			
4. PE	.5200	.6704	.6440	***.7680***		
5. FLOW	.5279	.6034	.5591	.6246	***.7373***	
6. USE	.4554	.5166	.3903	.5197	.5146	***.5499***

Notes: The square root of AVE is shown in bold italics at diagonal. Sample size (n) = 336.
Abbreviations: AVE = average variance extracted, TMP = trust in mobile payment, SYS = system quality, INF = information quality, PE = performance expectance, FLOW = flow, USE = usage continuance. Scores on 5-point scale (1 = strongly disagree)

RESULTS

Runners' Choice of Payment Method

All subjects were making mobile payments when shopping; however, only a minority (4%) stated using their fitness wearable for that purpose (96% using either a bank or non-bank payment app on smartphone). Figure 1 depicts the rank comparisons of the often preferred and the most frustrating ways of making payments. Mobile payment (M = 3.49, SD = 1.00) was among the three methods that runners frequently prefer, although ranked significantly behind the in-store EFTpos (M = 3.96, SD = 1.49) and debit card use [M = 3.80, SD = 1.54, F (2, 1005) = 10.189, p < .001]. Conversely, ranking was homogenous among store cards (M = 1.92, SD = 1.31), Paypal (M = 1.98, SD = 1.16), and cheques [M = 2.01, SD = 1.48, F (2, 1005) = .434, p = .648], which were the three payment methods used the least.

Paired comparisons revealed that frustration data were mostly in line with the frequency data. Runners, for instance, reported the least frustration in using EFTpos [M = 1.95, SD = .91, t (335) = 21.072, p < .001] and debit card payments in store [M = 1.76, SD = .85, t (335) = 20.803, p < .001]. Mobile data ranked relatively high on the frustration scale (M = 2.96, SD = 1.27), but its frequent use seemed to outscore the feeling of frustration [t (335) = 6.243, p < .001]. Findings indicated that online payments by credit (M = 4.01, SD = .92) and debit cards (M = 3.77, SD = 1.03) and through phone banking (M = 3.38, SD = 1.10) result in higher levels of frustration among other methods. A worthwhile finding to note is that online credit card and EFTpos use were both ranked in the top-five for not just the most frequently preferred payment methods (Ms = 3.22 and 3.20, SDs = 1.72 and 1.44, all respectively) but also the most frustrating (M EFTpos = 2.96, SD = 1.27). By frequency of use the two were indifferent [t (670) = –.219, p = .413], however, the runners found online payments by credit cards more frustrating [t (670) = –11.356, p < .001].

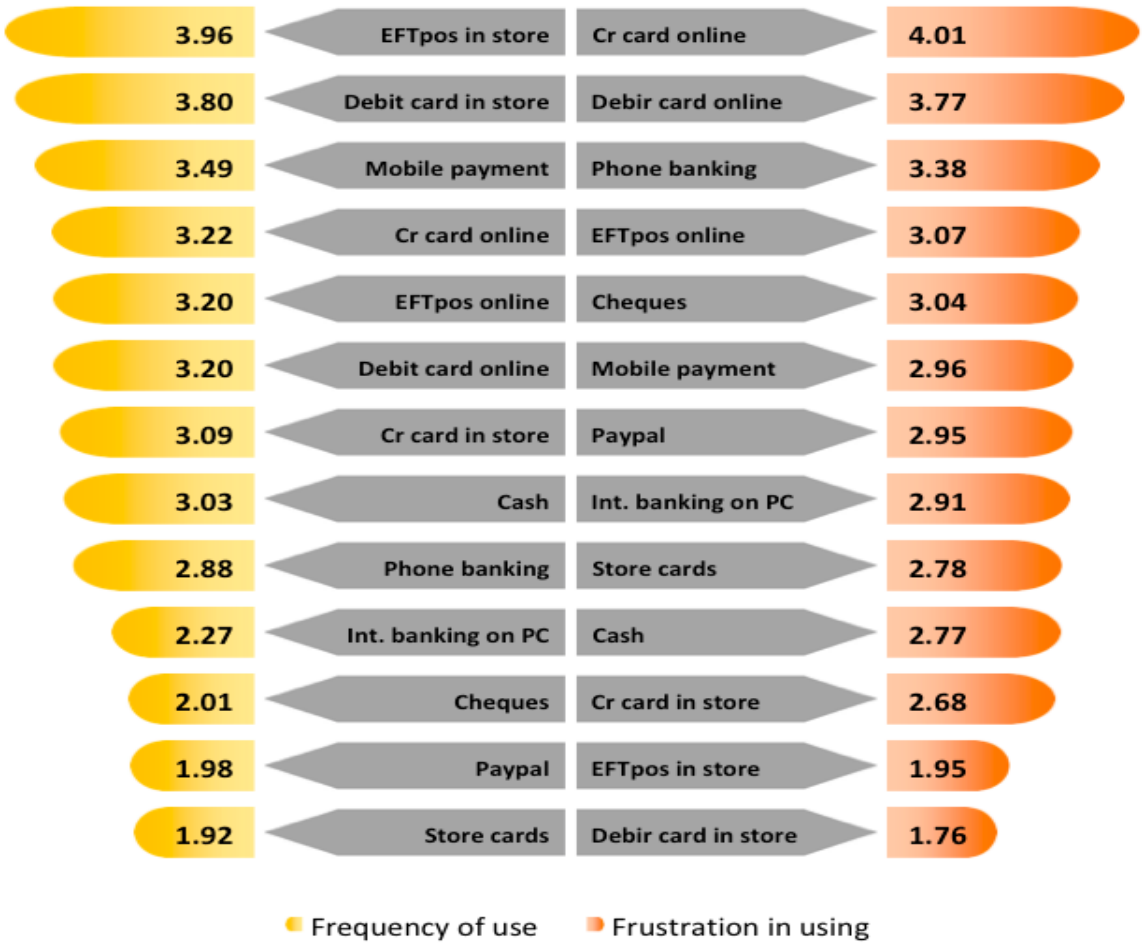

Figure 1. Runners' choice: Frequently used (left) vs the most frustrated payment methods

Notes: Sample size (n) = 336. Mean scores on 5-point scale, higher scores indicate higher levels of frequency and frustration.

Runners' Mobile Payment Use

Figure 2 illustrates the frequency distribution of the items (by category) that subjects purchase using mobile payment regularly. Nearly two-thirds of mobile payments were for two product categories. Necessity goods (i.e., food, clothing/footwear) were the top purchase item, constituting one-third of runners' mobile spending. Making up nearly 30%, service purchases (i.e., bills, tickets, bookings) followed that. The remaining 40% was evenly allocated across the three groups of items: household goods (i.e., appliances, furniture, DIY/home improvement, 14%), electronics and entertainment goods (13%), and health/beauty and adornments (13%).

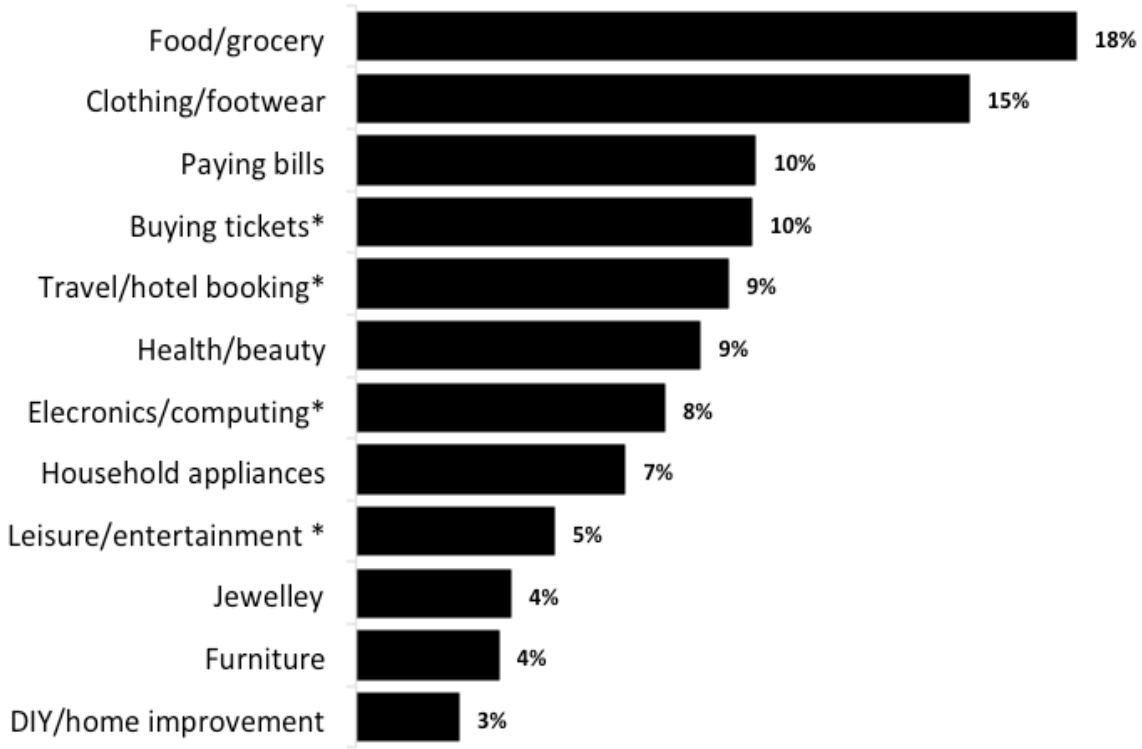

Figure 2. Items runners frequently purchased using mobile payment

Notes: Sample size (n) = 336. The % total is different from 100 due to rounding. DIY = do it yourself.

*Tickets include concert, movie, theatre, sport games, and public transportation. Tickets for flights and other travel arrangements are included in travel/hotel booking. The electronics/computing group captures phones, tech devices, and their accessories (e.g., ear plugs). Leisure/entertainment includes books, music, videos, and computer games.

Subjects stated six different non-bank apps that they were using for making mobile payments (see fig. 3). Alipay and Apple Pay were the two most used among them, preferred by slightly less than three-quarters in the sample. Almost a third of the runners stated their interest in using WeChat Pay, the only other Chinese mobile payment app among responses. Apple Pay seconded that (31%). It was typical across the sample that Android-based mobile payment systems (i.e., Samsung Pay and Android Pay) were not known, thus used by only a minority. Tap-to-pay was the choice of 75% while only a quarter was using the scan-to-pay way of making a mobile payment.

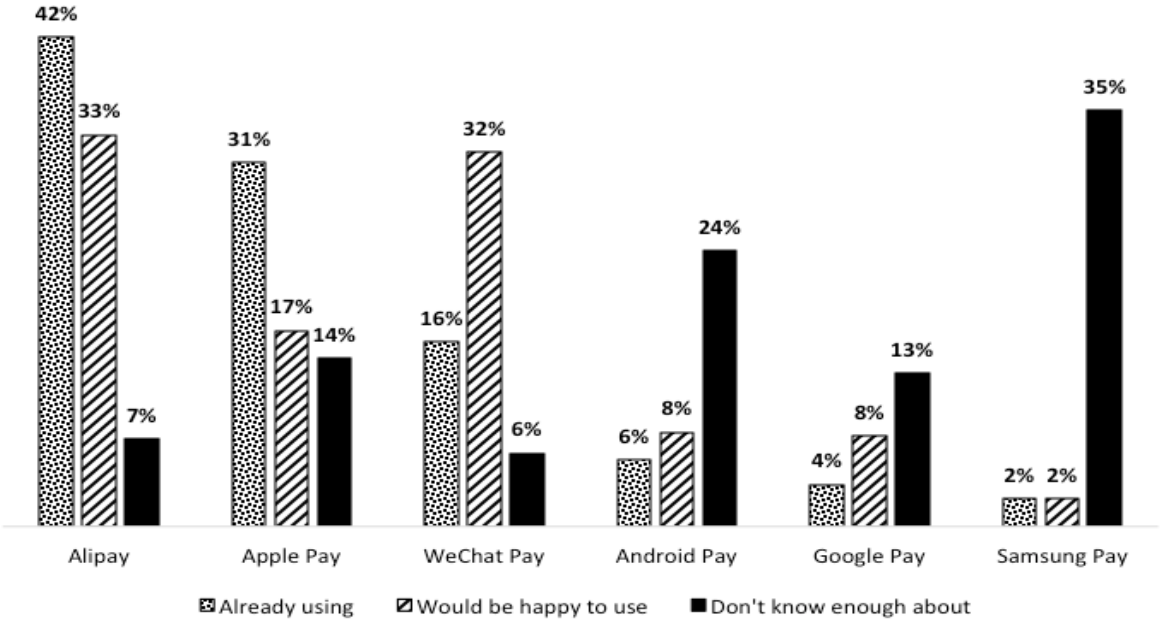

Figure 3. Non-bank apps that runners use for making mobile payment

Notes: Sample size (n) = 336. The % total is different from 100 in 'Already using' and 'Don't know enough about' responses due to rounding.

The current mobile payment usage was significantly correlated with all dimensions of the construct (see table 3). The relatively stronger correlations indicated that perceived information (INF) and system qualities (SYS), performance (PE) and trust (TMP) components could predict the runners' current mobile payment usage better than flow and usage continuance (USE).

The mobile payment usage was homogenous across the runners with respect to their sociodemographic characteristics: gender [t (334) = .235, p = .407], age [F (3, 332) = 1.454, p = .227], education level [F (2, 333) = 1.936, p = .146], and employment status [t (308) = –.693, p = .244]. The last of these foursome of analyses excluded the 8% who preferred to retain their employment information, and compared the economically active (i.e., employed and self-employed) to economically inactive runners (i.e., studying and not working). Similarly, the runners' mobile payment use did not differ by their physical activity levels as measured by the number of weekly runs [F (4, 331) = .403, p = .807]. Neither the times per week a runner was active [R = .016, F (1, 334) = .085, p = .771] nor the distance they travel per run [R = .022, F (1, 334) = .165, p = .685] predicted mobile payment use.

Table 3. Correlations between the usage frequency of mobile payment and the dimensions of the six-factor structure

Factors	*1*	*2*	*3*	*4*	*5*	*6*
1. TMP	—					
2. SYS	.6084	—				
3. INF	.5005	.6109	—			
4. PE	.5200	.6704	.6440	—		
5. FLOW	.5279	.6034	.5591	.6246	—	
6. USE	.4554	.5166	.3903	.5197	.5146	—
7. MP usage frequency	.3657	.4474	.4582	.4095	.2766	.1426

Notes: Correlations are significant at $p \leq .008$. Sample size (n) = 336. Dependent variable (*Y*) = MP usage frequency, multiple independent (predictor) variables (*X*s) = the six factors. $R = .5391$, $R^2 = .2906$, F (6, 329) = 22.461, $p < .001$

Abbreviations: TMP = trust in mobile payment, SYS = system quality, INF = information quality, PE = performance expectance, FLOW = flow, USE = usage continuance, MP = mobile payment. Scores on 5-point scale (1 = strongly disagree)

DISCUSSION AND CONCLUSION

We attempted to determine the perceptions and use of mobile payment among a sample of New Zealand-based runners using sports wearables (e.g., smartwatches), which appears in the relevant literature as an overlooked group despite their use of high-tech devices that allow making mobile payments. Our online instrument adopted a 20-item device developed to measure the perceptions and use of mobile payment technology.

A typical runner in the sample was an educated, employed, and adult female user of high-tech sports wearables, who makes nearly 9 kilometres on each of her four runs in a week, but taps her smartphone—not her wearable—to make payments for necessity goods (e.g., food, apparel) and services (e.g., bills, bookings) through either Alipay or Apple Pay. When the items purchased through mobile payment are considered, these findings seemed in line with those of other studies employing smartphone-using sedentary samples (10–13). Similarly, a majority in our sample was younger than 40 years of age, which conformed to the user typification by age that most studies report (e.g., 21, 22). Mobile payment usage was uniform between the categories of both the demographics and exercise metrics of the sampled runners. These results partly echoed the findings from studies with sedentary samples indicating more extensive use among young adults (23, 24) and homogeneity across gender groups (21, 22); however, conflicted few that report otherwise (25). Overall, the unvarying use of the technology among their statistical characteristics and running metrics indicates exercising groups could provide health-conscious samples that are as resourceful as those comprising people of sedentary lifestyles for studies that converge mobile shopping with health and wellbeing tracking.

Findings from the predictive analysis were somewhat monolithic in the runners' present and future evaluations of mobile payments. The frequency of a runner's mobile payment use at present (i.e., MP usage frequency) correlated strongly with their perceived information and system qualities of, the service performance of, and trust in the technology, as well as flow and future use (i.e., USE). Except for service performance and trust (26–28), our observations on system quality, information quality, and flow were in disagreement with earlier studies (5, 18, 29, 30). These results suggest that service performance and trust elements of mobile payment technology, as perceived by users, are universal among the sedentary and physically active samples whereas their perceptions of other factors indicative of mobile payment use distinguish the latter group. However, only a negligible 4% in our sample were using their wearable device for making payments; smartphone was their dominant payment-making device. When the fact that the use of mobile payment technology on a smartphone has become common is considered, our finding indicates that the convergence of that technology with a new device—that is, using high-tech sports wearables for making payments—seems to be in its early adoption stage. Therefore, similar studies in the future that will capture data from early or late majority could provide more insight into the perception and use of mobile payment and shopping on high-tech wearable devices.

Its limited geographical reach and selective activity-focus might have thwarted our study. Although a broader reach on the social fitness network, where we recruited our sample, was possible by the inclusion of groups throughout the world, this could have required longer time for data collection. We aimed to complete the study before the start of the festive season in December to optimise returns. Similarly, the findings from our analyses provide only a limited representation of the physically active users of high-tech sports wearables (i.e., runners) who make payments with their mobile devices. Involvers of a spectrum of outdoor sports (e.g., cycling, sailing, and walking) and indoor exercises (e.g., aerobic fitness programmes featuring movements to dance music) could have added more value to the utility of present findings. These limitations could be avenues for future research. It could also be interesting to compare sedentary versus physically active samples at different geographies for their utilisation of high-tech wearable devices in health-conscious purchases based on push notifications reminding them of their physical and physiological metrics.

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Relationship Between Negative Events and Depression Among Taekwondo Students in Mazandaran University's

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Abstract

This research aimed to examine the relationship between negative events and depression among Iranian Taekwondo students. This research was conducted on the appropriate sample of 116 Taekwondo students from Mazandaran University, being 18-24 years old. The applied measure instruments were - Adolescent Perceived Events Scale, Automatic Thoughts Questionnaire, General Self-Efficacy Scale, Confrontation with Stressing Situation Questionnaire, Social Support Questionnaire, Children's Depression Rating Scale-demonstrated satisfactory reliability. The data was processed using descriptive parameters, Pearson's correlation coefficient, and hierarchy regression analysis & SPSS22 software. Achieved results didn't show that predictor variables (common automatic thoughts, the sense of general self-efficiency, confrontation strategies, and perceived support of family, coach, and team peers) are the cause of the common negative events and depression relations of Taekwondo students in the middle period of adolescence. On contrary, the results have emphasized the fact that mutual relations of common negative events and depression of Taekwondo students, in this young category, can be explained using independent variables (unwilling unconscious negative thoughts, confrontation focused on feelings, as well as the support of family, coach and team peers).

Key Words: Depression, Negative Events, Taekwondo, Students Sport, University.

INTRODUCTION

The science of psychology concluded different fields and subjects and it is used to increase the life's qualities. Sports psychology is counted among the essential fields of psychology and it endeavors to make the desired level of athletes by using psychology facts [1, 2]. Today sports psychologists endeavor to use the theories of psychology in the fields of enthusiasm and motivation to bring the level of the movements to the desired level. Plus the sports psychologists are researching the effects of sports on personality traits and in some exceptional cases sport is used as a cure for mental disorder and meditating [3]. Athletes can use this to discourage their opponents and repel or decrease the mental pressure and by using team guidance learn successful team skills. The rivalry between individuals is the sports competitive spirit. The studding of psychology and using it in the field can be counted as an advantage to counter or describe a move [4].

Despite the great importance and contemporary status of everyday negative events and depression in adolescence, which include major changes in a cognitive, social, and emotional level, in our country, they have been relatively rarely investigated [5].

According to the studies presented,., this problem was studied in the last few decades by several authors. Studies by Croatian authors [6-9] emphasize that stressful life events, including war events, predict the formation and intensifying of

depression symptoms and other problems of adaptation on the sample of adolescents. Moreover, in their research [10-11], believe that the accumulation of less significant life events represents a better predictor of depression than major life events, as well as the fact that the relationship becomes stronger with the age.

In their studies [12-13], concluded that the sensitivity to the effects of life events is more intense in people, resulting from increasing cognitive and emotional maturity, romantic relationships, present and past negative events, complex social situations, and stress, which leads to increase of the level of depression during the stressful period of adolescence. According to a study [14], the model of individual factors, such as cognition and coping, social support, and environmental factor, permanently become significant in the prediction of depressive symptoms.

The results of the research conducted by [15-16], confirmed the hypothesis that negative cognitive tendencies of adolescents, independently or in combination with stress, contribute to their current depression. The research conducted by [11], suggests that depressed persons in adolescence are unable to successfully affect their daily negative events.

Their studies [14, 17], found out that adolescents coping skills with stress contribute to the prediction of depression symptoms and the interpretation of the relation of stress and adaptation. It is assumed that badly developed strategy or predominant use of inadequate skills, individually and interacted with stress, are especially harmful to the mental health of adolescents. Also, according to research [18], the social support of parents, peers, and teachers, is negatively interrelated with depression symptoms.

A review of previous research shows an obvious lack of research papers on the correlation of negative events, unconscious thoughts, self-efficacy, coping skills, and social support on the depression of Taekwondo students. It is evident that various factors influence the relationship of life events and depressive symptoms among adolescents, i.e. They can absorb or amplify the effects of stress for them. Therefore, it can be assumed that if Taekwondo students experience numerous negative events, have a low level of self-efficacy, and do not receive suitable social support, and do not apply positive successful ways of coping, they feel more depression symptoms. Also, it can be assumed that the prediction variables of cognition, coping, and perceived social support, can be transformed under the influence of stressful life events and act as a set of stress influences on the depression variable of Taekwondo students in middle adolescence. Acceptance or rejection of the hypothesis, and statistical relevance of the obtained coefficients, will be calculated with a critical value and the probability of error of less than 5 %.

The above review of relevant references indicates the complexity of the problem. The fact the relationship of the phenomenon of daily negative events and depression in adolescents has been investigated worldwide. Because correlation regression relationships between everyday negative events and depression in the sports population have not been found in previous research studies, it is extremely important to empirically investigate this phenomenon, which will lead to its complete understanding. Therefore, to obtain new information, i.e. a clear picture of whether the negative repeating day after day can be a predictor depression model, we need to research the sample Taekwondo students. Accordingly, the aim of this study was: a) to examine the effects of the interaction of negative events, unconscious thoughts, self-efficacy, coping skills, and social support on the depression of Taekwondo students and b) to investigate if automatic thoughts, self-efficacy, coping skills and social support mediate in the relations of negative events and depression in the adolescent population of Taekwondo students.

Finally, should be emphasize the fact that it is still known about the relationship between the phenomena of everyday negative events and depression in sports, i.e. Taekwondo population. Investigation of these problems may have important methodological and theoretical applications. Therefore, this study is very important, since it has been one of the first empirical studies of the given topic in our country on the sample of Taekwondo students.

METHODS & MATERIALS

Participants

The study involved 116 Taekwondo students, aged 18 to 24 years in the Mazandaran universities. The research was sampled in full .All subjects had at least five years of systematic and organized Taekwondo students training and competition. The

examinees had been informed about the aim of the research, before the implementation of the survey. They were asked to participate and explained that they have the right to give up whenever they want.

Participation in the survey was voluntary. It was conducted by the authors of this paper with the permission of Taekwondo student's university clubs. The study was conducted in groups during regular training. Group size varied from 20 to 30 examinees. Filling out the questionnaire, on average, took about 60 min before a survey, the examinees were informed about the research and the ay of data safety protection, after which they signed an agreement on participation in the study. Their task was to circle the appropriate number on the scales. After a review of test materials, seven questionnaires that did not conclude answers to all items were discarded so that the monitoring of the program included the final sample of 116 Taekwondo students.

Research Design

The measuring instrument is an adaptation of the Adolescent Perceived Events Scale- Apes (α=0.89), which was made by Kurtović (2007) [7], Croatian translation of the Automatic Thoughts Questionnaire (α=0.97) – ČUPAM by Hollon & Kendall (1980), [19], which estimates some cognitive aspects of depression by Proroković & Zelić (2002) [20], a modified version of the questionnaire (α=0.87) by Sorić i Proroković (2002) [21]. The measuring instrument Ivanov i Penezić (1998) [22] consists of 10 items for which the examinee assesses the extent to which a general and stable sense of their success in dealing with a variety of stressful situations relates to them. The examinees determined the importance of each value on a five-level Liquert's scale, ranging from 1 (absolutely untrue for me) to 5 (absolutely true for me), with the possible range of scores from 10 to 50. Reliability of the scale measured by Cronbach alpha coefficient is.

Conducted factor analysis – applying main components analysis (Varimax rotation and the Kaiser-Guttman criterion for factor extraction), confirmed the tri-factor structure, which describes coping directed to the problem (α=0.88), feelings (α=0.84), and avoidance (α=0.87). The measuring instrument Hudek–Knežević (1994) [23] is an adapted version of the Social Support Appraisal Scale - SS, by Vaux and associates, which measures three aspects of social support: the support of family, friends, and support at work. The questionnaire consists of 24 items, the answers are given at the five-level scale from 1 – absolutely true for me to 5 – absolutely true for me, with the possible range of results from 24 to 120. Applying main components analysis (Varimax rotation and Kaiser-Guttman criterion for factor extraction), three latent dimensions were isolated: support of the family, friends, and coaches. The coefficients of internal consistency, Cronbach alpha, for individual subscales are (α=0.89, α=0.92, and α=0.87), and it can be concluded that certain statements reliably represent the overall result of the subscales.

The Croatian version of this measuring instrument by Vulić-Prtorić (2003) [24] contains 26 sets of 3 three items covering the visible symptoms of depression (sadness, sleep disorders, appetite loss, suicidal ideas, etc. The strength of a symptom is changed within each set of items, and the examinee selects one of the proposed sentences that describe how he felt in the last two days. Answers are scored with 0, 1, or 2 points, and the results range from 0 to 54 points, whereas a higher score indicates greater depression.

Statistical Analysis

The total result is calculated as a linear combination of all answers. Cronbach's reliability coefficient was (α=0.88). For analyzing the data, we used Kolmogorov-Smirnov Test for checking data normality, hypotheses were tested by using Pearson's correlation, and regression test ($p \leq 0.05$), by SPSS22 software.

RESULTS

The result of this indicates the fact that the distribution of the results in this test does not deviate significantly from a normal Gaussian distribution ($p > 0.20$). Descriptive data on the measured variables in the survey sample are presented in Table 1a, 1b. Based on the distribution of values of arithmetic means and standard deviations, it is evident that the majority of junior Taekwondo sportsmen exhibit lower levels of depression, negative events, and negative subconscious thoughts without volition.

Table 1a. Descriptive parameters on the subscales of measuring instruments

ITEMS	MIN	MAX	Average	SD
Negative events	19.00	75.00	37.98	9.28
Automatic thoughts	29.00	145.00	60.02	24.01
Self-efficacy	9.00	49.00	37.00	5.99
Coping directed to a problem	15.00	80.00	54.97	8.72

Table 1b. Descriptive parameters on the subscales of measuring instruments

ITEMS	MIN	MAX	Average	SD
Coping directed to a problem	15.00	80.00	54.97	8.72
Coping focused on emotions	17.00	84.00	52.03	11.00
Coping by avoidance	14.00	66.00	44.05	9.11
Family support	10.00	75.00	36.00	5.97
Friend support	9.00	39.00	32.96	5.44
Support of a coach	7.00	38.00	24.95	5.99
Depression	0.01	49.00	13.02	7.22

Table 2a, 2b shows positive and negative inter correlations of the measured variables. By examining the table, it was observed that all the tested variables showed a significant linear correlation with depression in the assumed directions. Low and moderate nonzero values of Pearson's correlation coefficients were in the range of (r=-0.17) for Coping by avoidance, too (r=0.67) for negative automatic thoughts. Taking into account the obtained values of the variables, prediction of an examined variable according to the test results of the second variable, with an estimation error of (p>0.95), can be expected.

Table 2a. Pearson's correlation coefficients between examined variables

ITEMS	1	2	3	4
Negative events	-			
Automatic thoughts	0.52***	-		
Self-efficacy	-0.05	-0.38***		
Self-efficacy	-0.05	-0.38***		
Coping directed to a problem	-0.05	-0.17**	0.59***	-
Coping focused on emotions	0.40***	0.57***	-0.21**	0.13**

Table 2b. Pearson's correlation coefficients between examined variables

ITEMS	1	2	3	4	5	6	7	8	9
Coping by avoidance	0.05	-0.05	0.29	0.41	0.20	-			
Family support	-0.40	-0.29	0.31	0.19	0.05	0.17	-		
Friend support	-0.14	-0.19	0.29	0.30	-0.05	0.38	0.40	-	
Support of a coach	-0.29	-0.24	0.25	0.24	0.05	0.13	0.27	0.19	-
Depression	0.50	0.69	-0.41	-0.25	0.45	-0.12	-0.25	-0.26	-0.28

To test the interaction of predictor variables (negative events with negative unconscious thoughts without conscious volition, self-efficacy, problem-focused coping, emotion and avoidance, as well as the support of family, the Taekwondo sportsmen from the club and the coach), and the criterion of depression, in addition to correlation aspect, a series of hierarchical regression analysis was conducted. In the first step of each analysis, the predictors are categorized (Negative events and one of the possible moderators), and in the 2nd step, their mutual influence, to check whether it predicts the interaction of criterion variable of depression after controlling the effect of the predictor in the first step (Table 3a, 3b).

Table 3a. Hierarchical regression analysis for depression criterion variable			
ITEMS	R	R^2	ß
Automatic thoughts			
1. Step Negative events	0.69	0.57	0.19
Automatic thoughts			0.59
2. step Negative events x Automatic thoughts	0.69	0.57	0.03
Self-efficacy			
1. Step Negative events	0.60	0.36	0.52***
Self-efficacy			-0.29***
2. Step Negative events x Self-efficacy	0.60	0.36	0.01
Coping focused on a problem			
1. Step Negative events	0.49	0.29	0.51***
Coping focused on a problem			-0.19***
2. step Negative events x Coping focused on a problem	0.49	0.29	0.02

Table 3b. Hierarchical regression analysis for depression criterion variable			
ITEMS	R	R^2	ß
Coping focused on emotions			
1. step Negative events	0.60	0.29	0.28***
Coping focused on emotions			0.29***
2. step Negative events x Coping focused on emotions	0.60	0.29	0.05
Coping by avoidance			
1. step Negative events	0.52	0.26	0.50***
Coping by avoidance			-0.15***
2. step Negative events x Coping by avoidance	0.52	0.26	0.05
Family support			
1. step Negative events	0.56	0.31	0.39***
Family support			-0.19***
2. step Negative events x Family support	0.56	0.31	0.05
Friend support			
1. step Negative events	0.53	0.26	0.47***
Friend support			-0.20
2. step Negative events x Friend support	0.53	0.26	0.05
Support of a coach			
1. step Negative events	0.49	0.30	0.41***
Support of a coach			0.30
2. step Negative events x Support of a coach	0.49	0.07	0.05
***p < .05			

After examining the significant nonzero beta coefficients beta in the cells of the matrix, at the level of significance ($p < .05$), it is obvious that no mutual effect showed significant effects on the criterion variable depression, except the marginally significant effect of mutual influence of negative events, family support, and Taekwondo sportsmen from the club. It did not confirm the hypothesis that these factors adjust the effects of negative events on depression criteria.

To define if the individual variable represents a mediator between the predictor and criterion [25] consider it is necessary to fulfill three conditions: (1) a predictor must predict the mediator, (2), the mediator must predict the criterion variable after the verification of the predictor, and (3) the mediator must be introduced in the final step of the hierarchical regression analysis. The effect of the independent variables in the interpretation of the variance of criterion variable should not be statistically significant. Thus, if the impact of the predictor is greater than zero, but not statistically significant, then it comes to a complete mediator, and if the effect of predictors fell to a lower level, but it is still statistically significant, then it comes to a partial mediator.

Table 4 shows the results of the regression analyses used to investigate the first precondition, i.e. whether the predictor - negative events - predicts criterion variables: unconscious thoughts without conscious volition, self-efficacy, and the occurrence of observance and support of the family, Taekwondo sportsmen from the club and the coach.

Table 4. Contribution of a to the criterion

ITEMS	R	R^2	ß	p
Automatic thoughts	0.51	0.19	0.50	0.05
Self-efficacy	0.05	0.01	-0.07	0.17
Coping focused on a problem	0.03	0.01	-0.03	0.12
Coping focused on emotions	0.40	0.12	0.41	-0.05
Coping by avoidance	0.08	0.03	0.07	0.13
Family support	0.43	0.16	-0.40	0.05
Friend support	0.15	0.00	-0.15	0.05
Support of a coach	0.35	0.09	-0.36	0.05

Bearing in mind the fact that negative events predicted unconscious thoughts without conscious volition, coping focused on emotions and social support, further analysis in the second step was carried out at the level of significance ($p<0.05$) only with the unconscious thoughts, coping directed to feelings, family support, support of Taekwondo sportsmen from the club and the coach. To control the second and the third step [25] claim that applied hierarchical regression analysis represents the precondition for defining if a certain variable represents a mediator about a predictor and criterion, whereas negative events belong to the first step and Coping focused on emotions, and social support belong to the second step to control if relations of negative events and depression are completely caused by these variables. Depression is caused by multiple agents, whereas it is assumed that incomplete agents for particular mediators would be obtained. Also, due to the mutual dependency between the mediators, there is a greater possibility of false mutual relationships between variables. Thus, in the second step of hierarchical regression analysis, partial variables that represent important predictors of depression are noticed, which draws attention to their intermediate effects (Table 5).

A review of statistically significant nonzero beta coefficients, in the second step of hierarchical regression analysis of predictor variables (the unconscious mind without conscious volition, coping focused on feelings, family support, support of Taekwondo sportsmen from the club and the coach) indicated a significant partial effect in the interpretation of the variance of depression. At the same time, the impact of negative events in explaining the variance of depression after the introduction of additional independent variables (unconscious thoughts without conscious volition, coping directed to feelings and social support) in the analysis, is not statistically significant for the whole.

Table 5. Contribution of negative events to depression

PREDICTORS	R	R^2	ß	p
1. step				
Negative events	0.50	0.26	0.50***	0.50***
2. step				
Negative events			0.03	0.08
Automatic thoughts			0.48***	0.41***
Coping focused on emotions	0.80	0.08	-0.20***	0.19**
Family support			-0.18***	-0.16***
Friend support			-0.09*	-0.07*
Support of a coach			-0.22***	-0.20***

*p < .05, ***p < .01

Taekwondo player's population. From the point of view of the regression analysis, the results are reliable suggested that the linear correlation between the variables of negative events and depression, on the examined sample, was mediated by independent variables (unconscious thoughts without conscious volition, coping focused on feelings, family support, support of Taekwondo sportsmen from the club and the coach).

DISCUSSION

The aim of this study was relationship between negative events and depression among Taekwondo students in Mazandaran university's. These findings do not confirm the hypothesis that the unconscious thoughts, a sense of general self-efficacy, coping skills and support of family, Taekwondo sportsmen from the club, and the coach, coordinate relations

between daily negative events and depression of Taekwondo sportsmen in middle adolescence. On the contrary, the results hypothetically draw attention to the fact that the dependence of negative events and depression that occur every day is achieved by negative thoughts, coping focused on feelings, family support, support from the Taekwondo sportsmen from the club and the coach. However, we could be cautious in the interpretation of this new information, since we investigated the frequency of everyday psychological discomfort which is typical for the middle period of adolescence in a population of athletes. Having considered that experienced verification of such events was not investigated, it can be complex to conclude whether the amount and frequency of negative events predict depression in junior Taekwondo sportsmen and whether these relations can be interpreted by the main characteristics of the analyzed events.

Therefore, the hypothesis in this study that the negative automatic thoughts and inactive forms of coping with stress will be intensified, and that self-efficacy, active forms of coping and social support will alleviate the negative effects of the depression on Taekwondo sportsmen, is not confirmed, since there was no significant contribution of mutual contribution, although it turned out that the aforementioned factors predict depressive marks.

Fraizer et al. (2004) point out the fact that the intermediate effects are best manifested when the agent is not significantly associated with the predictor and criterion [26]. Given the fact that all possible mediators are in a significant correlation with depression and automatic thoughts, coping focused on emotions and social support with negative events, it is likely that this can explain the lack of expected related effects.

These authors consider it is likely that the unconscious mind without conscious volition, self-efficacy, coping strategies, and social support, directly affects depression, regardless of the level of negative events. Therefore, it is assumed that in the adolescent period of learning, coping and social support are not yet developed enough to stimulate the effects of stress, although to a certain extent they influence the development of depression.

The first important finding relates to the fact that the relations of negative events and depression are mostly caused by negative thoughts, feelings caused by coping and insufficient support of family, Taekwondo sportsmen from the club, and the coach.

According to a study Rose & Abramson [27], when negative events occur (disappointment, loss, failure, etc.) people are trying to understand the causes and consequences, and by reproducing the thoughts that are specific to these events, general cognitive style is formed. In their research Garber & Flynn, [28], argue that particularly unpleasant events can cause a comprehensive sense of hopelessness and despair, and individuals who believe they are subjects to these events, presumably develop a sense of hopelessness and lack of self-esteem. In a study Parker et al., [29], it was found that chronic negative experiences in adolescence contribute to the formation of negative cognition and depression in later life.

In their study Wadsworth et al., [30] state that: a) adolescents form abilities to apply coping skills during the period of maturing, b) under the influence of experience, their style of coping is subject to transformations, c) responds to stress mediate between stress and psychopathological symptoms and, therefore, later in life, they mitigate the effects of chronic stress conditioned by the unfavorable socio-economic situation. However, these findings did not determine whether the greater amount of everyday psychological discomfort increases an individual's susceptibility to depression in the way it influences their coping skills. Therefore, if an adolescent often experiences negative arousal, he will apply the skills that would reduce it, and not the skills that would adequately affect these negative events, particularly if there is not enough control over these events. To some extent, it explains the interdependence between large amounts of stress and higher levels of depression.

These findings have made clearer the fact that the mutual relationship of negative events and depression is caused by of lower perceived social support of parents, the Taekwondo sportsmen from the club, and the coach. Interpersonal stressful events have the most intense effects on mental health and emotional reactions, as is proved in the research by Scott et al., [11].

The results of correlation and hierarchical regression analysis in this study emphasize the fact that in the mid-adolescence of Taekwondo sportsmen, direct and indirect relationships of negative events and depression should be analyzed. Although many findings draw attention to the fact that depression may be the answer to major negative

events, it is assumed that the dependence of everyday psychological discomfort with depression is caused by a negative experience, inactive coping, and insufficient social support. Our findings especially emphasize the fact that daily negative life events in the youthful age of Taekwondo sportsmen can lead to depression.

Obtained results on the predictive function of negative events, automatic thoughts, coping, and social support may contribute to the assessment of risk for development of depressive symptoms, as well as in the planning of therapeutic and preventive procedures for junior Taekwondo sportsmen. At the same time, the hypothetical findings of the possible ways in which negative events affect depression, give valuable information about the latent dimensions that should be taken into account with Taekwondo sportsmen who are under the stress. However, it is important to draw attention to the fact that the negative events variable in our research are only one of the factors that can help in the prediction of negative experience, coping, and the perception of social support with Taekwondo sportsmen in middle adolescence.

The main limitation of our study is the investigation of exclusively male examinees and the impossibility of comparing the relations of analyzed variables and depression in female adolescent Taekwondo players. Also, the intersection draft of our study does not allow concluding cause-and-effect relationships, as well as the comparison of the levels of depression and negative events with the senior Taekwondo sportsmen population.

From a theoretical point of view, this correlation- regression study enabled initial insight into the complex interrelationships of different predictor variables (as the cause), which may affect various components of depression (as a result). In addition to scientific testing of theoretical models, this work made possible a reliable comparison with the results obtained in other European countries, because a unique methodology that provides a starting point for further quantitative analysis and prediction of everyday negative events and depressive symptoms in the population of athletes, was applied. From a practical point of view, the findings of the conducted research could be particularly important in the diagnosis of depressive symptoms in junior Taekwondo sportsmen.

It is important to emphasize the fact that our transversal study had several methodological limitations (relatively homogeneous sample, the lack of a theoretical frame of reference and research in this area, the collection of data in a very short period, the demographic characteristics of the analyzed samples, and a specific sample of junior Taekwondo sportsmen). Therefore, the possibility of interpretation and generalization of the obtained results is partly limited, which reduces its validity. The limitation is also applied to the sample selection and the cooperation with them. An additional limitation was related to the use of only questionnaires and self-assessment scales, so that in future studies it would be necessary to include other measuring instruments, with different types of stimuli, as well as techniques such as assessment by peers and Taekwondo coach. Despite the methodological limitations of this study and the impossibility of explaining and generalization to the entire population of Taekwondo sportsmen in Serbia, the obtained results are indicative and indicate the need for more extensive research in this area for a unique insight into this issue.

The present study investigated the relationship of predictor variables (negative events with the unconscious thoughts without conscious volition, self-efficacy, coping skills, and social support) on the depression of junior Taekwondo sportsmen (as a criterion).

In the analysis of the obtained values of Cronbach alpha coefficients of internal consistency, it was concluded that the applied questionnaires and scales in this study showed satisfactory homogeneity, and can be considered valid measuring instruments for further use and standardization in future theoretical and practical research of athletes in our environment.

Applied correlation and regression models showed with a certainty level of 95% that on the one hand, the predictors (automatic thoughts, feelings of general self-efficacy, coping strategies, and support of parents, peers, and the coach) affect the variability of the relations of daily negative events and depression of junior Taekwondo sportsmen. On the other hand, the results emphasize, with a probability of error ($p < 0.05$), that linear mutual dependence of everyday negative events and depression of Taekwondo sportsmen, aged 18-24 years, are generated by independent variables of automatic thoughts, emotion-oriented coping, family support, support of Taekwondo sportsmen from the club and the coach.

Summarizing basic facts, it can be concluded that the following longitudinal researches should be conducted on a larger and more representative sample of examinees of different gender and ages, and in other sports, with additional statistical procedures, with the increasing number of questionnaires and scales, which would, by including new variables examine indicative correlations between daily negative events and depression, which would lay the foundation for new research of athletes population.

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Economic Determinants of Success in Olympic Games

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Abstract

Sport economics is defined as the application of economic theories for analyzing of sport activities in which Olympic Games are the most famous ones. Activities in such games are measured by the number of medals that a certain country obtains. One way to predict medals winning by countries is to consider economic strength of the country in addition to the abilities of athletics. In this study, the effect of the most important economic factors on medals winning, such as Population, GDP per capita, and also hosting and the experience from past times in Olympics as explanatory variables are considered, which have not been reflected so far in the related studies. These variables are appropriate for the assessment of the potential of countries' success in Olympics. The data which is used, is in form of discrete data. Accordingly, Poisson Regression model is suitable for the purpose of this study. The period of examination is from 1992-2016 for evaluating the availability of having more medals in Olympics. The results, indicate a positive and significant relationship between economic factors, hosting and experiences in Olympic progressing. Since, countries expect from Olympics Games to derive more medals after the use of their resources, which have been allocated for this purpose, the study suggests that success in the Olympic need to consider the importance of economic factors.

Key Words: Population, GDP Per-capita, Olympic Hosting, Experience in Olympic Games, Poisson Regression

INTRODUCTION

The Olympic Games are not just a sporting event, but a broad social movement that contributes for the development of human harmony and the expansion of international relations among the countries promising peace in human society. The Olympic Games were initially a religious celebration held every four years and in the year of 776 BC in Olympia, the venue of the Zeus, to celebrate Zeus (the king of the Gods of Greece). The Olympics were of great importance among the Greeks, as ancient Greek historians used it as a unit for measuring time, and an "Olympiad" was a four-year-long one.

Centuries later, a German archaeologist and a scientist named "Pierre de Quentin" convened a meeting with their friends in Paris in 1889, in which the basis of the new Olympic Games was introduced. The games were officially launched in Athens in 1896, the capital of Greece, and since then, every four years (except for the three periods that coincided with World War I and II), took place around the world.

A glimpse into the history of the Olympic Games proves that all participating countries do not have the same ability to win Olympic medals. So, the question that is posed is why some countries can enjoy the Olympic medal while some cannot? The answer to the relative power of countries in sport is returned. For example, the United States has a large number of professional basketball players, and it certainly has more medals in the Olympics than other countries of the world (2004). With a glimpse into the history of these games, we find that the participating countries do not have the same ability and opportunity for medals. One way to predict obtaining medals by countries is to consider the athletic ability of individuals. However, since the 1950s, the estimation of the importance of sport in societies as the yield of countries in raising medals in Olympics has attracted many experts. Success in Olympic Games both in terms of how it influences the host country and in terms of the issue of

mediation by participants can be examined from different cultural, economic and political aspects.

In the economics literature, one of the area which is formed and studied is "sport economics", which is defined as such; the sport of economics is the application of economic theories for the analysis of sport activities and, more precisely, the sport's economy, to assess the issues and patterns of optimal allocation of resources in three parts: sport performance, sport products, and sports development (1). In the sport economic research that have studied so far, limited variables have been defined as vital factors for predicting Olympic medals. These factors have been steady in almost all studies and have had interesting results. In some studies Gross National Product and population as independent economic variables are considered. In other studies, in the years 2000, 2004 and 2008, there are also other factors involved, including hosting, socio situation, whether and etc. of the participating country (2). This study aims to consider the main economic and semi-economic factors for estimating medals winning in Olympics. For this purpose consideration of a brief review of some studies which have done before is valuable.

Many studies have been dealing with this particular topic of dispersion over the years after the completion of each round of Olympic Games. In a study entitled "Who Takes Olympics: Economic Resources and Total Medals, used a Probit Regression model, in which the question examined which country wins the number of medals in a period of the Olympic Games? This study begins with a simple hypothesis that sports talent is randomly distributed and is proportional to population size. It also includes a function that covers distribution of resources, population, hosting, and other national features. In this study, the population power hypothesis explains, it is ineligible to describe the distribution of medals among countries. Significant evidence has been obtained that other resources, especially national income, are crucial for the training of an Olympic athlete. Interestingly, per capita and population income has also similar effects to cottage GDP as the best predictor of Olympic performance (3).

In a paper titled "Economics and the Olympic: A Productivity Analysis," assesses the importance of sport in the community by using technical measurements to ration the success of the Olympic Games. The results show that gross domestic product is an appropriate indicator for predicting success for the output values of the model, namely, the medallion quota and the point of its contribution. The impact of population size is also positive for countries that are relatively wealthy. It has also been noted that the growing importance of sports among nations, races and laws is similarly increasing (4). In a paper titled "Why Do Some Countries Receive more Olympic Medals? Lessons for Social Mobility and Poverty Reduction," the study examined indicators such as health, education, and three variables of information and access (the size of the road in the country, the division of the population in villages and the amount of per capita output).

In relation to the ability of countries, given India's share of the world's total population, the country's Olympic medal is horribly low. For example, in the 2004 Olympics, India was the only winner of one medal (5). Meanwhile, Turkey, which has less than a tenth of India's population, has won ten times more than India. Thailand, which is hardly 6 percent of the population of India, won eight times more than that country. Indeed, what factors have caused a country with almost the sixth of the world's population to contribute very little to obtain Olympic medals? However, GDP per capita as an economic indicator has been shown to play a significant role in the success of the Olympic Games in obtaining a significant number of medals in various sports, but it cannot be said that GDP is a sufficient condition for this process (2). For example, countries such as Cuba, Ethiopia, Kazakhstan, Kenya and Uzbekistan do not seem to have higher per capita income than India, but their share of the Olympic medals is much higher than that for India.

In a study titled "Earning a Medal in the Olympics: Croatia Has a Chance?" examines variables such as population size, GDP and per capita GDP, hosting, political system, sports system, per capita health expenditure and the weather has paid attention. The results show that economic factors, especially GDP per capita and political system of the country, have a significant and positive effect on explaining the medallion of countries in these competitions. However, the impact of population size on the likelihood of the medal in Croatia has not been confirmed (6).

In a paper entitled "The Impact of the Economic and Social Factors Affecting the Sporting Success of Nations in the Olympics" during the period of 2012-

6, has studied for the countries participating in the Olympics. In this regard, the success of the sport of countries according to the medal received in these games is defined and function of the index of human development, per capita income, population, performance of previous courses, number of participants, trade balance, labor participation of 14-64 years and household expenses are considered. To investigate these factors, the regression model of panel data is used. The results of the estimation indicated that except for population variables, labor force participation rate and performance of the previous period, other variables were statistically significant. Also, except for the population variable, other variables have a positive impact on the sporting success of countries, so that the human development index was the most effective factor in the sport's success of the countries in the Olympic Games (1). The results indicate that many countries have been awarded medal in prediction by the aforementioned agents, that is, the number of predicted medals for them with the potential ability, which they were (with little difference) the same. Results mean that due to the political tensions and the type of economic situation in countries, may consider as factors which affects the success or failure in Olympics.

Goals are being pursued today in leading sporting countries. Investigating the role of economic factors in the modeling of the Olympic Games winning can be started using economic function theories. Although, according to Bernard & Busse (2), which they assume that athletic talent to be randomly distributed across the world, the development and discovery of these talents, as they point out, requires spending on the individuals and facilities that they need. Wealthy countries are both more capable and more willing to spend such investments. As a result, it seems rational that one of the most important variables i.e. per capita GDP should be included in the modeling of Olympic medal gain. Bernard & Busse (2) define the following function as which (i) stands for country i at time (t):

$$Tit = F(Nit, Yit, Ait)$$

In the above case Nit represents the population, Yit represents the GDP and Ait stands for the ability of experience of country i. In this research, it seems that the above function can be a good description of the success of countries in the Olympics, while the experience of participating countries, which were in the top Olympic winners, should be include in the function. This is because often the coaches or club advisors which are heroes or experienced people, that they can reflect their proficiency to involvement countries better. In addition, this paper have identified the experience of success in the Olympics as a variable which states the lack of Bernard and Busse's (2) work, then this experience as a variable is included in our study.

Variables and Method

Considering the research background in order to evaluate the overall performance of countries in the Olympics in the period 1992 to 2016, four main explanatory variables were identified as follows:

Domestic Production Per Capita: The degree of economic strength of countries is measured by this variable. The data from this variable are prepared by the World Bank and used in the model of the study logarithmically (Abbreviation, lgdppc).

Population: The size and number of sports talents with the population. In this regard, the population includes one of the main variables of the research. The data from this variable are prepared by the World Bank and used in the model of the study logarithmically (abbreviation, lpop).

Hosting as a virtual variable: It is anticipated that hosting will affect the number of medals received by countries. According to the data of the International Olympic Committee, the countries hosting the Olympic Games during the period under consideration have been identified using the dummy variable and, thus we have investigated the hosting impact on the volume of received medals (Abbreviation, Host).

Experience of attending the first 20 Olympic Games: the experience of attending the top 20 Olympic Games in terms of the ranking that the International Olympic Committee has introduced as an important factor in the success of further medals. Using this variable is considered also as a dummy variable. It is expected that this variable will be effective on the number of medals won at the Olympics (Abbreviation Proage). This variable has not been introduced in any of the studies have been done so far.

The total number of medals won in each Olympics: The total number of medals won in each Olympics has been used as a dependent variable of the research and its data has been obtained from the

International Olympic Committee (Abbreviation, Mtotal).

According to the above mentioned and the studies which have done so far, dependent variable of this study (number of total medals) is a kind of discrete and a numerical variable. Therefore, the assumption of the normalization of the function of the truth of this variable will result in incompatibility estimates of model coefficients. Therefore, the Poisson Model has been selected among different regression methods for these kinds of data, i.e. the discrete data.

RESULTS

Form 1 shows the total number of medals won by countries in different Olympic periods, which are represented by the abbreviation mtotal. Based on this form, it seems that during the period under consideration in the selected countries1 the medal process is almost the same. It also shows the difference between countries in medal gain and the time stability of this kind of difference.

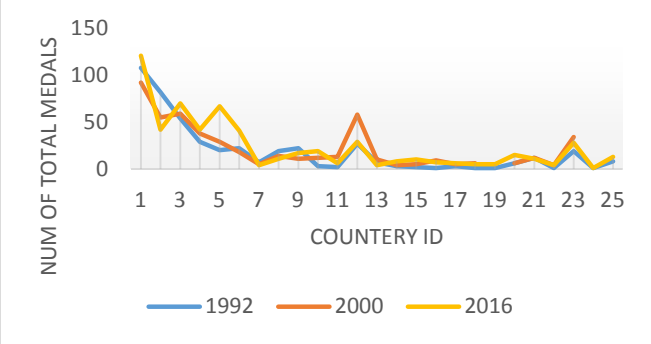

Figure - Form 1. The Mediation Process of the Selected Countries in the Olympic Games

Table 1. Transition Prob. Matrix for the No. of Medals in Countries (Von 10 or More)

No. of Medal Won in Time$_t$	**Prob. of Numbur of Medals Won in Time $_{t+1}$**											**Total 100%**
T	0	1	2	3	4	5	6	7	8	9	10	
0	34.78	21.74	17.39	13.04	0.00	4.35	0.00	0.00	0.00	0.00	8.70	100.0
1	21.05	15.79	26.32	10.53	10.53	5.26	5.26	0.00	0.00	0.00	5.26	100.0
2	9.09	22.73	36.36	13.64	13.64	0.00	4.55	0.00	0.00	0.00	0.00	100.0
3	12.50	0.00	25.00	25.00	6.25	12.50	0.00	18.75	0.00	0.00	0.00	100.0
4	11.11	22.22	22.22	0.00	22.22	11.11	11.11	0.00	0.00	0.00	0.00	100.0
5	0.00	14.29	0.00	71.43	0.00	0.00	0.00	0.00	0.00	0.00	14.29	100.0
6	25.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	100.0
7	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	25.00	50.00	100.0
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.00	0.00	25.00	100.0
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	0.00	0.00	66.67	100.0
10	5.13	0.00	0.00	0.00	0.00	2.56	0.00	2.56	5.13	5.13	79.49	100.0
Total	13.33	10.67	16.00	12.00	5.33	4.00	2.67	3.33	3.33	2.00	27.33	100.0

[1] Among all participating countries (169) which were in Olympic Games, 25 countries that were in all Olympics periods was selected as a random sample.

According on the descriptive findings presented in Table 1, the paper examines the transition probabilities matrix for all countries that won 10 or more gold medals at different Olympic Games. Table 1 indicate a significant continuation in the medallion of countries that have 0-10 and more gold medals. The probabilities in this table show, 79.49 percent of countries that won 10 or more medals at the Ex-Olympic have won more than 10 gold medals, in fallowing periods also would happen 10 or more medals again. Countries that won 4 gold medals at the Ex-Olympic failed to win more than six gold medals in the next Olympics. According to the probabilities that show in the mentioned table, countries that won one gold medal at the Ex-Olympics, have a chance to win almost 48 percent (26.32 + 10.53+ 10.53) to achieve 2-4 gold medals in the next Olympic.

It is unrealistic to assume that medal rates in the selected countries can be the same. To show this, we use an over-dispersion test to investigate inferential relationships. For this purpose, the null hypothesis is considered as follows:

$$H_0 : Var(terror \mid X) = E\left(terror \mid X\right)$$

To perform the above test, two new variables, (ystar and muhat which only use for the test) have been made. The test method is based on a test that was introduced by Gröger and Carson in 1991. The results of this test in Table 2 indicate that the medal gain in the selected countries is not the same (rejection of the null hypothesis as shown in Table 2).

Table 2. Test of Excessive Dispersal

ystar	Coef.	Std. Err.	t	p> |t|	[95%Conf. Interval]	
muhat	**-**.0231989	.0023699	**-9.79**	0.000	**-**.027878	-.0185198

The distribution of medals earned per year for selected countries (Form 2) shows that 25% of countries in different periods of the Olympic Games, from 1992-2016, won 5 medals and almost 6% of the selected countries earned up-to 70 medals or more. This indicates that the distribution of medals among countries is not homogenous which shows a huge gap between the lowest and highest frequency of earned medals. Thus, accordingly, on the basis of the different power of countries in acquiring medals is a real thing that should be considered in modeling.

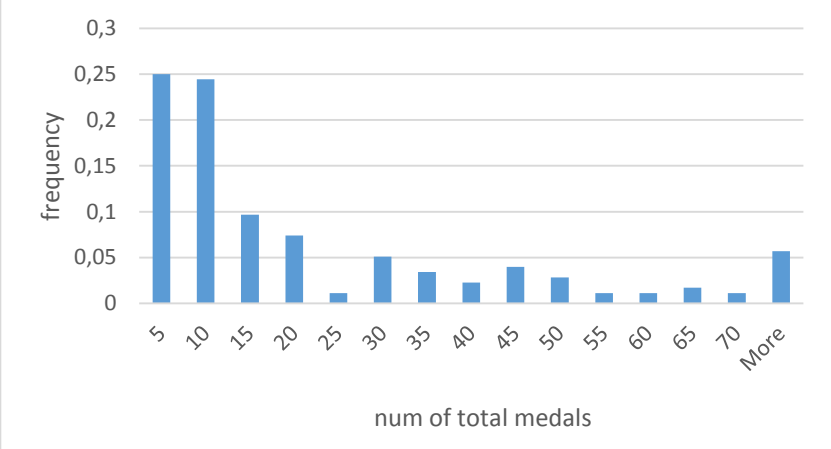

Figure - Form 2. The Distribution of Total Medals Won by the Selected Countries in the Period of 1992-2016

When the process generating data is over-dispersive, Laplace Regression Model (Negative Binomial) or Modified Poisson method can be used to estimate. Therefore, in this study, as explained in the methodology, the mentioned model is applied.

Due to the fact that the number of medals won in each Olympic is a variable from zero to any possible value, in this case as demonstrated, the Poisson Regression Method will be used to examine the relationship between economic indicators and

the success of countries in the Olympics. Modified Poisson estimator reveals the coefficients of explanatory variables are as follows:

Table 4. Model Estimation by Modified Poisson Method

		Robust		
Mtotal	**Coef.**	**Std. Err.**	**Z**	**p>|z|**
Lpop	.3416885	.0838611	4.07	0.000
Lgdppc	.2409657	.0779747	3.09	0.002
Host	.4226885	.1381906	3.06	0.002
Proage	.2198691	.0383763	5.73	0.000
_cons	-6.352633	2.092824	-3.04	0.002

The results of the estimation indicate that the number of medals obtained by selected countries are positively and significantly related with population (lpop), domestic production (lgdppc) and hosting (Host). Also, the number of times that a country was in the first 20 winner has a positive impact on the mediation potential of countries. The change in the earning medals (mtotal0 conditionality as a result of the change in the explanatory variables should be supported by the factor interpretation method which is shown in Table 5.

Table 5. Factor Interpretation of the Model Coefficients

Mtotal	**B**	**Z**	**p>|z|**
Lpop	0.34169	4.074	0.000
Lgdppc	0.24097	3.090	0.002
Host	.42269	3.06	0.002
Proage	.21991	. 5.73	0.000

Table 5 shows the explanation of four explanatory variables that the study applied are the most important economic factors of winning medals. Based on these results, a one unit increase in the logarithm of population affect equal to .0.34 increases the number of medals. Also, increasing one unit in the logarithm of domestic production increases the number of medications as 0.24 and the rest of variables as such.

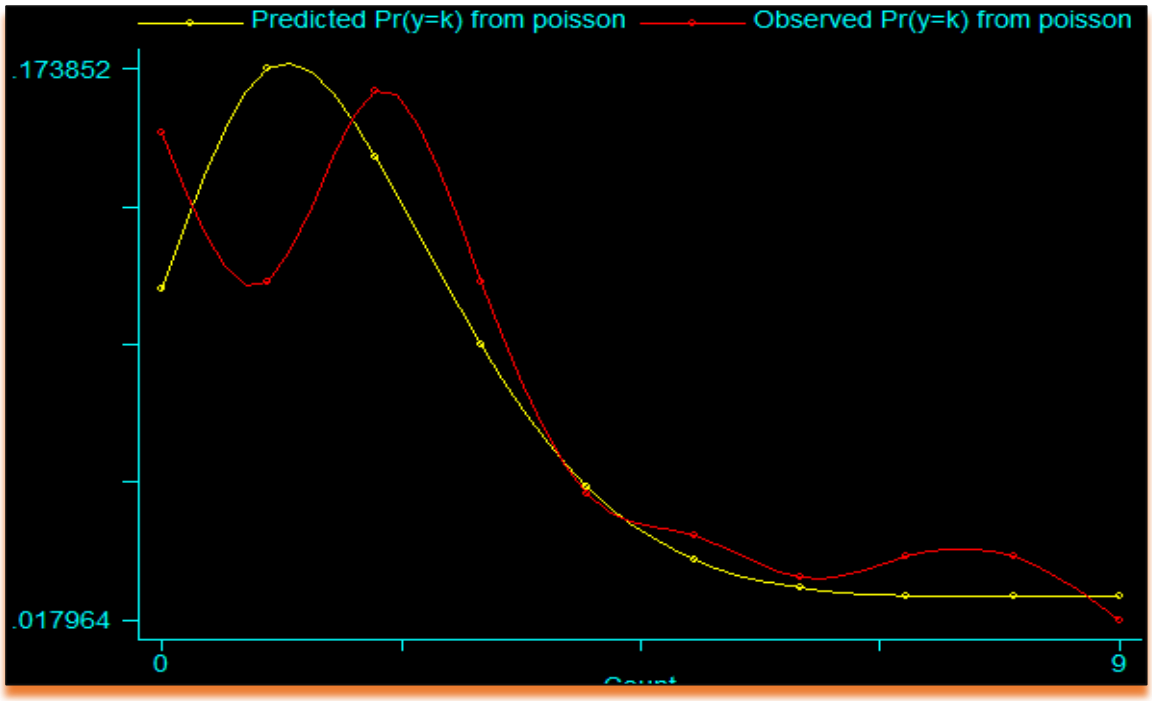

Figure - Form 3. Poisson Distribution Estimation of the Total Number of Gold Models versus Actual Data

The graph of the prediction distribution obtained from the findings of the model shows in Form 3 and with a comparison with the actual observation distribution chart shows that the model correctly adapts the actual data.

DISCUSSION

In this study, the relationship between economic indicators and Olympic medals in the period of 1992-2016 was investigated. The dependent variable in the research is the number of medals won by each country in the Olympics. The

data which is used, was in form of discrete data. Accordingly, Modified Poisson Regression form was suitable for the purpose of the study.

The results of model show a positive relationship between number of medals with population, per capita production, hosting and the experience of participating in the previous games. Using the prediction of the sample of this model, it can be seen that many countries have relatively large distances with their rating, which could be due to the inappropriate allocation of resources in athletes' activities. Many countries expect the Olympics to derive more from the use of resources, which have been allocated. The variable of accumulation of experiences, which is based on the number of times that a country is situated at the first 20 Olympic ranking (this variable has not been introduced in any of the studies presented in the field study provided in this area), reflects the relatively importance of this variable for the success of countries for medal gain. In other words, the experience from previous periods can enhance the possibility of improvement for the next time games. Results, indicates positive significant effects between the dependent and the explanatory variables for having more medals in Olympics. Therefore, it is suggested that to achieve a better rank in Olympic Games must take into account the importance of economic variables which have been done in this study.

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Wearable Technologies in Athletic Performance

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Abstract

Nowadays, not only training methods but also wearable player tracking systems provided by the developing technology to the experts play an important role in the development of sportive performance. Tracking of external load as work done in high-level athletes and by monitoring the internal load, these systems that train at the desired exercise intensity usage has increased. In addition, wearable technology products, which control the acute and chronic training load and related with increased injury risk, have started to serve as an important feedback mechanism in recovery from injury. It has been used in motion analysis to determine the activity pattern recently and to collect data within the competition. Wearable technology products use different ways such as "Global Positioning System, Local Positioning System, Micro Electromechanical System, Inertial Measurement System" and it should be taken into account that different sensors collect data at different frequencies and process this data with variable algorithms. With the widespread introduction of different commercial products in the last 10 years, using wearable technology can be said to be indispensable helpers for trainers working to improve performance in sports.

Keywords: Player load, Global Positioning System, Inertial Measurement System

Sporda Giyilebilir Teknoloji Kullanımı

Özet

Günümüzde sportif performansın geliştirilmesinde sadece antrenman yöntemleri değil gelişen teknolojinin uzmanlara sağladığı giyilebilir oyuncu takip sistemleri de önemli rol oynamaktadır. Üst seviye sporcularda yapılan iş olarak dış yükün takibi ve iç yük görüntüleyerek istendik egzersiz şiddetinde antrenman veren bu sistemlerin kullanımı artmıştır. Ayrıca, akut ve kronik antrenman yükü ile sakatlık risk artışını da kontrol eden giyilebilir teknoloji ürünleri, sakatlıktan geri dönüşte de önemli bir geribildirim mekanizması olarak görev yapmaya başlamıştır. Son dönemde aktivite paterni belirlemekte ve müsabaka içi veri toplanması için hareket analizinde de kullanıldığı not edilmektedir. Giyilebilir teknoloji ürünleri Küresel Konumlama Sistemi, Lokal Konumlama sistemi, Mikro Elektromekanik Sistem, Atalet Ölçüm Sistemi gibi farklı yolları kullanmakta ve farklı sensorların farklı frekanslarda bilgi toplayarak değişken algoritmalarla veri işlediği göz önünde bulundurulmalıdır. Son 10 yılda farklı ticari ürünlerin yaygın olarak piyasaya sunulması ile kullanımı artan giyilebilir teknoloji sporda performans geliştirmek üzere çalışan antrenörlerin vazgeçilmez yardımcıları olduğu söylenebilir.

Anahtar kelimeler: Oyuncu yükü, Küresel Konumlama Sistemi, Atalet Ölçüm Sistemi

INTRODUCTION

The use of glasses for the first time in the 1200s created the first example that existing technologies can also be used as a wearable. The use of television as glasses in 1963 enabled it to be integrated with technology even though the technology was still in its infancy. In addition, it enabled the emergence of the concept of cybernetics, but until today it has been generally expressed at the level of science fiction. The use of wearable technologies in professional sports has been a popular trend recently. It reflects its impact on sports not only on athletes and technical teams but also on other supporters such as fans and media. The Nike IPOD link in 2006 and the Fitbit product introduced to the end user in 2009 have revolutionized and become

one of the most widely used systems in the world for physical activity tracking. Although there is no branded and widely used wearable sports-related product in our country, there are initiatives working on wearable technology in the health field. With the rapidly developing Wearable Technology applications after 2010, it has become easier for sports professionals to monitor the physiological load in athletes in real-time, to track and understand the development of fatigue. It is also of great importance for determining position-specific motion patterns and optimizing performance. Many professional league organizations have allowed use in their routine matches and training (10, 19). The wearable tech market is growing at an incredible rate, with a market value of $34 billion by 2020, with an estimated 400 million wearable smart products sold (21). The aim of this study is to review the sports usage areas of wearable technologies, the advantages they provide and to expected development in the future.

Monitoring Performance and Player Load

An intimate dose-response relationship should be observed between training programs and match requirements for optimal sporting performance. It is possible to understand these high-intensity load and physiological responses and hence the sport-specific requirements the concept of player load or training load. In professional sports, it is widely used today to measure athlete activities in training and matches (2, 24). In this way, coaches, sports physicians and performance experts determine the player and training load of the sports discipline and designs its training programs at a load-rest ratio suitable for match requirements.

We examine training or match load for athletes in two parts; External Load (EL) and Internal Load (IL). EL can be defined as the work done by the athlete; such as the distance a football player in a midfield position perform in the match and / or the distance covered at high intensity. EL is important in understanding the work done or the capacity of the work that the athlete can perform. IL is the physiological stress caused by the load on the athlete during training or matches, oxygen consumption and cardiac output responses of the cardiorespiratory system that are most exposed to this stress primarily (16, 26). Likewise, physical requirements such as total running distance, speed of running distance, movement patterns in the relevant sports are EL and physiological requirements such as heart rate, lactate concentration, oxygen consumption and the scale of perceived exertion by the body are accepted as IL (Table 1).

Table 1. The players' external and Internal loads according to physiological and biomechanical concept

	External Load	Internal Load
Physiological	Distances covered	VO_2 consumption
	Running speed	Heart rate & Lactate level
		Rate of perceived Exertion
Biomechanical	Ground Reaction Forces	Joint load
	Accelerations & Decelerations	Muscle tendon forces
	Sum of Accelerations	Soreness
		Perceived effort

The most widely used technology in IL monitoring is heart rate monitors and metabolic analyzers. Also, portable for analyzing body fluids and easy-to-use blood, sweat, saliva and urine sample analyzers are useful to make inferences about the workload of the player during training and matches. Electromyography (Electromyography, EMG), Galvanic Skin Response (GSR) and Near Infrared Spectroscopy (NIRS) can be counted for internal load, muscle metabolism and neuromuscular parameter imaging technology (4). Thus, the concept of Biometric Data (BD) stands out, expressing the characteristic data created by the physical, physiological and behavioral characteristics of the individual. BD in the sports industry, heart rate from athletes, Global Positioning Systems (GPS) data (such as running distance or the athlete's running speed), accelerometer data (calculating the athlete's energy expenditure or measuring body and limb acceleration), blood oxygenation, sleep analysis and body temperature comprises valuable biological information. This important BD collection method is made possible by wearable technology (Figure 1).

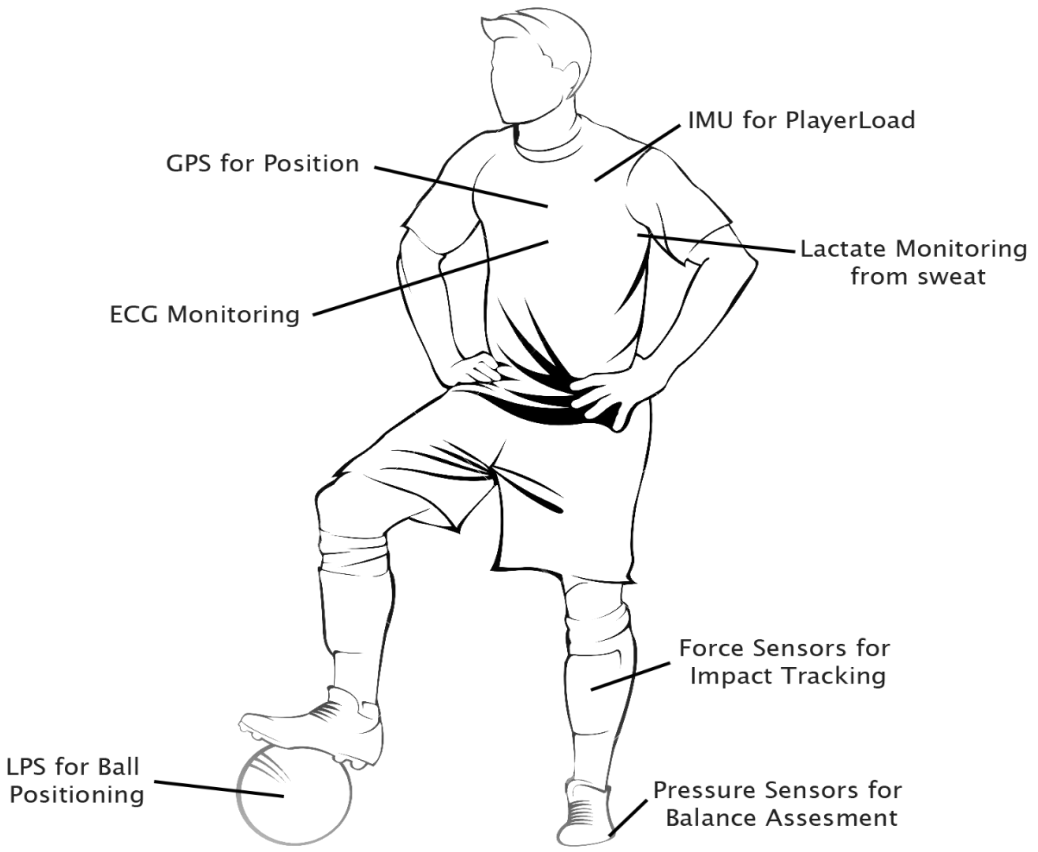

Figure 1. Demonstration of some instruments used as wearable technology in athletic performance.

Especially in team sports, because of the principle of individualization, it has become very important to monitor each player separately in order to determine a personal training load. Athlete tracking systems simultaneously describe the position, speed and acceleration of many athletes during the movement specific to the sport (5, 23). Among these systems, the ones based on using GPS were widely used in open field sports such as rugby and football (7, 20). Through to the technological developments, GPS started to be used to determine the external load in sports. GPS is a navigation system that uses 27 satellites orbiting the earth (22). However, it could not be applied for a long time due to the lack of GPS signal in indoor sports. Alternatively, the Local Positioning System (LPS) was developed. However, it has limitations such as high costs and requiring for fixed installation (17, 25). Currently, the image processing by camera method is widely used as a valid and reliable method, despite the limitations such as the need for manual intervention, image quality and camera position (1, 11). The validity and reliability of GPS or accelerometer-based wearable technologies used in EL determination are important for the sensitivity of training programs.

The most important advance in this process are the development of factors such as physical size and battery duration, which are the basic limitations of this wearable technology. In addition, advances in biosensor technologies have facilitated the application of wearable technology in the field. From basic microprocessors that only count steps, we have reached the level of electrochemical analysis units.

Inertial sensors are used extensively in wearable technology products. Wearable products can be used to evaluate movement-related or complex movements. These sensors are in Micro Electro Mechanical Systems (MEMS) structure and contain gyroscope, accelerometer and magnetometer. The data from the Inertial Measurement Unit (IMU), which is one of the wearable technology products, shows the change of the body center of gravity in 3

axes and the load of the player is calculated using the following equation (18).

$$\text{Player load} = \sqrt{\frac{\left(a_{y1} - a_{y-1}\right)^2 + \left(a_{x1} - a_{x-1}\right)^2 + \left(a_{z1} - a_{z-1}\right)^2}{100}}$$

In the formula, "ay" represents forward (anterior–posterior), "ax" represents lateral (medial–lateral) and "az" represents vertical acceleration. While the early sensors were 55mm x 34mm x 12mm and 22g, both memory increase and wireless connectivity were developed in the second generation production (13). In the future, the memory capacity of wearable devices needs to increase and by integrating 4.1 sensor elements in 2020, this problem was solved and an almost 3-fold increase was achieved (8). The data provided by the software of wearable technologies sold as commercial products are processed and prepared for the end user. For this reason, the problems encountered such as not providing raw data to work at research level and not specifying the algorithms used by some companies in calculations stand out.

Usage in Player Load and Injury risk Relationship

Thanks to this novel approach "Wearable Technology", it is aimed to reduce the probability of injuries such as tendon damage, fatigue and concussion in athletes. It is known that athletes' potential injury risk can be reduced with player load optimization (12). Recently, Gabbett (2016) emphasized in the Training-Injury Prevention paradox that athletes who have adapted to these high loads, who are exposed to high training volume, have less risk of injury than athletes working with low volume (14). Developments in wearable technology offer the opportunity to reduce the risk of injuries related to sports, as it allows monitoring, tracking and modification of athlete training and match load. Determination of neuromuscular fatigue facilitates the load management of athletes and allows player rotation and changes during the match and reduces the risk of injury (3). Recent studies focus on fatigue-sensitive measurements rather than traditional locomotor activities with accelerometer or GPS-based sensors. Accordingly, during the match, the reduction in the contribution of the total accelerometer load on the vertical axis to the player load (6), the ground contact time and the vertical stiffness (15) parameters are gaining importance with wearable devices.

It is known that there is a relationship between running injuries and running mechanics and economy. Increased hip abduction and vertical impact load in running mechanics are mostly factors that lead to injury (9, 27). Using wearable devices that make real-time identification in running pattern correction training can transfer hip and knee kinematics data in the field instead of simple parameters such as running step footwork pattern, frequency of steps and tibial shock. Thus, tendon and joint loads are not assessed by subjective feedback from athletes. Increasing the data storage capacity of future products will facilitate the evaluation of records taken from long-term runs such as marathons, as well as IMU and algorithms will help the decision to return to sports by allowing the lower extremity bone, ligament and joint loads to be viewed and adjusted according to injury.

Commercial Products

One of the wearable technology applications is its use in determining the activity pattern. It has become widespread to use accelerometer when GPS signals cannot be used indoors to define sport specific movements or when movement occurs in three axes. The Adidas miCoach Elite System is used in the American Professional Football League (Major League Soccer, MLS). In addition, German National Football Team benefited from this system in 2014 FIFA World Cup, where it became the champion. The system contributes to the decisions of the coach by sending an instant feedback of individual performance from the speed, acceleration, distance, power and heart rate data to the coach and protects the athlete about potential injuries.

Developed in cooperation with American entrepreneurs in the professional racing world and the automotive giant Renaults' sports technology department, the application provides instant display of car speed, distance and heart rate information with a shirt worn by professional racers. Other basic parameters such as lap times, acceleration forces are also used to increase athlete performance. Another commercial product, the Kinexon, uses Radio Frequency Identification (RFID) to precisely locate players' positions and movements (acceleration and leap). It was officially used by players and referees in the 2017-18 final game of Next Generations Tournament in the European League in basketball. Further, Catapult is an Australian company and is

probably the first company to apply wearable technologies to sports. Approximately half of the teams of the American National Football League (National Football League, NFL) and approximately 1/3 of the teams of the National Basketball Association (NBA) use this system. Through to a sensor integrated into the commercial boxing glove called the Hykso, it provides feedback to the coach on the number, type and speed of punches thrown. The VERT Wearable Jump Monitor is another commercial wearable technology product actively used by US national teams in the volleyball, where vertical jumping is a very important performance component. In team sports, which play with a ball, the ball is tracked with sensors integrated into it, the number of shots and passes, and their speed can be measured, and the trajectory, angle and spin tracking provide technical corrections and suggestions.

CONCLUSION

In this study, the basic working principles of wearable technology products, which are more commonly used to improve sports performance, and the parameters followed in athletes are reviewed. In addition, attention was drawn to the areas that stand out from commercial products in the market and are used most. While the data processing of the sensors, whose use is prominent in displaying player load, determining activity patterns and preventing disability, continues at the research level with different algorithms, it is seen that commercial products give feedback through applications that are easier to reach the end user. Since the development in the sensor technology used in these products can enable us to obtain more detailed information, the data of current studies should be closely followed in their use in sports. Despite the widespread use of these technologies, one of the disadvantages is that there is no definite opinion about the processing of the data here and the metrics used during calculation and analysis. A new metric and high performance claim suggested in each new article suggests that there is still a long way to go.

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Analysis on Sportsmanship as a Universal Value and Sportsmanship Orientations of Candidate National Athletes

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Abstract

This study aimed to analyze the sportsmanship orientations of candidate national athletes in the context of sportsmanship as a universal value, and included a total of 95 athletes, with the age range of 18.11 ± 3.58, 54 of whom were female, while 41 were male, who were all selected to the athletic development camp of the national hockey team. Data were collected through the demographic form containing personal information and the 'Multidimensional Sportsmanship Orientation Scale' (MSOS) developed by Vallerand et al. (1997), and adapted into Turkish by Sezen-Balçıkanlı (2010). The results indicated that there was statistical significance in the sportsmanship orientation of candidate national hockey athletes as to gender, education level, and age range that sportsmanship values of female athletes were more prominent, and that athletes with a lower level of education, and less athletic experience as well as those who were at a younger age appeared to contribute to the sportsmanship values more positively in relation to complying with social norms, respecting rules and management, and adhering to responsibilities in sports, whereas those who were older and more experienced besides having higher education levels turned out to be more attentive in terms of respect for one's opponents. Considering the mean values obtained from the research scale form, it can be assumed that the sportsmanship orientation of the candidate national athletes is at a remarkably good level. It is a fact that the positive behavior of national athletes will add a positive value to all humanity.

Keywords: Hockey, Candidate National Athlete, Sportsmanship.

Evrensel Bir Değer Olarak Sportmenlik ve Aday Milli Sporcuların Sportmenlik Yönelimlerinin İncelenmesi

Özet

Evrensel bir değer olarak sportmenlik çerçevesinde aday milli sporcuların sportmenlik yönelimlerinin incelendiği bu araştırmaya hokey milli takım atletik gelişim kampına seçilen ve yaş ortalamaları 18.11 ± 3.58, 54 kadın, 41 erkek olmak üzere toplamda 95 sporcu katılmıştır. Verilerin toplanmasında kişisel bilgilerin yer aldığı demografik form ile Vallerand ve arkadaşları (1997) tarafından geliştirilen ve Türkçeye uyarlaması Sezen-BALÇIKANLI (2010) tarafından yapılan Çok Boyutlu Sportmenlik Yönelimi Ölçeği (MSOS) kullanılmıştır. Sonuç olarak; aday milli hokey sporcularının sportmenlik yönelimlerinde cinsiyet, eğitim seviyesi ve yaş gruplarına göre anlamlı farklılıklar bulunduğu; kadın sporcuların sportmenlik değerlerinin daha ön planda olduğu, sosyal normlara uyum, kurallara ve yönetime saygı, sporda sorumluluklara bağlılık hususunda; eğitim seviyesi daha düşük, yaşları daha küçük, sporculuk tecrübesi daha az sporcuların sportmenlik değerlerine daha olumlu katkıda bulundukları; rakibe saygı hususunda ise eğitimi seviyesi daha yüksek, yaşı daha büyük, sporculuk tecrübesi daha çok olan sporcuların ön planda oldukları tespit edilmiştir. Araştırma ölçeği formundan elde edilen ortalama değerler göz önünde bulundurulduğunda, aday milli sporcuların sportmenlik yönelimlerinin iyi düzeyde olduğu söylenebilir. Milli sporcuların sergilemiş oldukları pozitif davranışların, tüm insanlığa artı bir değer katacağı da bir gerçektir.

Anahtar Kelimeler: Hokey, Aday Milli Sporcu, Sportmenlik.

INTRODUCTION

Although sports is a great struggle to reach higher, be faster, stronger, it is also a game, race and entertainment performed under universal principles and rules (1). Sport is also one of the very important values that shapes society or societies.

The concept of value is defined in Turkish language as "the abstract measure that helps to determine the importance of something, the value of something, the whole of material and spiritual elements that include the social, cultural, economic and scientific values of a nation" (2). Socially, values are generalized principles of behavior that are considered by society to be the best, most accurate and most beneficial. It is seen that the basic institutions that constitute the social structure all contain their own values. These institutions (family, education, religion, politics, economy, sports, etc.) play an important role in the adoption, survival and dissemination of values (3).

The value of human existence is within universal criteria (4). Sports generates a new culture with values that are universal and recognized by everyone, and offers an application area to learned values (5). Education, sports, values and sportive values are among the products of a culture. The person who puts his ability of moving into action by combining his mental and affective characteristics with the sports education and values he has acquired from his culture, becomes a "person doing sports" after a while. So, he/she eventually became equipped with sports culture. Therefore, he/she cares about all kinds of sporting values and shows behavioral patterns accordingly (6).

Sportsmanship behavior is a universal value (7). Sportsmanship is a consistent behavior within the framework of normative principles, related to social and moral values within sports activities (8). The concept of sportsmanship includes qualities such as being sincere, courageous, showing patience, being able to restrain yourself, self-confidence, not despising other people, being respectful of people's rights and thoughts, being dignified, being generous (9). Sportsmanship, at the same time; is a preference for an honorable gain over an honorable loss.

Intensifying sportsmanship behaviors in youth and sports environments can help to counter non-active lifestyles about sportsmanship tendency (10). Sportsmanship tendencies decrease immoral behaviors in sports (11). Important messages can be conveyed to the whole society, especially thanks to these behaviors performed by national athletes who are in front of the entire sports universe. Finally, the spirit of sportsmanship is one of the important building blocks of society (12). If the spirit of sportsmanship was not existing, sportive concepts would not be meaningful either; Therefore, we can say that sportsmanship is indispensable for sportive life (13).

Considering that sportsmanship tendencies of sportsmen who represent countries at the national team level are particularly important as a value, and that eventually a behavior in the sports universe concerns the whole country and constitutes a role model for future generations, it can be said that it is very important for athletes to be equipped with sportsmanship values. With this study, it is aimed to examine the sportsmanship tendencies of candidate national athletes and the results of the study are thought to be a guide for athletes, families, trainers, and sports managers. What should not be forgotten is that sportsmanship is structured in a way that strengthens both universal and national values and harmonizes with developing world values.

MATERIAL AND METHOD

Research Model

In this study, scanning model, which is one of the quantitative research models, was used. Research aiming to determine individuals' attitudes, beliefs, opinions, behaviors, expectations and characteristics with the help of surveys are called screening studies (14).

Study Population

The universe of the study consists of national athletes who participated in the hockey national team athletic development camp in 2019 in Osmaniye. While the sample group is composed of a total of 95 candidate national athletes, 54 women and 41 men, with an age average of 18.11 ± 3.58 who voluntarily accept to participate in the study.

Data Collection Tool

In data collection, demographic form was uses in the first section containing personal information and the 'Multidimensional Sportsmanship Orientation Scale' (MSOS) developed by Vallerand et al. (1997), and adapted into Turkish by Sezen-Balçıkanlı (15) was used. The scale consists of 4 sub-dimensions and 20 items: "compliance with social norms (5 statements)," respect for rules and

management (5 statements)", "commitment to responsibilities in sports (5 statements)", and" respect for rivals (5 statements) ". Cronbach's Alpha (α) values of the scale calculated in this study are: (Compliance with Social Norms: ,82), (Respect for Rules and Management ,77), (Commitment to Responsibilities in Sports: ,86), (Respect for the rival, 71), (sportsmanship tendency scale: 88).

Analysis of Data

In order to evaluate the internal consistency of the scales used in the study, reliability analysis was performed using Cronbach's Alpha (α) method. First of all, missing values are examined and then outliers are examined. Data were collected from 100 candidate national athletes in total. After the problematic forms were excluded, statistical works were carried out on the final 95 forms in the data set. Two elements of normality are kurtosis and skewness (16). In this study, it was decided to apply parametric tests by looking at kurtosis and skewness values. Besides descriptive statistics, Independent-Samples T test was used for paired comparisons and One-Way Anova test for multiple comparisons. Significance level was determined as 0.05.

FINDINS

Table 1. Sportsmanship orientation t test by the gender variable of athletes

Gender	n	%	Compliance with social norms		Respect for rules and management		Commitment to responsibilities in sports		Respect for the opponent	
			x̄	s.	x̄	s.	x̄	s.	x̄	s.
Female	54	56.8	4.50	,557	4.21	,672	4.70	,551	4.04	,795
Male	41	43.2	4.06	,859	3.62	,732	4.14	,776	3.87	,799
p			,004*		,000*		,000*		,306	

As can be seen in Table 1, depending on the gender variable of the candidate national athletes, in all sub-dimensions except for the "respect for the rival" sub-dimension of the sportsmanship scale, the average values of female athletes were found to be higher than that of male athletes and this change was found to be statistically significant ($p < 0.05$).

Table 2. Sportsmanship orientation Anova test by the sports experience variable of athletes

Sp. Experiece	n	%	Compliance with social norms		Respect for rules and management		Commitment to responsibilities in sports		Respect for the opponent	
			x̄	s.	x̄	s.	x̄	s.	x̄	s.
1 -3 Years	12	12.6	4.70	,395	4.15	,512	4.56	,790	3.73	,891
4 -6 Years	44	46.3	4.26	,808	4.09	,721	4.43	,729	3.99	,779
7 and more	39	41.1	4.25	,696	3.75	,818	4.46	,683	4.03	,795
p			,147		,083		,857		,524	

As can be seen in Table 2, there are no significant changes in the sportsmanship orientation of the candidate national athletes according to the athletic experience variable ($p > 0.05$).

Table 3. Sportsmanship orientationt test by the age groups of athletes

Age group	n	%	Compliance with social norms		Respect for rules and management		Com.to responsibilities in sports		Respect for the opponent	
			x̄	s.	x̄	s.	x̄	s.	x̄	s.
15-18	55	57.9	4.35	,770	4.15	,711	4.49	,714	3.90	,834
19-21	40	42.1	4.26	,681	3.70	,742	4.42	,715	4.07	,743
		p	,544		,004*		,617		,323	

As seen in Table 3, it was determined that the average values of 15-18 age group athletes in the "respect for rules and management" sub-dimension in the sportsmanship tendency of candidate national athletes according to age groups were significantly higher than the average values of athletes in the 19-21 age group ($p < 0.05$). There are no significant changes in the other three sub-dimensions ($p > 0.05$).

Table 4. Sportsmanship orientationt test by the education level variable of athletes

Education level	n	%	Compliance with social norms		Respect for rules and management		Com. to responsibilities in sports		Respect for the opponent	
			x̄	s.	x̄	s.	x̄	s.	x̄	s.
High school	62	65.3	4.36	,763	4.12	,716	4.48	,735	3.97	,822
University	33	34.7	4.22	,670	3.66	,744	4.42	,675	3.98	,761
		p	,388		,004*		,700		,993	

As can be seen in Table 4, it was determined that the average values of high school athletes in the sub-dimension of "respect for rules and management" in sportsmanship tendency in the educational level variable of candidate national athletes were significantly higher than the average values of the athletes in the university group ($p<0.05$). There are no significant changes in the other three sub-dimensions ($p > 0.05$).

Table 5. Descriptive statistical results of the research scale

Sportsmanship Scalen: 95	min.	max.	x̄	s.
Compliance with social norms	1.80	5.00	4.31	,732
Respect for rules and management	2.20	5.00	3.96	,754
Commitment to responsibilities in sports	2.20	5.00	4.46	,712
Respect for the opponent	2.00	5.00	3.97	,797
Overall average	2.05	5.00	4.17	,748

For this study, the general average value of the "sportsmanship scale" was calculated as (4.17 ±, 748). While the highest average value belongs to the "commitment to responsibilities in sports" sub-dimension (4.46 ±, 712); the lowest mean value (3.96 ±, 754) belongs to the "respect for rules and management" sub-dimension. The mean value of the "compliance with social norms" sub-dimension was found to be (4.31 ±, 732), and the average value of the "respect for rival" sub-dimension (3.97 ±, 797). Considering the mean values obtained from the research scale form, it can be assumed that the sportsmanship orientation of the candidate national athletes is at a remarkably good level.

DISCUSSION AND CONCLUSION

A total of 95 athletes, with an average age of 18.11 ± 3.58, 54 females and 41 males, participated in this study, which was carried out to examine the sportsmanship tendency of male and female candidate national athletes participating in the hockey national team athletic development camp.

In the study, depending on the gender variable of the candidate national athletes, in all sub-dimensions except for the "respect for the rival" sub-dimension of the sportsmanship scale, the average values of female athletes were found to be higher than that of male athletes and this change was found

to be statistically significant. It has been observed that the average values of respect for rules and management of women are higher than men (17). It has been determined that there are significant differences between male and female genders in the sub-dimensions of compliance with social norms, respect for rules and management, and respect for rivals, and women's sportsmanship averages are higher than men's averages (18). Compared to men, female athletes have found significantly higher values for compliance with social norms (9). While women's scores for compliance with social norms, respect for rules and management, and commitment to responsibilities in sports did not differ significantly, their scores were higher than men (19). There were statistical differences in favor of women in the total scores of sportsmanship behavior in physical education lesson and in the sub-dimension of avoiding inappropriate behavior according to the gender of hockey players (20). It has been understood that the sportsmanship of women is significantly better than men (21). Tsai and Fung (22) found that women's sportsmanship tendency is higher than men. According to the results of their research on college basketball players, Kavussanu and Roberts (23) commented that male athletes exhibit lower levels of immoral and unsportsmanlike behaviors compared to female athletes.

Another finding of the study is, there are no significant changes in the sportsmanship orientation of the candidate national athletes according to the athletic experience variable. There are different findings in the related literature. According to the athletic experience variable of amateur football players, a significant difference was found between the groups in the sub-dimension of respect for rules and management in sportsmanship tendency (24). According to the athletic experience variable of female basketball players, statistically significant differences were found in the sub-dimensions of respect for rules and management and respect for the opponent in their sportsmanship tendency (13). Yıldız (11) suggests that the hypothesis that sportive experience has an indirect effect on reducing immoral behavior in sports is confirmed. It was determined that the average scores of the amateur football players who played football for 7 years and above were significantly higher than the average scores of the football players in the other playing year categories (25). Kılıç (29) reports that the average values of national athletes in terms of compliance with social norms and commitment to responsibilities in sports are significantly higher than non-national athletes.

It was determined that the average values of 15-18 age group athletes in the "respect for rules and management" sub-dimension in the sportsmanship tendency of candidate national athletes according to age groups were significantly higher than the average values of athletes in the 19-21 age group. In all sub-dimensions except respect for the rival, the average values of younger athletes were found to be higher. In studies that coincide with our findings, Tsai and Fung (22) suggested that older athletes have lower sportsmanship tendencies than younger ones. Scores for breaking the rules were found to be higher in the adult category than the athletes in the junior category (28).

It was determined that the average values of high school athletes in the sub-dimension of "respect for rules and management" in sportsmanship tendency in the educational level variable of candidate national athletes were significantly higher than the average values of the athletes in the university group. It has been determined that there are significant differences in favor of athlete students at secondary education level in the sub-scale of respect for rules and management (8). According to the educational levels of female basketball players, statistically significant differences were found in the sub-dimensions of respect for rules and management, commitment to responsibilities in sports, and respect for rivals in sportsmanship tendency; female basketball players with a medium level of education make more positive contributions to the values of sportsmanship tendency than female basketball players with a higher education level. Has been identified (13). It was determined that the education level of hockey players did not affect the total scores of sportsmanship behavior in physical education lesson, displaying appropriate behaviors and avoiding inappropriate behaviors sub-dimensions (20). There are no significant differences between the groups according to the educational status variable of the sub-dimension and total scores of the sportsmanship tendency scale (25). According to the education variable, although the sportsmanship tendency of the high school and associate degree-bachelor graduate participants did not differ in other sub-dimensions and showed a significant difference in respect to the rival sub-dimension, the average values of high school graduates were higher

in all sub-dimensions (26). It was found that the factor of displaying positive behavior and total sportsmanship scores of male high school students were statistically significantly higher than male secondary school students, and that the scores of male high school students' feeling of responsibility and responsible behavior factors were significantly higher than male secondary school students (27). It is thought that education taken at school cannot be an explanatory concept alone in explaining sportsmanship tendencies. The family upbringing style of the athletes, their environment, etc. may also be effective.

The results indicated that there was statistical significance in the sportsmanship orientation of candidate national hockey athletes as to gender, education level, and age range, that sportsmanship values of female athletes were more prominent, and that athletes with a lower level of education, and less athletic experience as well as those who were at a younger age appeared to contribute to the sportsmanship values more positively in relation to complying with social norms, respecting rules and management, and adhering to responsibilities in sports, whereas those who were older and more experienced besides having higher education levels turned out to be more attentive in terms of respect for one's opponents. Considering the mean values obtained from the research scale form, it can be assumed that the sportsmanship orientation of the candidate national athletes is at a remarkably good level.

It is thought that creating societies equipped with sportsmanship values will be an added value for all humanity. It is a fact that research to be carried out with the participation of different population and sample groups will contribute to the relevant literature.

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The Effect Of Different Training Methods On The Biomotoric and Respiratory Parameters Of Adolescent Swimmers

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Abstract

Aim: In this study, the effect of water and thera-band training with flipper outside water on selected physiological and biomotoric properties of adolescent swimmers was investigated. Method: The volunteers who participated in the study on the basis of their personal identifying information were randomly divided into two groups as training and control groups. The 38 volunteers in the training group participated in the training program for eight weeks, 19 of them used hand flippers inside water three days a week, while 19 of them used thera-band outside water three days a week. The participants using hand flippers, swam along 25 meters long lanes in the swimming pool for 8x25m, 4x100m 4x200m, 4x100 and 4x25m. The participants using thera-bant outside water make 12 repetitions with yellow resistance bands for 3 sets. The volunteers in the control group (n=19) participated in swimming training only. Height, body weight, respiratory functions, strength and flexibility parameters were measured and the data were evaluated in SPSS 22.0 statistical package program. The t-test was used to determine the difference between before-training (BT) and after-training (AT) measurements. $p<0.05$ was considered as statistically significant. Results: In the experimental groups, the differences between the variables of flexibility, back strength, leg strength, hand grip strength, vital capacity, forced vital capacity and forced expiratory volume were statistically significant before and after the training ($p<0.01$).Conclusion: As a result, considering the findings obtained it was seen that regular swimming exercises were effective in the development of physiological and biomotoric characteristics of the children.

Key Words: Swimming, hand flipper, thera-band, training

INTRODUCTION

Swimming, which is one of the oldest sports activities of human beings, is a branch of sports which is widely done with great pleasure in many parts. Swimming is a branch of sports, contains the biomotoric characteristics such as strength, speed, endurance, mobility, agility, coordination, in which performance and technical skills are at the forefront [25]. In swimming, performance is highly dependent on muscular force, speed and explosive power [13,16]. The trainings that improve the biomotor properties and be done outside water are also important in order to improve swimming performance and get a better result against time [1].

Trainings other than swimming being done outside water are called “land exercises” or land training. These trainings are performed to improve the physical fitness level of athletes. The trainings inside water should be done after land trainings and should be done to support land trainings [20]. Land exercises can be done with body weight or by using different tools and equipments. One of these equipment is thera-band. Thera-band exercises not only increase strength, but also contribute to the development of other biomotoric properties [8]. Thera-bands provide the advantage of being able to feel the movement made at all angles by means of multi-directional movement. The all-age usability of

thera-bands is another reason to prefer to use them in training [17]. In swimming, different training programs are applied, the intensity of the training in water is high. In swimming in which the gravity is almost zero, all muscles should work in harmony. Since it is done against water resistance, it increases body resistance without wearing down [18].

In swimming, the position of the body is horizontal. Swimmers have to overcome the existing passive resistance of water to move on in the water. In order to overcome this resistance, they must form more effective resistance in the opposite direction to the direction in which they swim, especially with hands, arms and feet surfaces. The idea of greater contribution of hand and foot surface areas to increase this resistance made use of materials that could create additional resistance in swimming training widespread. In swimming sport, there are exercises using different materials (pedal, flippers, pull-buoy and resistance rubber) in the water in order for the swimmer to reach higher speed and to maintain this speed [26]. In the study conducted to determine the effects of the use of palette in swimming, it was found that the energy expenditure in the swimming using hand flippers was lower than that in normal swimming. This situation positively influences swimming performance [29].

In order to be successful in swimming, athletes should start to swim at a young age, the most effective element in the training of athletes is coaches with high technical knowledge. The most important strategy for the success of an athlete in swimming is the regular application of training programs [6].

Swimming is a sport doing against water resistance and therefore the muscles in the body work symmetrically. The most active parts of the body in swimmimg are the arms and legs. Therefore, it is a sport that plays an active role in the development of body composition and obtaining an appropriate posture [10]. It is effective in the formation of a suitable physical structure since it does not cause a local pressure on a particular area in the formation of body composition.

The age of 10, which is the subject of our study, is generally the beginning of the changes in movements, thinking and physical structure. This age, which is now considered as pre-puberty, may be different for some children. Adolescence, which is defined as the stage of maturation, is a physical and psychological transition period between childhood and adulthood. The significant changes in three fields such as fast physical growth, sexual development and psychosocial development are observed in adolescence, which is a transition period from childhood to adulthood [9]. In this study, the effects of different training methods applied with hand flipper and thera-band on swimming performance were investigated.

MATERIALS AND METHODS

The participants in the study were informed verbally and in written about the study and measurements to be performed. The ages of the children participating in the study were determined based on their personal identifying information. 57 children aged 10 years participated in the study voluntarily. These children were randomly divided into three groups as 2 training groups and a control group. Each group (swimming thera-band group (STG), swimming hand flipper group (SHFG), control group (CG)) consisted of 19 children. The children in the CG had a mean age of 10.60±0.69 years, a mean height of 1.51±0.03 cm and a mean body weight of 47.70±2.83 kg. The children in the SHFG had a mean age of 10.42±0.60 years, a mean height of 1.55±0.03 cm and a mean body weight of 45.85±3.31 kg. The children in the STG had a mean age of 10.60±0.80 years, a mean height of 1.54±0.02 cm and a mean body weight of 47.00±2.70 kg.The swimmers in the SHFG did training using hand flippers (figure 1) in addition to swiming exercises while the swimmers in the STG did land training using thera-bands (figure 2) in addition to swimming exercises. The children in the control group did not participate in any additional training except the swimming training program.

The delta hand flippers (fig. 1), which were made of hard plastic material, were used for the group trainings of swimming with hand flippers, while thin and yellow Busso brand thera-bands (figure 2), which were suitable for low intensity studies, were used in thera-band trainings.

Figure 1. Hand Flipper

Figure 2. Thera-band

The children in the SHFG and STG groups participated in the training program for eight weeks, three days a week. After the warm-up period with active and passive flexibility exercises, the land trainings group with yellow thera-bands (STG) were done by repeating 12 over 3 sets.

The swimming training group were done with hand flippers (SHFG) by using the appropriate flippers, in 25 meters long swimming pool for 8x25m, 4x100m 4x200m, 4x100, and 4x25m. The swimming exercises were applied between 14:50 and 43:06 seconds depending on the distance change. Full rest principle applied. Children in the control group participated in only freestyle swimming sessions. Trainings were held between 18:00 and 20:00.

The training were done in Ankara Swimming Facilities under the supervision of the researcher and a swimming coach. The measurements were made with the measurement tools provided from the laboratory of Gazi University Faculty of Sport Sciences.

The statistical analysis was performed by taking measurements from the groups before and after the training periods. The length measurements were recorded in cm by measuring the distance between the vertex of the head and the soles of the foot 1 mm with the Rodi Super Quality brand tape measure after a depth inspiration, while the participants were bare foot, their heads were in the upright position and in the frankfort plane. Children's body weight was measured with a Tanita BC 418 MA (Tokyo, Japan) brand scale with a precision of 100 grams (g). Body mass indexes (BMI) of the children were calculated using the formula of BMI = body weight (kg)/squre of height (m2) for body weight and height measurements taken from the swimmers participating in the study.

Lung volumes and capacities such as vital capacity (VC), forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) were measured by a Cosmed brand spirometer [23]. During the measurement of respiratory parameters, the children were standing, placing the spirometer mouthpiece into their mouths, attaching pegs to their noses in order to avoid air escaping, and the respiratory parameters were measured after a deep inspiration. This process was repeated three times and the best value was recorded [12].

A Takei brand digital dynamometer (camry) was used for power measurements. In the hand grip strength measurement, the measurements were taken by keeping the arm 10-15 degrees away without bending the arm and without touching it to the body. The measurements were taken from the dominant side. The best value in kg was recorded after two measurements. Many researchers have reported that the use of dynamometers is reliable in measuring leg strength [23]. The leg strength measurement was made by placing the feet of the participants on the dynamometer stand by bending their knees when their arms were stretched, their backs were straight and their bodies slightly bent forward. They grasped the dynamometer bar with their hands and vertically pulled it up by using their legs at the maximum rate.

The back strength measurement was performed by pulling the dynamometer bar up after being grasped it with their hands by using their backs at the maximum rate, when their arms were stretched and their backs were straight [4,23].

The sit-and-reach test was applied to all volunteers for flexibility measurement. A 35 cm long, 45 cm wide and 32 cm high sit and reach test table was used as a measurement tool. During the test, the participants took off their shoes and sat down on the floor, placed the soles of their feet on a flat position on the face of the sit-and-stand table, facing them. The participants were asked for pushing the measuring grid slowly forward, by reaching out forward as far as they could with bending her body without bending her knees. They also asked for waiting two seconds at the farthest distance without stretching forward or backward when their hands, arms and legs were straight. The test was repeated 3 times for each individual and the best result was recorded as the flexibility value [23].

SPSS 22.0 statistical package program was used to evaluate the data obtained from the measurements. Shapiro-Wilk test was used to determine whether the data showed a normal distribution or not. The measurement results were given as mean (X) and standard deviation (Sd). paired t-test was performed to compare pre-training and post-training measurements. $p<0.05$ was accepted as statistically significant.

RESULTS

Table 1. The distribution of the participants' BT and AT physical measurements

Variables		SHFG (n=19)					STG (n=19)				CG(n=19)				
		X	Ss	t	p	Cohen d	X	Ss	t	p	X	Ss	t	p	Cohen d
Age (year)	BT	10.42	0.60	-	-		10.60	0.84	-	-	10.60	0.69	-	-	
	AT	10.42	0.60				10.60	0.84			10.60	0.69			
Height (cm)	BT	1.55	0.03	-	-		1.54	0.02	-	-	1.51	0.03	-	-	
	AT	1.55	0.03				1.54	0.02			1.51	0.03			
Weight (kg)	BT	45.84	2.31	-9.436	0.00**	0.76	47.00	2.70	-6.530	0.000**	47.70	2.83	0.480	0.64	
	AT	47.73	2.62				50.40	1.83			47.50	3.37			
BMI (kg/m²)	BT	19.09	1.07	-9.375	0.00**	0.68	19.63	1.02	-6.409	0.000**	20.80	1.45	2.558	0.03*	0.31
	AT	19.88	1.22				21.06	0.87			20.33	1.57			

*P<0.05 **p<0.01

BT: before test; AT: after test, STG: swimming thera-band group: SHFG: swimming hand flipper group SHFG, CG: control group

When the table was examined, the difference between the body weight and BMI measurements of the volunteers in the SHFG and STG groups was found to be statistically significant ($p<0.01$). In the control group, only the difference between the BMI measurements was found to be statistically significant ($p<0.05$).

Table 2. The distribution of the measurements of the Biomotoric Characteristics of the Participants

Variables		SHFG (n=19)					STG (n=19)				CG(n=19)				
		X	Ss	t	p	Cohen d	X	Ss	t	p	X	Ss	t	p	Cohen d
Flexibility (cm)	BT	25.31	1.66	-9.962	0.00**	0.61	27.80	2.04	-13.038	0.000**	27.60	2.36	-3.873	0.004**	0.43
	AT	26.26	1.76				31.90	2.33			28.60	2.22			
Back Stenrgth (kg)	BT	35.13	2.50	-15.204	0.00**	0.27	35.51	2.05	-15.886	0.000**	33.39	3.41	-14.525	0.000**	0.24
	AT	35.80	2.43				36.90	2.18			34.34	3.39			
Leg Strength (kg)	BT	40.68	3.26	-9.939	0.00**	0.48	39.32	3.76	-10.485	0.000**	39.40	3.68	-2.333	0.045*	0.20
	AT	42.26	3.28				41.60	3.53			40.10	3.28			
Hand Grip Strength (kg)	BT	15.74	1.98	-10.377	0.00**	0.32	14.96	1.26	-19.218	0.000**	15.11	1.50	-5.288	0.001**	0.61
	AT	16.47	2.04				16.87	1.37			15.96	1.25			

*P<0,05 **P<0.01

BT: before test; AT: after test, STG: swimming thera-band group: SHFG: swimming hand flipper group SHFG, CG: control group

When the table was examined, the differences between the values of flexibility, back stenrgth, leg strength and hand grip strength were found to be statistically significant ($p<0.05$).

Table 3. The distribution of the BT and AT Respiratory Parameters of the Participants

Variables		SHFG (n=19)					STG (n=19)				CG(n=19)			
		X	Ss	t	p	Cohen d	X	Ss	t	p	X	Ss	t	p
Vital Capacity (VC) (ml)	BT	3.34	0.01	-2.64	0.016*	0.89	3.34	0.02	-2.811	0.020	3.24	0.34	1.000	0.343
	AT	3.41	0.11				3.40	0.05			3.21	0.33		
Forced Vital Capacity (FVC) (ml)	BT	2.66	0.06	-5.64	0.000**	0.30	2.67	0.05	5.237	0.001**	3.04	0.47	0.497	0.631
	AT	2.68	0.07				2.66	0.04			2.95	0.67		
Forced Expiratory Volume (FEV_1) (ml)	BT	2.44	0.02	-12.69	0.000**	1.17	2.46	0.02	-0.999	0.344	2.46	0.06	-1.957	0.082
	AT	2.47	0.02				2.70	0.65			2.53	0.11		

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

BT: before test; AT: after test, STG: swimming thera-band group: SHFG: swimming hand flipper group SHFG, CG: control group

When the table was examined, the differences between the first measurement values and second measurement values of vital capacity, forced vital capacity and forced expiratory volume were statistically significant ($p<0.05$) in the volunteers in the SHFG. For the STG, the differences between the measurements of vital capacity and forced vital capacity, forced expiratory volüme were not statistically significant ($p>0.05$) For the CG, the difference between the first and second measurements of forced expiratory volume was not statistically significant ($p> 0.05$).

DISCUSSION

In the study, the differences between the forced expiratory volumes, body weights, vital capacities, forced vital capacities and forced expiratory volumes were not significant in the STG ($p>0.05$). The differences between the other variables were found to be significant in all three groups ($p<0.05$).

In the study of Atar, the mean age, height and boody weight of the participants in the swimming exercise group were 10.53 ± 0.83 years, 136.60 ± 6.93 cm, and 34.68 ± 9.57 kg, respectively. In the group consisting of the individuals that did not swim, the mean age, height and body weight were 10.86 ± 0.83 years, 139.60 ± 6.11 cm, and 38.33 ± 5.81 kg, respectively. The difference between numerical values was not found to be statistically significant [2].

We examined the studies conducting with children in the literature. Yazarer et al. found that the mean height of the participants was 142.4 cm in 11-year-old children [27]. When the results in the literature were compared with our findings, it was seen that the mean height is higher. The main reason for this was thought to be due to the differences between the age and nutritional habits of the children participating in the other studies and the children participating in our study.

Selçuk determined that the pre-test and post-test BMI were 16.08 kg/m2, 15.83 kg/m2 in the STG, respectively. The pre-test and post-test BMI were found as 17.75 kg/m2 and 18.29 kg/m2 in the SG, respectively. The differences beween the pre-test and-posttest BMI values of the groups in the study were not significant [20]. Saygın et al. calculated the BMI value as 18.12 ± 3.08 kg/m2 in the age group of 11-16 years [19].

When the results of this study were compared with our findings, it was seen that our BMI values are high. The main reason for this is thought to be due to the fact that the nutritional habits and physical activity levels of the children participating in the other studies and the children participating in our study were different.

In our study, the differences between the measurements of flexibility, back strength, leg strength and hand grip strength were found to be statistically significant ($p <0.05$). In the swimming hand flipper group, differences in elasticity, back strength, leg strength, and hand grip strength were found to be statistically significant.

In a study on strength development, girls and boys aged 7-12 years done 10-15 repetitions and one set of strength training. It was stated that 1-2 times a week strength training increased the strength of the children. In this study, it was emphasized the idea that muscle strength can be improved at a young age [5]. Ziyagil et al compared the hand grip strengths of the children aged 11 years who swam and who did not, they found that children who did sports had higher hand grip strength than those who did not [30]. Selçuk stated that the swimming+thera-band (STG) and swimming group (SG), groups had a significantly higher grip strength

after training while there was no improvement in the control group [20]. Although these lithareture findings are in line with our findings, they support the hypothesis that participating in swimming training increase the grip strength of children significantly. The use of hand flippers and the positive resistance of water are thought to have a positive effect on the hand grip strength.

Muratlı stated that depending on the development profile between the ages of 7 and 18, strength improvement was limited at the end of school age and club activities caused significant strength differences between children in this period [14]. In the literature, it was stated that muscle strength in children may improve during childhood in accordance with the principle of appropriate loading. The studies also reported that moderate strength trainings with high repeat numbers were more efficient in the adaptation process [3]. In many studies, it was emphasized that exercise participation increased hand grip strength in children [7,21,27].

In different studies in the literature, they stated that there were significant improvements in muscle strength of children with different exercise models applied to children in parallel with our study findings. In the age group of 10-14 years, Sevinç found leg strength as 84.85±40.06 kg and 105.65±42.73 kg in in the pre-test and post-test, respectively [21]. Şahin found leg strength in the experimental group consisting of 12-14 years old children as 74.93 ± 23.34 kg in the pre-test, 83.17 ± 23.20 kg in the post-test [22]. These results are not parallel with the findings of our study. These results are higher than our findings. This difference is thought to be the result of the applied training methods, the materials used and the characteristics of the study group.

Ozmun et al. conducted a study with 10-14 years old boys and girls and applied a training program that improved maximal strength for 3 days a week, 7 repetitions, and 3 sets for 8 weeks. As a result of their study, they observed a significant increase in the muscle strength of children [15].

Yolcu conducted a study for improving strength in children with resistance machines and rubber bands, and stated that the strength of the group training with resistance machines was higher than that of children training with rubber bands. However, Yolcu also expressed that there was a numerical increase in stregth of the children using rubber bands [28].

In our study, the improvement of elasticity was recorded in the swimming group, the groups training with thera-bands and hand flippers. However, some studies in the literature reported that there is no linear relationship between swimming and the development of elasticity. Selçuk compared the values of elasticity and shoulder elasticity of the STG for pre-test and post-test, and determined that there was a significant increase in both the STG and SG while there was no improvement in the control group [20].

It was found that swimming exercises applied to children positively contributed to their elasticity, hand grip strength, leg strength and back strength values and the exercises were effective on the basic motoric characteristics of children. From this point of view, it reveals the necessity of more systematic and regular application of swimming for the physical, physiological and performance development of children.

The difference between the measurements of vital capacity, forced vital capacity, and forced expiratory volume in the SHFG volunteers were statistically significant (p0.05) in our study. The differences between vital capacity and forced vital capacity, forced expiratory volume for the STG were not statistically significant (p>0.05). The difference in forced expiratory volume between the first and second measurements in the CG was not statistically significant (p> 0.05).

The differences between the vital capacity and forced vital capacity measurements of volunteers in swimming thera-band group were statistically significant (p<0.05). The difference between the forced expiratory volume measurements was not statistically significant (p>0.05).

Tunay et al. found that pulmonary function test results as FVC: 1.65±0.32 lt., FEV1: 1.62±0.31 lt. in the sedentary children while FVC: 2.48±0.49 lt., FEV1: 2.37 ± 0.41 lt. in the basketball playing children [24]. When our findings are compared with those of Tunay, it seems that our findings are higher than other results. This is probably because of the positive effects of swimming exercises and trainings on respiratory parameters. It has been thought that swimming has a positive effect on respiratory parameters due to the pressure of water which

makes breathing more difficult. The literature knowledge supports this result [11].

As a result, considering the findings obtained it was seen that regular swimming exercises were effective in the development of physiological and biomotoric characteristics of the children. Swimming is a sports branch in which all muscles are used. As it is a sport doing against water resistance, it also contributes to the balanced development of all body muscles and thus to the development of strength. It is considered that all muscles work in harmony and water resistance is thought to affect the increase in body resistance considering the low gravity during swimming. In line with these studies, it should be ensured that children should be participated in regular swimming trainings for the development of physical and basic motoric functions. It is recommended that such studies should be carried out with multiple repetitions and with multiple subjects and measure different parameters, and the results of these studies should be shared with the practitioner coaches in order to create norms and to make contributions to sports science.

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Analysis of Tennis Competitions on Different Court Surfaces*

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Abstract

The purpose of this study is to analyze the match statistics of men and women tennis players in the singles category in the 2019 Grand Slam tennis tournaments (Australian Open, French Open, Wimbledon, US Open) according to different court surfaces. Winning matches in 1004 competitions made up of 250 men's singles and 252 women's singles played on hard court (US Open and Australian Open); 127 men's singles and 122 women's singles played on the clay court (French Open); and 127 men's singles and 126 women's singles played on grass court (Wimbledon) were analyzed. SPSS 22.0 statistical package program was used to evaluate the data and find the calculated values. As the data showed normal distribution, One-Way Analysis of Variance (ANOVA) was used for comparisons of more than two sets. Tukey HSD multiple comparison test was used to determine the source of significant differences as a result of ANOVA. The level of significance in the study was taken as 0.05. It was determined that ace in women athletes, winning % on 1st serve, unforced error and the fastest service variables differ significantly based on the court grounds ($p < 0.05$). In male athletes, it was determined that ace, double fault, winning % on 1st serve, break points won, unforced errors, fastest service and match duration variables differ significantly according to court surfaces ($p < 0.05$). As a result, the findings show that the game elements that affect the outcome of the match are affected by the court surface and players tend to change their game patterns, in other words, the tactical structure of the important game elements that will make the match win and to adapt themselves to the playing court surface.

Key words: Grand Slam, Match analysis, Tennis, Court Surface

Farklı Kort Yüzeylerinde Tenis Müsabakalarının Analizi

Özet

Bu çalışmanın amacı 2019 Grand Slam tenis turnuvalarında (Avustralya açık, Fransa açık, Wimbledon, Amerika açık) tekler kategorisinde oynayan erkek ve kadın tenisçilerin farklı kort zeminlerine göre maç istatistiklerinin analizini yapmaktır. Müsabakalar süresince sert zeminde oynanan (Amerika Açık ve Avustralya Açık) 250 tek erkekler, 252 tek kadınlar, toprak zeminde oynanan (Fransa Açık) 127 tek erkekler, 122 tek kadınlar ve çim zeminde oynanan (Wimbledon) 127 tek erkekler, 126 tek kadınlar olmak üzere toplam 1004 müsabaka analiz edilmiştir. Verilerin değerlendirilmesinde ve hesaplanmış değerlerin bulunmasında SPSS 22.0 istatistik paket program kullanılmıştır. Veriler normal dağılım gösterdiğinden dolayı ikiden fazla küme karşılaştırmaları için Tek Yönlü Varyans Analizi (ANOVA) kullanılmıştır. ANOVA sonucu anlamlı farklılıkların kaynağını belirlemek üzere Tukey HSD çoklu karşılaştırma testi kullanılmıştır. Araştırmada anlamlılık düzeyi $p<0.05$ olarak alınmıştır. Kadın sporcularda doğrudan puan kazandıran servis, 1. servisten kazanılan puan (%), basit hata ve en hızlı servis değişkenlerinin kort zeminlerine göre anlamlı ölçüde farklılaştığı tespit edilmiştir ($p<0,05$). Erkek sporcularda ise doğrudan puan kazandıran servis, çift hata, 1. servisten kazanılan puan (%), servis kırma puanı, basit hata, en hızlı servis ve maç süresi değişkenlerinin kort zeminlerine göre anlamlı ölçüde farklılaştığı belirlenmiştir ($p<0,05$). Sonuç olarak, bulgular maçın sonucunu etkileyen oyun unsurlarının kort yüzeyinden etkilendiğini ve oyuncuların oyun kalıplarını, diğer bir deyişle maçı kazandıracak önemli oyun unsurlarının taktik yapısını değiştirme eğiliminde olduklarını ve kendilerini kort yüzeyine göre adapte ettiklerini göstermiştir.

Anahtar kelimeler: Grand Slam, Maç analizi, Kort yüzeyi, Tenis

INTRODUCTION

Tennis is a world class competitive sport attracting millions of players and fans world wide. Competitive tennis is played under the rules of the International Tennis Federation (ITF), and its competitions range from top professional events for example, the Grand Slams and the Olympic Tennis Event to the entry level ITF men's and women's circuits, including tournaments and team events for junior, seniors, and wheelchair players (8).

Tennis is a sports branch in which high performance is determined by qualities such as speed, reaction time, accuracy and efficiency in the movement of the athlete (14). In competitions, professional tennis athletes' performances and match tactics can be affected by various factors (9,21,25). The most common surfaces used for playing professional and recreational tennis are clay and hard courts. Court speed is determined primarily by the friction between the ball and the court surface and the bounce coefficient. The greater the friction, the slower the ball. The higher the bounce, the slower the ball. How well a player performs during professional tournaments is related to the surface on which the matches are played (20). When the total number of strokes between the tournaments is compared, the effect of the tennis court surface is evident. Total number of strokes per game was greater in the French Open than Wimbledon. This result is consistent with the clay court having a slower surface than grass (15). Training on clay courts results in trends for increased heart rate and lactate values, suggesting that sessions on clay courts tend towards higher physiological and perceptual loads than hard courts (26). When playing on clay court surfaces tennis players were required to cover more total and high-intensity running distances and engage in more high-intensity activities than on hard courts. In addition, the body load and the number of accelerations performed were possibly higher when played on a clay court. This shows that the intensity of physical demand required from tennis players is directly influenced by the playing surface (5).

The highest indicator of how effective players are in tennis in terms of competition is their ranking in the national, European or world ranking lists and the statistical data of each individual tennis match. Using the statistical data, it can be better define the successful performance of individual strokes in the match (serve, return), excellent and poor characteristics of an individual's game, the way of playing (aggressive, defensive) and some other factors that contribute to a successful tennis game. With the statistical analysis of game characteristics, it can be establish the reasons for winning or losing a game (10). The purpose of this study is to analyze the match statistics of male and female tennis players in the singles category of the 2019 Grand Slam tennis tournaments (Australian Open, French Open, Wimbledon, US Open) according to different court surfaces.

MATERIAL & METHOD

In this study, the official websites of the 2019 Grand Slam tennis tournaments in the single men and single women category were used as data collection tools (1,2,3,4). Within the scope of the research, a total of 1004 competitions were analyzed including 250 single men and 252 single women played on hard ground (US Open and Australian Open); 127 men's singles, 122 women's singles played on a ground floor (French Open) and 127 men's singles and 126 singles played on a grass floor (Wimbledon). In the competitions won, the variables of aces, double faults, winning % on 1st serve, winning % on 2 nd serve, break points won, unforced errors, winner, total points won, fastest serve and match duration were evaluated. The study was approved by the ethics committee of Selçuk University Faculty of Sports Sciences non-interventional clinical research.

Statistical Analysis

SPSS 22.0 statistical package program was used to evaluate the data and find the calculated values. Data are summarized by giving means and standard deviations. Whether the data showed a normal distribution was checked with the range of Kurtosis and Skewness Coefficients, and it was determined that the data were normally distributed, since the range did not exceed +1.5 and -1.5 (29). As the data showed normal distribution, One-Way Analysis of Variance (ANOVA) was used for comparisons of more than two sets. Tukey HSD multiple comparison test was used to determine the source of significant differences as a result of ANOVA. The level of significance in the study was accepted as $p<0.05$.

RESULTS

Table 1. ANOVA and Tukey test results for variables of women athletes participating in the study according to court surfaces

Variables	Court surfaces		n	X	Ss	Sd	F	P	Tukey
Aces	A	Hard	252	4,273	3,169	2	9,808	**0,000***	A>B
	B	Clay	122	2,762	2,805	497			
	C	Grass	126	3,595	3,306	499			
Double faults	A	Hard	252	2,853	2,535	2	0,290	0,749	
	B	Clay	122	2,754	2,117	497			
	C	Grass	126	2,658	2,298	499			
Winning % on 1st serve	A	Hard	252	72,555	8,294	2	12,007	**0,000***	B<A B<C
	B	Clay	122	67,819	9,379	497			
	C	Grass	126	70,611	9,188	499			
Winning % on 2 nd serve	A	Hard	252	52,333	11,397	2	1,835	0,161	
	B	Clay	122	50,409	12,136	497			
	C	Grass	126	53,023	10,167	499			
Break points won	A	Hard	252	52,067	17,559	2	1,209	0,299	
	B	Clay	122	55,147	17,392	497			
	C	Grass	126	53,182	19,305	499			
Unforced errors	A	Hard	252	24,785	11,295	2	4,860	**0,008***	A>C
	B	Clay	122	24,221	10,939	497			
	C	Grass	126	21,119	10,307	499			
Winner	A	Hard	252	25,734	9,615	2	0,867	0,421	
	B	Clay	122	25,426	9,573	497			
	C	Grass	126	24,325	10,643	499			
Total points won	A	Hard	252	77,353	17,593	2	0,233	0,792	
	B	Clay	122	78,688	20,989	497			
	C	Grass	126	77,349	18,910	499			
Fastest serve (km/h)	A	Hard	252	178,187	6,851	2	18,785	**0,000***	A>B A>C B<C
	B	Clay	122	173,682	5,723	497			
	C	Grass	126	176,246	7,268	499			
Match duration (min)	A	Hard	252	95,313	30,211	2	0,250	0,779	
	B	Clay	122	94,311	32,823	497			
	C	Grass	126	92,944	29,983	499			

***p<0,05**

It was determined that the variables ace, winning on % on 1st serve, unforced errors and fastest serve differ significantly in women athletes compared to court surfaces ($p<0.05$). A statistically significant difference was observed between the hard and clay court in the ace variable. Ace averages were significantly greater in hard court than clay court ($p<0.05$). A statistically significant difference was observed between the clay court and both the hard and grass court in winning on % on 1st serve ($p<0.05$). A statistically significant difference was observed between the hard and grass court in unforced errors variable. Unforced errors averages were significa tly greater in hard court than grass court ($p<0.05$). In the fastest service variable, a statistically significant difference was observed between all courts ($p<0.05$).

Table 2. ANOVA and Tukey test results for variables of men athletes participating in the study according to court surfaces

Variables	Court surfaces		n	X	Ss	Sd	F	P	Tukey
Aces	A	Hard	250	12,196	7,460	2	21,199	**0,000***	A>B C>B
	B	Clay	127	7,283	5,974	501			
	C	Grass	127	10,464	6,705	503			
Double faults	A	Hard	250	4,432	3,512	2	5,351	**0,005***	A>B
	B	Clay	127	3,370	2,905	501			
	C	Grass	127	3,724	2,605	503			
Winning % on 1st serve	A	Hard	250	77,880	6,666	2	13,252	**0,000***	B<A B<C
	B	Clay	127	74,661	7,033	501			
	C	Grass	127	78,653	6,540	503			
Winning % on 2 nd serve	A	Hard	250	55,652	9,142	2	2,850	0,059	
	B	Clay	127	56,480	9,016	501			
	C	Grass	127	57,984	8,556	503			
Break points won	A	Hard	250	45,880	17,414	2	3,717	**0,025***	B>C
	B	Clay	127	49,259	15,680	501			
	C	Grass	127	43,629	15,900	503			
Unforced errors	A	Hard	250	35,652	16,094	2	13,042	**0,000***	C<A C<B
	B	Clay	127	33,417	15,569	501			
	C	Grass	127	27,196	12,996	503			
Winner	A	Hard	250	42,712	15,066	2	1,660	0,191	
	B	Clay	127	39,850	14,546	501			
	C	Grass	127	41,834	12,899	503			
Total points won	A	Hard	250	125,376	31,474	2	1,139	0,321	
	B	Clay	127	120,724	32,083	501			
	C	Grass	127	122,078	26,297	503			
Fastest serve (km/h)	A	Hard	250	205,705	8,325	2	11,637	**0,000***	B<A B<C
	B	Clay	127	201,618	7,513	501			
	C	Grass	127	205,165	7,630	503			
Match duration (min)	A	Hard	250	159,956	49,169	2	3,858	**0,022***	A>C
	B	Clay	127	154,488	50,654	501			
	C	Grass	127	145,401	43,192	503			

***p<0,05**

It was determined that the variables of the aces, double faults, winning % on 1st serve, break points won, unforced errors, fastest serve, match duration differ significantly in male athletes compared to the court floors ($p<0.05$). Averages of ace were highest on the hard court and lowest on the clay court ($p<0.05$). Double faults differed significantly on the hard and clay court. It was determined that the players made the most double faults on the hard court ($p<0.05$). Winning% on 1st serve was least observed on clay court ($p<0.05$). The break points won differed significantly on the clay and grass court. Break points won were higher on the clay court than on the grass court ($p<0.05$). Unforced errors values were significantly lower on the grass court compared to both court surfaces ($p<0.05$). Fastest serve averages had the lowest values on the clay court ($p<0.05$). The match duration varied significantly on the hard and grass court. Match duration was highest on the hard court and lowest on the grass court ($p<0.05$).

DISCUSSION AND CONCLUSION

A number of important findings have been obtained as a result of this study, which aims to analyze the single men's and women's tennis competitions played on different court surfaces. First one; In women athletes, it was determined that aces, winning % on 1st serve, unforced errors and fastest service variables differed significantly from court surfaces. Secondly, it was determined that the variables of aces, double faults, winning % on 1st serve, break points won, unforced errors, fastest service and match duration differ significantly in men athletes compared to court surfaces.

Even on clay, the slowest court surface, serves and serve-returns remain the strokes that most influence the match results in modern tennis games (13). However, it has been stated that the service is not enough to earn points only, the success of serve-returns, the technical level and condition of the athlete and the strategy in the game are very important (24). The results did not reveal a direct

correlation between the serve and the match result; nevertheless, a successful serve helps players to win games during their own serve (11). Surface also had a significant influence on the proportion of points won when serving, with a significantly greater proportion of points won when serving by both winning and losing players at Wimbledon than at the Australian and French Opens (22). In our current study, the ace, winning % on 1st serve and fastest serve averages of both men and women were the lowest on the clay court. Break points won reached the highest values on clay court in men. In 2011 Grand Slam, while there were significant differences between tournaments in the 1st percentage of service, aces, the average 1st serve speed and the average 2nd serve speed in champion men tennis players, there was no significant difference in the other data. Service values are generally high in fast courts (Wimbledon), while low service speeds and percentages of service increase in slow (France Open) courts (17). O'Donoghue and Ingram (21) investigated the influence of the sex of the player and court surface on elite tennis strategy at all four Grand Slam tournaments between 1997 and 1999. The serve was least dominant at the French Open and male players could not rely on aces and serve winners to provide points as they did at other tournaments. The shortest rallies and highest shot rates in Grand Slam tennis occurred in the men's singles at Wimbledon, where almost half of the points were 'service points'. Unlike women's singles, there were differences between the Australian and US Opens for men's singles. The serve was more important at the US Open, with more serve winners but similar numbers of aces. As a result of the analysis of the 2014 Grand Slam tournament (US Open, Australian Open, French Open), there was no significant difference between the tournaments in the variables of double faults, break points won and points won on first serve for both men and women. Significant differences were observed between tournaments for both genders in the service variable that ace. Aces reached their highest values at the Australian Open for both men and women (27).

In our study, the fastest service averages reached the highest values on the hard court and the lowest values on the clay court in women. The fastest service averages reached the highest on the hard and grass court and the lowest on the clay court in men. In a different study, the fastest service was highest at the French Open (clay) in 2008 for both men and women. The fastest service was lowest for men at the French Open (clay) in 2016, while the fastest service was the lowest for women at the Australian Open (hard) in 2012 (31). Analysis of data from the men's singles event at the four Grand Slam events shows that the nature of the game of tennis is continuing to change from 1991 to 2009. Serve speeds are now higher than they have ever been and the number of aces continues to rise (6). However, the highest and lowest service speed values may vary depending on weather conditions such as sun, wind and temperature or the use of different systems to measure or calibrate the service speed (31). In addition, O'Donoghue (23) reveals that service speed influences a number of factors that in turn influence the proportion of points won on first and second service in his study. In ladies' singles, the success of points emanating from first serve depends on aces, ability at the net and the number of winners played per unforced error. Effectiveness in points emanating from second service, however, depends largely on the number of winners played per unforced error. In men's singles, the success of points emanating from first serve depends on aces, number of net points, ability at the net and the number of winners played per unforced error. Ability at the net and number of winners played per unforced error are the main determinants of second service points in men's singles.

Tennis performance varies according to game-specific variables such as different court surfaces and balls, as well as gender and player levels (18). In our current study, it has been determined that the unforced errors values of women tennis players are higher on the hard court than on the grass court. It was determined that the double faults variable were not significantly affected by the court surfaces. In men tennis players, unforced error averages were highest on the hard court and lowest on the grass court. Double fault values were found higher on the hard court than on the clay court. At Roland-Garros the number of unforced errors increased in 2011, whereas on the fast surfaces of Wimbledon (grass court) and US Open (hard court) the number of unforced errors, as well as winners, decreased. Researchers indicate that the players tend to manifest a safer playing style when playing on the fast courts with a lower risks in the starting and middle stages of points, whereas when playing on slow courts, they tend to play more aggressively in the middle stages of points (30). In different Grand Slams (2014-2017) women players had more service

winners, double faults, return winners and return unforced errors in the Australian Open and US Open, implying a "fast-fast" serve strategy, and higher dominance ratio and better serving performance in Wimbledon. While receiving players had better chances to break opponents' service game in Roland Garros (7). For the same training session on hard and clay courts, there were no differences in total distance or stroke volume. However, clay courts resulted in fewer errors compared with the increased (forced) error rate noted on hard courts (26).

In our current study between match durations and court surfaces; there was a significant difference in men, but no significant difference in women. It was determined that the match durations of the men tennis players were higher on the hard court than on the grass court. Smith and Holmes (28) indicated that men have continued to have a greater length of rally than women on clay and hard courts, however women saw a longer rally duration when playing on the grass courts of Wimbledon, but fewer shots were played. Significant results were found when comparing both rally duration and number of shots across the three playing surfaces, with clay showing the longest rally duration and grass the shortest. In a study evaluating the correlation between certain tennis game elements and match results in Wimbledon and Roland Garros tournaments (2009), it was found that Wimbledon winners are characterized by the variables related to service which the players rely on, while Roland Garros winners are characterized by baseline play predominated by basic strokes (16). These data reflect the different demands and strategies used by the players on different court surfaces. For example, a more aggressive game is associated with a faster surface such as grass. In addition, the data suggest that various factors such as gender and surface have a significant effect on match activity. These observations mean that the training components must be specific to the court surface and gender, so that players do more aerobic training as they prepare for competitions on slower surfaces (8). Martin et al. (19) stated that the court surface influences tennis match characteristics. On clay courts, effective playing time and mean duration of rallies are increased, whereas effective resting time is decreased. On hard courts, effective playing time, and mean duration of rallies are reduced, whereas effective resting time is increased. Gale-Ansodi et al.(12) reported that there were differences in the physical demands, in both velocity and acceleration dimensions, on tennis players depending on the kind of surface they played on. Tennis players who played matches on hard court developed more amount and higher intensity of acceleration/deceleration motion and high velocities than on clay court. Therefore, all our results indicate that tennis players develop high neuromuscular activities on hard court.

As a result, the findings show that the game elements that affect the outcome of the match are affected by the court surface and players tend to change their game patterns, in other words, the tactical structure of the important game elements that will make the match win and to adapt themselves to the playing court surface.

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Examination of Locus of Control Levels of University Students Staying in Credit and Dormitories Institution

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Abstract

This study was aimed to determine the locus of control levels of university students staying in the Credit and Dormitories Institution and to reveal whether the locus of control levels differed according to demographic characteristics.In the study, the locus of control scale adapted into Turkish by Dağ (2002) was used on 455 (170 males and 285 females) students, who were studying at KaramanoğluMehmetbey University in 2018-2019 academic year and staying at the Credit and Dormitories Institution. Due to the parametric distribution p ≤0.05, independent samples t-test and One-way ANOVA tests were used in the statistical evaluation of the obtained data. As a result of the research, the locus of control level of the students participating in the research was determined as = 134.2747, and considering the lowest and highest value that can be taken from the scale (the lowest 47 - the highest 235 points can be obtained from the scale.) The gender, age, faculty of education of the participants / college / vocational school, class, credit dormitories, the education status of the father and mother, father's occupation, mother's employment status and family's monthly income, while there is a significant difference according to the environment in which they grow up and the participants have internal control levels. It has been determined.

Keywords: Locus of control, credit dormitories, student.

Kredi ve Yurtlar Kurumunda Kalan Üniversite Öğrencilerinin Kontrol Odağı Düzeylerinin İncelenmesi

ÖZET

Bu araştırma; Kredi Yurtlar Kurumunda kalan üniversite öğrencilerinin kontrol odağı düzeylerini tespit ederek, kontrol odağı düzeylerinin demografik özelliklere göre farklılaşıp farklılaşmadığını ortaya koymak amacıyla yapılmıştır. Araştırmada, 2018-2019 eğitim öğretim yılı Karamanoğlu Mehmetbey Üniversitesinde öğrenim gören ve Kredi Yurtlar Kurumunda kalan 455(170 erkek ve 285 kadın) öğrenciye Dağ (2002) tarafından geliştirilmiş "Kontrol Odağı Ölçeği" kullanılmıştır. Elde edilen verilerin istatistikî değerlendirilmesinde parametrik dağılım göstermesinden dolayı p ≤0.05 T-Testi ve One-Way Anova Testleri uygulanmıştır. Yapılan araştırma sonucunda, araştırmaya katılan öğrencilerin kontrol odağı düzeyleri X= 134,2747 olarak tespit edilmiş ve ölçekten alınabilecek en düşük ve en yüksek değer göz önüne alınarak (ölçekten en düşük 47 – en yüksek 235 puan alınabilmektedir.) ortalamanın altında bir değerde olduğu sonucuna ulaşılmıştır. Katılımcıların cinsiyet, yaş, öğrenim gördüğü fakülte/yüksekokul/meslek yüksekokul, sınıf, kredi yurtlar kurumunda kalma süresi, baba ve annenin eğitim durumu, baba mesleği, annenin çalışma durumu ve ailenin aylık gelir gibi özelliklerine göre farklılık görülmezken, yetiştikleri çevreye göre anlamlı farklılık olduğu ve katılımcıların içsel denetim düzeylerine sahip oldukları tespit edilmiştir.

Anahtar Kelimeler: Kontrol odağı, kredi yurtlar, öğrenci.

INTRODUCTION

The first studies on the locus of control have not directly related to the general expectations of the person that the audit is mostly internal or external, but are studies that investigate the effects of skill and chance factors on affecting the expectations of the subject's success in a given job or task. The perception of control is defined by Rotter (1966) as a general expectation regarding whether rewards and

punishments are controlled by the individual or by several factors other than the individual (12). According to the studies of Lefcourt, Hogg, Struthers, and Holmes (1975), one's perception of the locus of control is one of the factors that direct their behavior (10). According to the social learning theory, which has been created by revealing the behavioral theory with the cognitive theory, the locus of control is related to the expectation that the person develops about what consequences his/her behaviors will create. It is possible for the individual to perceive the locus of control within or outside of himself/herself. In sum, people tend to put the responsibility of what happened to them either to themselves or to powers other than themselves, such as fate, fortune, destiny, and luck (11).

Individuals, based on their reinforcing histories in their past, can attribute behavioral results, the occurrence of events in their lives and their environment, to their own control or the control of external focus (luck, destiny, God, etc.) In other words, some individuals may be at the extremes of this internal-external control belief dimension (6).

According to Rotter (1966), the locus of control has formed as a result of the strengthening of an expectation that a certain reinforcer will follow a certain behavior of the person. When an individual perceives that his/her own behavior results in a positive or negative reinforcer, it will create an expectation that the reinforcer will follow this behavior in the future. This perception of reinforcement that the individual experiences in every field throughout the development process can create a generalized reinforcement expectation as a result of his/her experiences. In this context, the individual may adopt a general expectation (belief) that reinforcers are either under the control of himself/herself or by forces outside himself/herself, and by chance or destiny. It is conceptualized that the individual believes in the "internal" locus of control in the first case and in the "external" locus of control in the second. However, due to the nature of reinforcement experiences during the development process, it is also possible that there is no distinct polarization and it is in the middle of this dimension (7).

Rotter (1966) has defined locus of control as "the tendency of a person to perceive the events affecting him/her, good or bad, as the consequences of his/her own abilities, characteristics, and behaviors or as the work of powers other than himself/herself, such as luck, fate, fortune and power of others". While people who believe that the events affecting them are mostly under their control are internally controlled, and those who believe that what happens to them are under the control of forces other than themselves, are referred to as externally controlled (13). Again, according to Rotter (1975), people cannot be invariably divided into two classes as strictly internally controlled and strictly externally controlled. It should not be forgotten that many variables together determine the behavior of an individual in a certain situation. Dividing people into two unchangeable and definite classes regarding the locus of control would be a classification error that overlooked these variables, and explains that it reduces the process of predicting behavior to a very plain way (12).

According to Kavuncu (2014), youth; it is the most dynamic segment of society. It is even more important today that this elite group, which will play an active role in the future and development of countries, is well educated and addressed to their problems. Among the accommodation alternatives for university students; public and private dormitories, private hostels, apart hotels, rental student houses or living with relatives. Many factors such as the socio-economic status of the student and his family, proximity to the school and ease of transportation, security, the quality and capacity of the housing and / or buildings built for the purpose of housing in the city where the university education is continued are effective in the selection of the accommodation types. A "healthy" dormitory environment at the university provides our youth; In addition to socialization, maturation, responsibility, and sharing awareness, it can provide many important features such as knowing people, learning to trust them, being able to distinguish between good and bad, spending more moderately, having a broad circle of friends, being able to make decisions freely, and manage life in the community.

Arlı (2013) conducted a study on "the effects of housing on university students' personal and social development and academic achievement through focus group interviews" that studying and living in the dormitory increased their self-confidence. It was also seen that they learned to stand on their own feet, to distinguish between good and bad, to respect others' behaviors, ideas and thoughts, to share and to be able to control their expenditures. Individual differences are among the important factors affecting the success of individuals in education and

training activities. In this sense, the importance of individuals' structures such as intelligence, ability, self-confidence, motivation, locus of control, learning and thinking styles has been emphasized by many studies (17).

Many studies on the locus of control have conducted in the psychological or educational field such as Cihangir and Haktanır (5), Derman (9), Saracaloğlu and Yılmaz (21), Özen and Vatansever (20), Yurtseven and Özaydınlık (24), Zembat, Tunçeli, Yavuz and Kılıç (25), Demirtaş and Yener (14), Ordu (19). In this study we conducted, the gender, age of the students staying in the Institution of Credit and Dormitories in Karaman, the faculty/college/vocational school, class, the duration of stay in the institution of credit dormitories, the educational status of the father and mother, the father's occupation, the mother's employment status and the monthly income of the family questions have answered to understand whether these variables affect the locus of control states or not.

METHOD

Participants

A method for descriptive screening aiming to reveal the current situation was used in the study. The universe of the study consisted of the students studying at Karamanoğlu Mehmetbey University and staying at the Institution of Credit Dormitories in the fall semester of the 2018-2019 academic year. The scale was applied to 500 of these students and 455 (170 males and 285 females) the average age of the students is 20.2 years questionnaires were evaluated.

Measurement Tools

Personal Information Form and Locus of Control Scale were used as data collection tools in the study.

Personal information Form

In the Personal Information Form, a total of twelve questions about gender, age, faculty/college/vocational school, class, duration of stay in the institution of credit dormitories, the environment in which the father and mother's education status, father's occupation, mother's employment status, and family's monthly income was asked.

Locus of Control Scale

The locus of control scale developed by Dağ (7) was used to determine students' locus of control orientations. As a result of the validity and reliability study of 111 students studying in the Department of Psychology, the Cronbach Alpha internal consistency coefficient was found to be .92, and the test-retest reliability coefficient was found to be .88 (7).

Locus of Control Scale was a 5 Likert type and consisted of 47 questions in total. The scale had 5 subscales as Auto control (18 questions), Belief in luck (11 questions), the Meaninglessness of striving (10 questions), Fatalism (3 questions), and Unfair world belief (5 questions). In the scoring of the scale, "not at all suitable" was equal to 1 point, "not very suitable" was equal to 2 points, "suitable" was equal to 3 points, "quite suitable" was equal to 4 points, and "completely suitable" was equal to 5 points. In the scoring of subscales of the scale, the lowest 18 points and the higher 90 points can be obtained in the auto control subscale, and the lowest 11 points and the higher 55 points can be obtained in the Belief in luck subscale. The lowest 10 points and the higher 50 points can be obtained in the meaninglessness of striving subscale, and the lowest 3 points and the higher 15 can be obtained in the fatalism subscale. Moreover, the unfair world belief subscale was the lowest 5 and the higher 25 points. In the entire scale, 22 items were scored reversely. The lowest point that can be obtained from the whole scale was 47 and the highest point was 235. The high values that can be obtained from the scale indicate that the external locus of control has increased, while the low level indicates that the internal locus of control has increased (7). The reliability coefficient of the Rotter Internal-External Locus of Control Scale applied to students in present study was determined as .72.

Statistical Analysis

In addition to descriptive statistics (i.e., mean and standard deviation), the Skewness and Kurtosis values were checked for the normality of data. Independent samples t test was used for One-way ANOVA was used for comparing the means of more than two groups. A Tukey post-hoc test was applied for determining the source of the difference between groups. Significance was set at $p<0.05$. Skewness and kurtosis values were examined to control the normal distribution of the data.

RESULTS

The demographic characteristics of the students participating in the study were interpreted as follows. 170 (37.4%) of the participants were males and 285 (62.6%) of them were females. The distribution of researchers according to age was 53 (11.6%) were up to 18 years old, 233 (51.2%) were between 19-20, 126 (27.7%) were between 21-22, and 43 (9.5%) of them were 23 and older. 328 (72.1%) of the researchers were studying in the postgraduate program and 127 (27.9%) in the associate degree program.181 (39.8%) of the participants were in the first grade, 142 (31.2%) were in the second grade, 89 (19.5%) were in the third grade, and 43 (9.5%) were in the fourth grade. The distribution of the participants according to the duration of staying in the dormitory was determined as 241 (53.0%) up to 11 months, 75 (16.5%) between 12 months-23 months and 139 (30.5%) for 24 months and over. The majority of the participants 68 (14.9%) lived in the metropolitan area, 170 (37.4%) were in the province, 120 (26.4%) in the district and 97 (21.3%) in a village/town. The distribution of the fathers of the participants by occupation groups, 92 (20.2) were workers, 121 (26.6%) were farmers, 66 (14.5%) were tradesmen, 70 (15.4%) were civil servants. Moreover, 63 (13.8%) were retired and 43 (9.5%) were self-employed. While the mothers of 88 (19.3%) of the researchers work in any job, the mothers of 367 (80.7) did not work in any job. The distribution of the researchers according to the education status of the fathers was found as 47 (103%) were illiterate, 159 (34.9) were primary school graduates, 115 (25.3%) were secondary school graduates, 91 (20.0%) were high school graduates, and 43 (9.5%) of them were university graduates. The distribution of researchers according to maternal education status is that 75 (16.5%) were illiterate, 169 (37.1%) were primary school graduates, 124 (27.3%) were secondary school graduates, 56 (12.3%) of them were high school graduates and 31 (6.8%) were university graduates. The distribution of participants families according to their monthly income was found as; 135 (29.7%) up to 2020 Turkish Liras, 180 (39.6%) between 2021-4000 Turkish Liras, 82 (18.0%) 4001-6000 TL between 25 (5.5%) was between 6001-8000 Turkish Liras and 33 (7.3%) is 8001 Turkish Liras and above.

Table 1. Participants' mean scores from Locus of Control Scale

	Auto control	Belief in luck	Meaninglessness of striving	Fatalism	Unfairworldbelief	Total
n	455	455	455	455	455	455
$\bar{x}$	52,97	31,94	26,57	9,08	13,70	134,27
S.D.	11,47	4,87	7,62	3,06	4,74	15,52

In Table 1, the students' mean score in the locus of control scale was $\overline{X}$ =134,27. It was observed that the students' mean scores in the auto control subscales were $\overline{X}$ =52,97, the belief in luck subscale were $\overline{X}$ =31,94, the meaninglessness of striving subscale was $\overline{X}$ =26,57, the fatalism subscales was $\overline{X}$ =9,08, and the unfair world belief subscale was $\overline{X}$ =13,70.

Table 2. Results regarding the subscales and total scores of participants' General Locus of Control Levels

Locus of Control Levels Subscales	n	$\bar{x}$	S.D.	Min	Max	The Lowest and Highest Scores
Auto control	455	52,97	11,47	18,00	90,00	18-90
Belief in luck	455	31,94	4,87	11,00	51,00	11-55
Meaninglessness of striving	455	26,57	7,61	10,00	50,00	10-50
Fatalism	455	9,08	3,05	3,00	15,00	3-15
Unfair world belief	455	13,70	4,74	5,00	25,00	5-25
Total	455	134,27	15,52	83,00	178,00	47-235

Table 2 showed the general subscales of the locus of control and the total score means of the participants. As a result of this examination, it was found that the mean score of the participants in the auto control subscale was $\bar{X}$=52,97, while in the belief in luck subscale the mean score of the participants determined as $\bar{X}$=31,94. In the meaninglessness of striving subscale, the mean score was determined as $\bar{X}$=26,57, and in the fatalism subscale, it was determined as $\bar{X}$=9,08. Moreover, in

the unfair world belief subscale mean score was determined as X̄=13,70 and the locus of control total mean score was determined as X̄=134,27 points. According to the values that can be obtained from the scale, it can be said that the participants had medium mean scores in the auto control, the meaninglessness of striving and fatalism subscales, and in the belief in luck and fatalism, the participants had mean scores under the medium level. Besides, the participants had a mean score under the middle level in the general score of locus of control. According to the mean scores of the participants X̄= 134,27 from the total locus of control, it was determined that the participants had internal control levels.

Table 3. One-Way ANOVA Test results regarding subscales of Locus of Control and total score means by location variable of participants' lives

Locus of Control Subscales	Where Most of Their Life Spent	n	$\bar{x}$	S.D	Df	F	p	Difference
Auto Control	Metropolitan	53	52,05	9,85	451	,797	,496	-
	Province	233	52,42	11,93				
	District	126	54,21	11,41				
	Village/Town	43	53,39	10,92				
Belief in luck	Metropolitan	53	31,20	10,35	451	1,482	,219	-
	Province	233	31,68	10,42				
	District	126	32,59	14,89				
	Village/Town	43	32,34	15,23				
Meaninglessness of striving	Metropolitan	53	24,45	8,30	451	4,047	,007	1-4
	Province	233	25,98	7,69				
	District	126	27,99	7,21				
	Village/Town	43	28,23	6,54				
Fatalism	Metropolitan	53	8,71	2,93	451	,839	,473	-
	Province	233	8,99	3,05				
	District	126	9,42	3,01				
	Village/Town	43	9,00	3,37				
Unfair world belief	Metropolitan	53	12,62	4,24	451	1,218	,303	-
	Province	233	13,87	4,74				
	District	126	13,65	4,93				
	Village/Town	43	14,25	4,59				
Total (≤)	Metropolitan	53	129,05	15,88	451	5,494	,001	1-3 1-4
	Province	233	132,96	16,70				
	District	126	137,88	12,94				
	Village/Town	43	137,23	12,66				

Table 3 showed the results of the oneway Anova test on Subscales of Locus of Control and Total Score means, according to the where most of the participants' life spent variable. In this context, the participants who lived in metropolitan areas mean scores determined as X̄= 52,05 and the participants lived in the province mean score determined as X̄= 52,42. Moreover, while the participants' mean scores lived in the district determined as X̄ = 54,21, the participants' mean scores lived in the village or town determined as X̄= 53,39. Accordingly, a significant difference was not determined in the variable of the place where most of the participants' spent their life in the auto control subscale from the locus of control scale ($p < 0.05$). In the subscales of locus of control, belief in luck subscale, the participants who spent most of their life in the metropolitan areas mean score determined as X̄= 31,20, and the participants lived in the province X̄= 31,68. Moreover, while the participants' mean scores lived in the district determined as X̄= 32,59, the participants' mean scores lived in the village or town were X̄= 32,34. Accordingly, in the belief in luck subscale, no significant difference was found in the variable of the place where most of the participants' spent their life ($p < 0.05$). According to the meaninglessness of striving subscale, the participants who spent most of their life in the metropolitan areas mean scores determined as X̄= 24.45, and the participants' who lived in the province mean scores determined as X̄= 25.98. Besides, the participants' mean scores lived in the district determined as X̄= 27.99, and the participants' mean scores lived in the village or town determined as X̄= 28.23. Accordingly, in the meaninglessness of

striving subscales, a significant difference was found in the variable of the place where most of the participants' lives passed ($p < 0.05$). It was observed that the mean scores of those who spent most of their lives in villages or towns were higher than those who spent most of their life in a metropolitan city. In the fatalism subscale which was one of the subscales of locus of control, the majority of their life spent in the metropolitan were $\bar{X}$= 8,71, those living in the province were $\bar{X}$= 8,99, those living in the district were $\bar{X}$= 9,42, and those living in the village or town were $\bar{X}$= 9,00. Accordingly, no significant difference was found in the locality variable of the participants' life in the fatalism subscale from the locus of control scale ($p < 0.05$). In the unfair world belief subscale, most of their life spent in the metropolitan were $\bar{X}$= 12,62, those living in the province were $\bar{X}$= 13,87, those living in the district were $\bar{X}$ = 13,65, and those living in the village or town were $\bar{X}$= 14,25. Accordingly, no significant difference was found in the place where most of the participants' spent their life in the fatalism subscale which was the subscale of locus of control ($p < 0.05$). In the locus of control total score mean, most of their lives spent like this in the metropolitan = 129,05, in the province = 132,96, in the district = 137,88, in the village or town = 137,23. Accordingly, a significant difference was found in the variable of the place where most of the participants' life spent in terms of the total score mean of the locus of control ($p<0.05$). According to this; those who spent most of their lives in the district and village or town had a higher mean point of locus of control than those who spent most of their lives in a metropolitan area.

In terms of locus of control subscales and total score of the participants, no significant difference was determined in a variable such as gender, age the education, the class, the duration of staying in a dormitory, father's job, the situation whether the mother works or does not, father's educational background, mother's educational background, and the monthly income of the families of the participants.

DISCUSSION and CONCLUSION

This study was conducted to determine the locus of control levels of university students staying at the Credit and Dormitories Institution and to reveal whether their locus of control differs according to demographic characteristics.

As a result of this examination, it was found that the mean score of the participants in the auto control subscale was $\bar{X}$=52,97, while in the belief in luck subscale the mean score of the participants determined as $\bar{X}$=31,94. In the meaninglessness of striving subscale, the mean score was determined as $\bar{X}$=26,57, and in the fatalism subscale, it was determined as $\bar{X}$=9,08. Moreover, in the unfair world belief subscale mean score was determined as $\bar{X}$=13,70 and the locus of control total mean score was determined as $\bar{X}$=134,27 points. According to the values that can be obtained from the scale, it can be said that the participants had medium mean scores in the auto control, the meaninglessness of striving and fatalism subscales, and in the belief in luck and fatalism, the participants had mean scores under the medium level. Besides, the participants had a mean score under the middle level in the general score of locus of control. According to the mean scores of the participants $\bar{X}$= 134,27 from the total locus of control, it was determined that the participants had internal control levels.

While there was a significant relationship between subscales of locus of control and total mean scores of the participants, the variable of the place where most of the participants' spent their life in the subscale meaningless of striving of locus of control; mean scores of those who spent a most of their life in village or town were higher compared to those who spent most of their lives in a metropolitan. In total point means of locus of control; the total point means of those who had passed a big part of their lives in district and village or town were higher compared to those who had passed a big part of their lives in a metropolitan. no significant difference was determined in a variable such as gender, age the education, the class, the duration of staying in a dormitory, father's job, the situation whether the mother works or does not, father's educational background, mother's educational background, and the monthly income of the families of the participants.

In the study conducted by Cengil (4), the locus of control perceptions of the students of the theology faculty was mostly internal control. There was no significant relationship between students' locus of control and gender. Moreover, according to the results, there was no significant relationship between the class variable and the locus of control in the economic level variable. According to the research conducted by Şara (22), there was no significant difference in terms of gender in the internal locus of control scores and external locus of control scores of classroom teacher candidates.

Durna and Şentürk (14) did not found a significant difference between the gender factor of students and their locus of control in their study. In terms of gender, the studies of Cengil (4), Şara (22), Durna, and Şentürk (14) showed parallel results with the results of this study results. According to the result of the study conducted by Beytekin, Kadı, and Toprakçı (3), while there was a significant difference between the meaninglessness of striving, fatalism and unfair world belief scores of the teacher candidates according to the gender variable, there was no significant difference between the belief in luck and auto control scores. In their study, Gencer and İlhan (15) found that female athletes' locus of control scores were significantly higher than male athletes.

In the result of the study, no significant difference was found in the variables of age, education, class, duration of stay in the dormitory, father's occupation, whether the mother worked or not, father's education status, mother's education status, and families' monthly income. In the studies conducted by Beytekin, Kadı, and Toprakçı (3), it was found that teacher candidates' unfair world belief scores differed according to the department variable, and they did not found a difference between the scores according to the grade level variable. In the study conducted by Şen, Amanak, Akgün, and Karagöz (23), no statistically significant difference was found between the locus of control scale mean scores of midwifery students according to their classes. In their study, Günüşen and Üstün (16) found that students' locus of control scores were meaningful to their grade level. It was determined that the locus of control scores of the first-grade students were significantly higher than the second and fourth graders, and there was no difference with the third-grade students. According to the research of Şara (22), it was found that the control centers of the classroom teacher candidates did not differ significantly according to the residential areas where their families lived. Durna, Şentürk (14) stated that 48.8% of the students were internal control, 27.3% were internal-external control and 23.9% were external control according to the locus of control of students. The striking point here was that almost half of the students were internal control, which was they believe that they lead their own lives, and they look for their failures in their own mistakes. There was a significant difference between the locus of control that a student had and the faculty/department he/she was studied. There was no significant difference between the place of life and the locus of control.

Considering the results, it can be said that the participants had internal control levels. According to the result of the research conducted by Kızanlıklı and Konaklıoğlu (18), the majority of the participants (56.9%) consisted of individuals with an internal locus of control who believe that they can direct the events around them and interpret their lives according to their characteristics and behaviors. In general, it can be said that the participants were internal control and the reasons for those who spend most of their lives in towns and districts to had a higher locus of control scores were due to the difficulties in living conditions from metropolitan to rural life and the experiences of students living in rural areas in solving their problems.

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Examining Self-Esteem and Socialization Levels of The Students Aged 9-14 Participating in Recreational Activities*

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Abstract

The aim of this study is to examine the self-esteem and socialization levels of the students aged 9-14 participating in recreational activities. The population of the study is comprised of 87.814 students attending 5th, 6th, 7th, and 8th grades in public schools in Meram and Selçuklu districts of Konya province in the 2016-2017 academic year. The sample of the study is comprised of 1204 students who were randomly selected from among the research population. In order to reach the predetermined objectives of the study, the Personal Information Form, Self-Esteem Scale, and Socialization Dimension were used. In the analysis of the data, independent group t test, frequency and percentage distributions, one-way variance analysis (ANOVA), post-hoc LSD, T2 tests of Tamhane, and Pearson product moment correlation analyses were used. In the interpretation of the results, the significance level was accepted as $p< 0.05$. Among the findings of the study, it was concluded that the self-esteem levels of female students were higher compared to the males, their self-sufficiency levels increase as their ages progress, and the self-value, self-confidence, achievement and productivity levels of students increase as the parental education level increases. It was also observed that individuals with high socio-economic levels have higher self-esteem scores. In relation to socialization, it was concluded that the socialization levels of female students were higher than male students, and that the socialization levels of the students increased as their parental education and income levels increased. It was concluded that the time spent for recreational activities positively affect self-esteem and socialization levels.

Keywords: Recreational activities, socialization, self-esteem, secondary school students.

Rekreatif Faaliyetlere Katılan 9-14 Yaş Grubunun Benlik Saygısı ve Sosyalleşme Düzeylerinin İncelenmesi

Özet

Bu çalışmanın amacı; rekreatif faaliyetlere katılan 9-14 yaş grubunun benlik saygısı ve sosyalleşme düzeylerinin incelenmesidir. Araştırmanın evrenini 2016-2017 eğitim-öğretim yılı Konya ili Karatay, Meram ve Selçuklu ilçelerindeki devlet ortaokullarında 5., 6., 7. ve 8. Sınıflar da öğrenim gören 87.814 öğrenci oluşturmaktadır. Araştırmanın örneklemini ise; evren gurubundan tesadüfi yöntemle seçilmiş, 1204 öğrenci oluşturmaktadır. Araştırmada belirlenen amaçlara ulaşabilmek için kişisel bilgi formundan, Benlik Saygısı Ölçeğinden ve Sosyalleşme Boyutundan yararlanılmıştır. Verilerin analizinde ise; bağımsız grup t testi, frekans ve yüzde dağılımları, tek yönlü varyans analizi (ANOVA), post-hoc LSD veya Tamhane'nin T2 testleri ve Pearson çarpım moment korelasyon analizi kullanılmıştır. Sonuçların yorumlanmasında $p< 0.05$ anlamlılık düzeyi kabul edilmiştir. Araştırma bulgularında kız öğrencilerin benlik saygılarının erkek öğrencilere göre daha yüksek olduğu, öğrencilerin yaşları ilerledikçe kendilerine yetme düzeylerinde artış olduğu ve anne-baba eğitim düzeyi arttıkça öğrencilerin benlik değeri, özgüven, başarma ve üretkenlik düzeylerinin de arttığı sonucuna ulaşılmıştır. Yine yüksek sosyo-ekonomik seviyeye sahip bireylerin daha yüksek benlik saygısı puanlarına sahip oldukları gözlenmiştir. Sosyalleşme ile ilgili olarak ise kız öğrencilerin sosyalleşme düzeylerinin erkek öğrencilere göre daha yüksek olduğu, anne-baba eğitim ve gelir düzeyleri arttıkça öğrencilerin sosyalleşme düzeylerinin de arttığı sonucuna ulaşılmıştır. Rekreatif faaliyetler için harcanan zamanın benlik saygısı ve sosyalleşme düzeylerini olumlu yönde etkilediği sonucuna ulaşılmıştır.

Anahtar Kelimeler: Rekreatif faaliyetler, sosyalleşme, benlik saygısı, ortaokul öğrencileri.

INTRODUCTION

Recreation is the activities or experiences of a person in his/her spare time to enjoy or achieve a number of physical, social, and emotional movements [15].

Recreational activities, which have gradually evolved since the first civilizations to the present day, were conducted in the first civilizations believing that the only way to move away from the things that were endured for life and exhausting the human being was through the spiritual world, with the eternal peace. In the following periods of history, it was employed in the form of relaxation in the old age, seasonal or weekend holidays, and participation in recreation activities in their free times that arises on a daily basis. In parallel with the increase of leisure time and the increase in the level of prosperity have brought better living conditions with more emphasis on recreational activities [17].

People with high levels of self-esteem clearly know their personal characteristics. They have a positive opinion about themselves. They set feasible aims for themselves. They can criticize themselves in a way that positively affects their self.

The concept of self has a decisive effect on how people live their lives. When people live happily and peacefully, it will positively affect both themselves and their surroundings. In order for the individual to be happy and helpful for both oneself and his/her surroundings, the personality must develop in a healthy way. In order for the positive development of personality, the individual must live certain experiences such as having a profession, obtaining efficient results from his/her profession, reaching a level of satisfaction, and maintaining his/her freedom. How the individual understands his/her environment, what kind of attitudes he/she displays to the environment, what kind of reactions he/she gives, and his/her harmony reflects the personality of the individual, and a sub-dimension of personality is the self. Self is a driving element for the personality. It consists of the views of the individual about his/her own personality. Self is the basis of personality [4].

The concept of the healthy self helps the individual to be safe in his/her life, achieve success and happiness, overcome and change the frustrations of his/her life [10].

People have chosen to live in groups since their existence. This preference has brought about some developments. After the culture of cohabitation improved and became widespread, human beings not only existed with their physical beings, but also with their social beings in life. Particularly the development of the industry and the change of the rules of cohabitation, which continues to develop with the industrial revolution and is growing rapidly today, brought about certain developments.

While the human being, who developed the ability to live together, reveals his/her presence in the social life, he/she expresses that he/she has certain characteristics with his/her social behaviors. In the process of explaining the self, the human beings established the rules of social life through the level of their social considerations. However, they also discovered the use of some means when creating this phenomenon. The leading of these means is the 'recreational' activities. Due to the ever-increasing working pace and inability to spare time for themselves, people are observed to tend to more monotonous and sedentary lifestyles, particularly at the busy working pace of today. Recreation is the voluntary act of individuals, who have an intensive working pace, by spending individually or collectively quality time, in order to regain the physical and psychological well-being, which is negatively influenced from uniform lifestyle or negative social factors, to enjoy, to maintain continuity while preserving one's health, and to achieve individual pleasure [14].

Material and Method

Participants

The population of the research is comprised of 87.814 students attending 5th, 6th, 7th, and 8th grades in public schools in Meram and Selçuklu districts of Konya province in the 2016-2017 academic year. The sample of the study was comprised of 1204 students who were randomly selected from among the research population.

Research Design: This research study, which was conducted to examine the self-esteem and socialization levels of 9-14 year-old secondary school students, and to determine the relationship between their self-esteem and socialization levels in terms of certain variables such as the gender, age, birthplace, grade, parental educational level, monthly average income, participation level in recreational activities, and the participation frequency in recreational activities, is a relational screening model, which is a type of the general survey model. In order to

achieve the objectives of the research, the personal information form developed by the researcher, the Self-Esteem Scale developed by Arıcak [3], and the Socialization Dimension developed by Şahan [19] were used.

Self-Esteem Scale

In order to measure the level of self-esteem of secondary school students, the Self-Esteem Scale developed by Arıcak [3] was used.

The 32-item scale was prepared according to the 5-point Likert rating and participant students were asked to read each item and select one of the following choices: "5: I Definitely Agree", "4: I Agree", "3: Neutral", "2: I Don't Agree", and "1: I Definitely Disagree".

The scale consists of five factors. Since the self-esteem theoretically consists of self-value, self-confidence, depressive affect, self-sufficiency, achievement and productivity dimensions, these were determined as the dimensions of the scale [3].

The self-value is to value the characteristics that one has on oneself and those one should have. This factor includes seven items (1, 13, 16, 19, 22, 27, 29).

Self-confidence is the way a person attributes value to one's own characteristics and approves oneself through these values. This factor is expressed by nine items (5, 8, 9, 10, 11, 17, 20, 21, 25).

Depressive affect is the process in which the individual perceives oneself to be helpless, weak and powerless. This factor consists of five statements (3, 4, 6, 12, 31).

Self-sufficiency is the process in which the individual realizes one's own expectations and goals in a mental and behavioral sense. This factor consists of five items (14, 15, 24, 26, 30).

Achievement and productivity is the individual's feeling of being successful and helpful enough. This factor consists of six items (2, 7, 18, 23, 28, 32).

Of the 32 items within these five factors, 13 are positive (2, 5, 8, 10, 12, 14, 17, 20, 22, 24, 26, 28 and 30), and 19 are negative (1, 3, 4, 6, 7, 9, 11, 13, 15, 16, 18, 19, 21, 23, 25, 27, 29, 31 and 32). The scale yields a score of 32 to 160. In scoring, 19 items are reversely scored. The increase in points indicates increasing level of self-esteem, while the decrease points to a fall in the self-esteem level.

Reliability of the Self-Esteem Scale

A two-stage process was followed to test the reliability of the scale. The first is the calculation of the reliability coefficient with the Cronbach Alpha formula, which is an indicator of the scale's internal consistency and is primarily preferred for Likert type scales. The second is the reliability coefficient obtained as a result of the test-retest method [3].

Based on the SPSS package program, the Cronbach Alpha reliability coefficient of the scale, which was applied to 152 students and reduced to 32 items as a result of item analysis, was determined as 0.90. The correlation coefficients of the sub-dimensions are as follows; self-value; .74, Self-confidence; .68, Depressive affect; .75, Self-sufficiency; .60, Achievement and productivity; .70 [3].

Subsequent to the item analysis, the final version of the scale was re-administered to the students with a two-week break and Pearson moment multiplication correlation was calculated. The test-retest reliability coefficient of the scale was found to be .70 [3].

Validity of the Self-Esteem Scale

The validity of the scale was tested in three stages. Expert opinions were asked for the content validity, the items approved by the majority of the experts were included in the scale, and others were removed from the scale. In terms of the similar scales validity, the relationship between the self-esteem scale of this study and the Rosenberg self-esteem scale, which was adapted to Turkish by Çuhadaroğlu, was calculated as .69. Factor analysis method was used to test the construct validity and it was employed over the scale whose reliability coefficient was calculated and which was decreased to 32 items following the item analysis that was administered to 152 students. In order to test whether the sample was appropriate, the Kaiser-Meyer-Olkin sampling adequacy and Bartlett Sphericity tests were applied and the sample adequacy coefficient was calculated as .82. In the factor analysis, which was re-conducted following the evaluations, varimax conversion analysis was employed, and a five-factor structure was created, which explains 46% of the total variance, with a value higher than 1 [3].

Socialization Dimension

In the study, in order to measure the socialization levels of secondary school students, the "Socialization Dimension" of Şahan was used. The socialization dimension consists of "Socialization" and "Socialization with Sports" dimensions. In accordance with the purpose of this research, only the socialization dimension was used. The socialization dimension consists of 34 questions aimed at revealing the concept of socialization. In preparation of the questions, 5-type Likert scale was used with closed-ended and open-ended types of questions. Among the scaling methods, this method is the most preferred and easiest in terms of reliability. The Likert scale rating that we used in the research is "1: I Definitely Disagree", "2: I Don't Agree", "3: Neutral", and "4: I Agree", "5: I Definitely Agree" [19].

Reliability of the Socialization Dimension

In order for analyzing the reliability of the socialization dimension, the Cronbach Alpha formula was used and the reliability coefficient was calculated. Accordingly, the reliability of the socialization dimension was calculated as α =0.739 [19].

Statistical Analysis:

In this part of the study, the distributions of the descriptive frequencies and percentages were prepared concerning the demographic characteristics (gender, age, place of birth, class of education, parental education level, average monthly income, participation in recreational activities, and participation frequency in recreational activities) of the students in the research group, subsequently, for the score averages of the scales, the $\overline{X}$, sd, Sh$\overline{x}$ values were presented in tables. After determining that the data demonstrated a normal distribution, parametric analysis techniques were used that are used for the distributions with normal distribution. Since the statistical techniques used show normal distribution of the data, parametric tests were used.

The independent group t test was used to determine whether the scores of the students in the research group concerning the socialization dimension, self-esteem scale and its sub-dimensions differed depending on the variables of gender and participation in recreational activity. One-way variance analysis (ANOVA) was used to determine whether the scores of the students in the research group concerning the socialization dimension, self-esteem scale, and its sub-dimensions differed according to the variables of age, birthplace, grade, parental educational status, and monthly average income. As a result of the one-way variance analysis (ANOVA), if there are intra-group differences, the Post-hoc LSD or Tamhane's T2 tests were performed to determine the source of differences (among which groups). Pearson moment multiplication correlation analysis was applied to determine the relationship between the socialization dimension and self-esteem scales of the students in the sample group. In the interpretation of the results, the significance level was accepted as $p< 0.05$.

Results of the research

Frequency and percentage distributions of the students in the sample group are respectively given below.

Table 1. Frequency and Percentage Values Concerning the Gender, Age, Birthplace, and Grade Variables.

Variables		N	%
Gender	Female	567	47,1
	Male	637	52,9
Age	9-10 year-old	61	5,1
	11-12 year-old	532	44,2
	13-14 year-old	611	50,7
Birthplace	Village	73	6,1
	District	313	26,0
	City	378	31,4
	Metropolitan area	440	36,5
Grade	5th Grade	270	22,4
	6th Grade	306	25,4
	7th Grade	319	26,5
	8th Grade	309	25,7
	Total	1204	100,0

As is seen in Table1, among the secondary school students in the sample group, 567 (47.1%) are female, 637 (52.9%) are male; 61 (5.1%) are 9-10 years old, 532 (44.2%) 11-12 years old, and 611 (50.7%) are 13-14 years old; 73 (6.1%) were born in villages, 313 (26.0%) were born in districts, 378 (31.4%) were born in the city, 440 (36.5%) were born in the metropolitan area, and 270 (22.4%) were studying at the 5th grade, 306 (25.4%) at the 6th grade, 319 (26.5%) at the 7th grade, and 309 (25.7%) at the 8th grade

Table 2. Frequency and Percentage Values Concerning the Variable of Participation in the Recreational Activities.

Participation in the Recreational Activities	N	%
Yes	888	73,8
No	316	26,2
Total	1204	100,0

As is seen in Table 2, it was determined that 888 (73,8%) of the secondary school students participated in recreational activities, while 316 (26,2%) did not participate in recreational activities.

Table 3. Frequency and Percentage Values Concerning the Variable of Participation Frequency in the Recreational Activities.

Participation Frequency in the Recreational Activities	N	%
Once a week	288	23,9
3-4 times a week	252	20,9
Several times a month	250	20,8
Each day of the week	98	8,1
Total	888	73,8
Not answered	316	26,2
Total	1204	100,0

As is seen in Table 3, 316 (26.2%) of secondary school students did not respond (26.2%) to the question concerning the recreational activities, while 250 (20.8%) participated several times a week, 288 (23.9%) once a week, 252 (20.9%) 3-4 times a week, and 98 (8.1%) participated in recreational activities each day of the week.

Table 4. Arithmetic Mean and Standard Deviation Values of the Scores of Secondary School Students, Who Participated and did not Participate in the Activities, Concerning the Sub-Dimensions of the Self-Esteem Scale.

Sub-dimensions	Participated			Not-Participated		
	N	$\overline{X}$	sd	N	$\overline{X}$	sd
Self-Confidence	8	34,86	5,87	6	32,56	5,79
Self-Value	8	26,20	5,55	6	25,03	5,58
Achievement and Productivity	8	22,29	4,27	6	20,76	4,25
Self-Sufficiency	8	20,10	3,72	6	18,92	3,89
Depressive Affect	8	19,52	4,44	6	18,07	4,58

As is seen in Table 4, the arithmetic mean values of the secondary school students in the sample group concerning the scores they received from the self-value sub-dimension of the self-esteem scale was $\overline{X}$= 26.20 (sd=5.55) for the students participating in recreational activities, while it was $\overline{X}$= 25.03 (sd=5.55) for the students, who did not participate; the arithmetic mean of the scores they received from the self-confidence sub-dimension was $\overline{X}$= 34.86 (sd=5.87) for the students, who participated in recreational activities, while it was $\overline{X}$= 32.56 (sd=5.79) for the students, who did not participate; the arithmetic mean of the scores they received from the depressive affect sub-dimension was $\overline{X}$= 19.52 (sd=4.44) for the students participating in recreational activities, while it was $\overline{X}$= 18,07 (sd=4,58) for the ones, who did not participate; the arithmetic mean of the scores they received from the self-sufficiency sub-dimension was $\overline{X}$= 20.10 (sd= 3.72) for the students, who participated, while it was $\overline{X}$= 18.92 (sd=3.89) for the students, who did not participate; the arithmetic mean of the scores they received from the achievement and productivity sub-dimension was $\overline{X}$= 22.29 (sd=4.27) for the students participating in recreational activities, while it was $\overline{X}$= 20.76 (sd=4.25) for the students, who did not participate. Based on these findings, it is observed that the self-esteem levels of students participating in recreational activities are higher for all sub-dimensions of the self-esteem scale compared to the students, who did not participate in recreational activities.

Table 5. Arithmetic Mean and Standard Deviation Values of the Scores of Secondary School Students, Who Participated and did not Participate in the Activities, Concerning the Socialization Dimension.

Dimension	Participated			Not-Participated		
	N	$\overline{X}$	sd	N	$\overline{X}$	sd
Socialization Level	888	3,71	0,45	16	3,52	0,51

As is seen in Table 5, the arithmetic mean of the scores that the secondary school students in the sample group received from the socialization dimension was $\overline{X}$= 3,71 (sd=0,45) for the students participating in the recreational activities, while it was calculated as $\overline{X}$= 3,52 (sd=0,51) for the non-participating students. Therefore, it could be said that when the arithmetic average and standard deviation values regarding the socialization dimension of the scores of secondary school students participating in the activities and not participating in the activities were examined, it was seen that the averages of the participants and the non-participants were close to each other.

Table 6. Results of the Independent Group t-test Conducted to Determine Whether the Self-Esteem Scale Scores of the Secondary School Students Varied Based on the Variable of Participation in the Recreational Activities.

Sub-dimensions	Participation	N	$\overline{X}$	Sd	t	sd	p
Self-value	Participating	888	26,20	5,55	3,234	1202	,001
	Non-Participating	316	25,03	5,58			
Self-confidence	Participating	888	34,86	5,87	5,982	1202	,000
	Non-Participating	316	32,56	5,79			
Depressive Affect	Participating	888	19,52	4,44	4,950	1202	,000
	Non-Participating	316	18,07	4,58			
Self-sufficiency	Participating	888	20,10	3,72	4,745	1202	,000
	Non-Participating	316	18,92	3,89			
Achievement and Productivity	Participating	888	22,29	4,27	5,484	1202	,000

As shown in Table 6, as a result of the independent group t-Test which was conducted to determine whether there were statistically significant differences among the self-esteem scale scores of secondary school students based on the variable of participation in recreational activities; it was determined that there were statistically significant differences among the arithmetic mean values of the groups in favor of the students participating in the recreational activities, in the self-value sub-dimension (t=2,712; p<,05), in the self-confidence sub-dimension (t=3,651; p<.05), in the depressive affect sub-dimension (t=2,712; p<,05), in the self-sufficiency sub-dimension (t=2,712; p<,05) and in the achievement and productivity sub-dimension (t=2,712; p<,05). Therefore, when the results of the independent group t-test conducted to determine whether the self-esteem scale scores of secondary school students differentiated according to the variable for participation in recreation activities, it was observed that the group averages were close to each other. In other words, students participating in recreational activities perceive higher levels of self-value, self-confidence, depressive affect, self-sufficiency, and achievement and productivity compared to non-participating students.

Table 7. Results of the Independent Group t-test Conducted to Determine Whether the Socialization Dimension Scores of the Secondary School Students Varied Based on the Variable of Participation in the Recreational Activities.

Dimension	Participation	N	$\overline{X}$	Sd	t	sd	P
Socialization Level	Participating	888	3,71	,45	6,254	1202	,000
	Non-Participating	316	3,52	,51			

As shown in Table 7, as a result of the independent group t-Test which was conducted to determine whether there were statistically significant differences among the socialization dimension scores of secondary school students based on the variable of participation in recreational

activities; it was determined that there was a statistically significant difference between arithmetic mean values of the groups (t=6,254; p<,05). The difference was in favor of the students participating in recreational activities. When the results of the independent group t-test conducted to determine whether the socialization dimension scores of secondary school students differentiated according to the variable for participation in recreation activities, it was observed that the group averages were close to each other. In other words, students participating in recreational activities perceive their socialization levels higher compared to the non-participating students.

Table 8. Findings Concerning the Relationship Between the Self-Esteem Scale Scores and Socialization Dimension Scores of the Students Participating in the Recreational Activities.

Variable		Self-confidence	Depressive Affect	Self-sufficiency	Achievement and Productivity	Socialization Level
Self-value	r	,642**	,690**	,433**	,658**	,238**
	P	,000	,000	,000	,000	,000
	N	888	888	888	888	888
Self-confidence	r		,604**	,523**	,597**	,394**
	P		,000	,000	,000	,000
	N		888	888	888	888
Depressive Affect	r			,445**	,607**	,244**
	P			,000	,000	,000
	N			888	888	888
Self-sufficiency	r				,470**	,393**
	P				,000	,000
	N				888	888
Achievement and Productivity	r					,264**
	P					,000
	N					888

As shown in Table 8, concerning the students participating in recreational activities, it was determined that there was a positive significant relationship between their socialization scores and their self-value sub-dimension scores of the self-esteem scale (r=,238; p<,01), similarly a positive significant relationship was detected between their socialization scores and the self-confidence sub-dimension scores (r=,394; p<,01), a positive significant relationship was determined between their socialization scores and depressive affect sub-dimension scores (r=,244; p<,01), a positive significant relationship was determined between their socialization scores and self-sufficiency sub-dimension scores (r=.393; p<,01), and again a positive relationship was determined between their socialization scores and achievement and productivity sub-dimension scores (r=,264; p<,01). Findings regarding the relationship between the self-esteem scale scores of the students participating in the recreation activities and the socialization dimension scores also showed that many dimensions had moderate significant relationships. In other words, as the socialization levels of students participating in recreational activities increase, their levels of self-value, self-confidence, depressive affect, self-sufficiency, and achievement and productivity sub-dimensions of the self-esteem scale increase as well.

Table 9. Findings Concerning the Relationship Between the Self-Esteem Scale Scores and Socialization Dimension Scores of the Students who are not Participating in the Recreational Activities.

Variable		Self-confidence	Depressive Affect	Self-sufficiency	Achievement and Productivity	Socialization Level
Self-value	r	,601**	,679**	,427**	,601**	,066
	P	,000	,000	,000	,000	,244
	N	316	316	316	316	316
Self-confidence	r		,540**	,458**	,518**	,339**
	P		,000	,000	,000	,000
	N		316	316	316	316
Depressive Affect	r			,389**	,548**	,183**
	P			,000	,000	,001
	N			316	316	316
Self-sufficiency	r				,425**	,374**
	P				,000	,000
	N				316	316
Achievement and Productivity	r					,186**
	P					,001
	N					316

As is seen in Table 9, concerning the students not participating in recreational activities, it was determined that there was no significant relationship between their socialization scores and their self-value sub-dimension scores of the self-esteem scale; however, a positive significant relationship was detected between their socialization scores and the self-confidence sub-dimension scores (r=,339; p<,01), a positive significant relationship was determined between their socialization scores and depressive affect sub-dimension scores (r=,183; p<,01), a positive significant relationship was determined between their socialization scores and self-sufficiency sub-dimension scores (r=,374; p<,01), and again a positive relationship was determined between their socialization scores and achievement and productivity sub-dimension scores (r=,186; p<,01). In other words, as the socialization levels of students not-participating in recreational activities increase, except for the self-value sub-dimension, their levels of self-confidence, depressive affect, self-sufficiency, and achievement and productivity sub-dimensions of the self-esteem scale increase, as well.

DISCUSSION

Social life has been evolving since the human beings started living in groups. Especially after the industrial revolution, rapid urbanization and then complex urban life has caused people to move away from each other. Ultimately, the age of information and technology began to become effective in the lives of today's people. However, in addition to the advantages of technology, a number of negative effects have also emerged. The human became stuck in his/her daily life, away from society, and unhappy with the feeling of loneliness.

People looking for ways out have tried to re-adapt to social life as a social entity in line with various interests. In this context, people from different social classes began to meet in common grounds in open or closed areas. Recreational activities, which are among these common grounds, have been an effective means of social development and socialization of individuals [20].

Individuals, who develop their social perceptions, try to be part of the social life by participating more in recreational and social activities. Individuals participating in recreational activities begin to enjoy life more by discovering themselves, their abilities, and some of their features they haven't realized. Because recreational and sporting activities are an indispensable element in socialization of an individual, and in doing this, the self-esteem is the indispensable element in developing the social perception.

As a result, recreational activities, as a social phenomenon, help people to be at peace with themselves, with a developed self-esteem, socialized, happy, and productive individuals in their inner worlds. The socialization processes of individuals with developed social perception levels are gaining momentum. In this way, the person who is involved in every step of social life increases his/her efficiency and happiness without getting stuck in his/her own small world.

Results Concerning the Self-Esteem Scale

In our study, it is observed that the self-esteem and self-confidence levels of the male students comprising the sample group were higher than the female students. There was no significant difference among the arithmetic means of groups concerning the sub-dimensions of depressive affect, self-sufficiency, and achievement and productivity.

In parallel with the research findings, some other researchers reported that the genders of students caused differences between their self-esteem levels, and that the self-esteem levels of female students were higher compared to male students [11].

In other studies, it was found that the self-esteem levels of male students were higher than those of females [11].

However, in a study examining the self-concepts of children studying in Regional Primary Boarding Schools conducted by Akyol [1], it was found that gender did not make a significant difference in terms of self-concept.

Mullis and Normandin [18] determined, too, that there was no significant relationship between the development of gender and self-esteem in adolescents.

In the study, when it is examined whether the scores of the students in the sample group from the self-esteem scale demonstrated a significant difference concerning the age variable, it was determined that there was no significant difference among the mean scores of age groups in the sub-dimensions of self-value, depressive affect, and achievement and productivity. However, the difference between the mean scores of 9-14 age groups concerning the self-sufficiency sub-dimension was found to be statistically significant. Students older than the age of 9-10 have higher self-sufficiency perceptions. It points to the fact that as the students get older, there is an increase in their self-sufficiency levels. This, in turn, means that as students get older, they tend to decide and act independent and free from any external factor, based on their own opinions and wills.

In the results of some previous research studies on the subject, it was stated that there was a significant relationship between the ages and self-esteem levels of students, and that the self-esteem levels increase as age increases [11].

Unlike these results, there are also research studies reporting that self-esteem levels decrease with increasing age [11].

The age ranges mentioned in the study are quite close to each other, and coincide with adolescence period. In addition, since the self and personality development of individuals in this period is not complete, it is an expected result to observe a change in these developments and increase in self-esteem scores depending on the age ranges.

Examining whether there is a significant difference between the self-esteem and parental educational level variables of the students in the sample group, it was determined that there were statistically significant differences between the maternal education level and the self-value, self-confidence, and achievement and productivity sub-dimensions. As the maternal education level increased, the self-value, self-confidence, achievement and productivity levels of students also increased. It can be stated to be emerging from the secondary education age of the students, wherein the students reflect the positive feedbacks of the educated mothers, their unconditional affection towards the students, and appreciation for their success, since it is a period when the students have an identity confusion.

In the study conducted by Kahriman [12], it was found that the difference between the maternal educational status and self-esteem score averages was not statistically significant.

Results Concerning the Socialization Dimension

As a result of the analysis to determine whether the socialization dimension scores of secondary school students differ according to the gender variable, it was found that the socialization scores of female students were higher than male students. Based on the research findings, it was determined that female students' socialization skills were higher than male students based on gender variable. Studies with similar findings were encountered in the relevant literature.

Dodson [7] claimed that females develop socially faster, mature faster, and are more compatible compared to the males.

In the study on socialization of the secondary school students, Aytan Korucu [6] found that the

socialization levels of female students were higher than male students.

Similarly, Kandır and Orçan [13] concluded that, in all age groups, female students performed better in social skills than male students.

Altinköprü [2] concluded that female children have a more developed tendency to collaborate and socialize compared to male children. While no statistically significant difference was detected between the socialization levels of secondary school students and age, birthplace, grade, and monthly income variables, a meaningful relationship was determined between the socialization levels and parental education level variable. As parental education level increase, so does the socialization level of the student.

Examining the relationship between the self-esteem and socialization levels of secondary school students who participate in recreational activities, it is observed that the self-esteem levels of the students participating in recreational activities are higher in all dimensions of self-esteem compared to the students who do not participate in recreational activities.

In the study conducted on high school students, who were doing sports and not dealing with sports, Asci et al., [5] found that participating in sports had a significant impact on the self-concept. This result is in parallel with the results of this research.

Slutzky et al., (2009) concluded that the time spent on recreational activities positively affected the levels of self-esteem [9].

In another study that is in parallel with this research, the self-esteem scores of students attending summer sports schools were compared, and it was determined that there were statistically significant differences between the pretest and posttest overall scores of the students attending summer sports schools concerning the general self-esteem, social self-esteem, and academic self-esteem levels. Reflecting the positive impact of sports on self-esteem, this result reveals that it would be especially helpful for children to participate in recreational activities not only in the summer but all year round [16].

Similarly, it is seen that the socialization levels of the students participating in recreational activities are higher compared to the students who do not participate in recreational activities. In other words, students participating in recreational activities perceive higher levels of self-esteem, self-confidence, depressive affect, self-sufficiency, and achievement and productivity compared to students who do not participate in recreational activities. In addition, students participating in recreational activities perceive their socialization levels higher than students who do not participate in recreational activities. While the socialization levels of students participating in recreational activities increase, self-value, self-confidence, depressive affect, self-sufficiency, and achievement and productivity sub-dimensions of the self-esteem also increase. Similarly, as the socialization levels of students participating in recreational activities increase, self-confidence, depressive affect, self-sufficiency, and achievement and productivity levels increase as well, except for self-value sub-dimension.

These results also confirm the study of Erdogdu at al., (2018). In that study it has been determined that the socialization variable has a positive and statistically significant effect on self-esteem. It has been observed that the self-esteem and socialization characteristics of those who participated in recreational activities are higher than those who do not participate in recreational activities at all. There is a relationship between socialization and self-esteem. It was concluded that recreational activities positively affect the self-esteem and socialization levels of university students, and this supports the results of the study [8].

Suggestions

The impact of participation in recreational activities on the past and future achievements, socialization, and self-esteem levels of students is undeniable. In line with this purpose, it is not sufficient to provide only the academic qualifications necessary for professional development in secondary education institutions, therefore, it is of vital importance to make necessary regulations for the implementation of activities, in which social and personality development is supported.

Based on the fact that participation in recreational activities will provide positive and constructive support for socialization and increase in the personal development of students, it can be recommended to organize counseling and guidance activities for students.

It can be suggested that Psychological Counseling and Guidance services in secondary schools should be supported by recreational activities in order to support the socialization and personal development needs of students, and in this context, expert opinions and expert support can be received.

In order to increase the self-esteem levels of secondary school students, it will be useful to increase the number of research studies determining the factors influencing the self-esteem and socialization levels of students, and to use the findings of these studies in the program preparation processes.

By including recreational activities into the secondary school education program objectives, an awareness can be raised that recreation should not be employed for a certain period of life, and additionally, further studies can be conducted on advanced ages emphasizing the adoption of the philosophy to participate in recreational activities throughout life.

Families can be given various seminars in order to emphasize that the perception of parents labeling recreational activities as a waste of time is groundless, and to raise their awareness about the fact that recreational activities are a great part of physical, mental, and social development, and socialization and self-esteem surveys can be applied to the parents. While students adopt the habit of participating in systematic recreational activities, the training program should be implemented in consideration of the student expectations. Through various organizations in secondary schools, students can socialize by performing activities such as going to picnic, cinema, theatre, historical and touristic places, inter-class competitions, music, etc.

By directing people to individual activities, the number of people should be increased who are happy, with a high level of self-confidence and a developed self-esteem. Recreational activities should be increased to keep the youth from harmful habits. For this purpose, pitches and appropriate conditions should be prepared in each neighborhood. Organizations should be held in different sports branches, not in a particular sports branch (like football), that each student can participate at least once throughout his/her education life. Recreational activities should be supported for happy societies with high self-esteem and socialization levels.

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Effect Of Caffeine On Exercise Performance: Current Review

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Abstract

Caffeine is an ergogenic supplement that has been attracting attention in the sports community for many years. It has been proven in many studies that coffee consumption has a positive effect on exercise performance. This study was conducted to (I) examine the effects of caffeine on exercise performance and different performance areas, (II) to provide comprehensive recommendations on the use of caffeine in sports and exercise, and (III) to identify existing gaps in the literature and to make key recommendations for future research. This current review article provides an analytical view of studies involving the use of caffeine for the physical, physiological, and cognitive performance of individuals, and discusses factors that may affect the ergogenic effects of caffeine on the different proposed activities. Within the scope of this review, previously published studies were searched using comprehensive keywords related to "caffeine" through "ELSEVIER Science Direct (SciVerse), Taylor & Francis, EBSCOhost-Academic Search Complete, PubMed and SpringerLink, Google Scholar" databases until January 2021. As a result, it has been reported that caffeine increases endurance performance by 2-4% and improves short-term and intense intensity exercise performance in highly trained individuals. The improving effect of caffeine on cognitive performance supports the use of caffeine as an ergogenic supplement. Caffeine has been shown to increase sympathetic nervous system activity and release fatty acids from adipose and / or intramuscular stores. This mechanism, which occurs indirectly through increased adrenaline levels, has the potential to increase the availability of fatty acids for oxidation and the resting metabolic rate. At the same time, it has been observed that caffeine does not cause dehydration and is a reliable ergogenic supplement in this respect. The ergogenic effect of caffeine should be clarified by focusing on questions such as at what time of the day caffeine consumption affects caffeine ergogenicity, the effect of age on caffeine ergogenicity, caffeine intake according to athlete's training level, and the importance of genotype in terms of caffeine consumption.

Keywords: Caffeine, Exercise, Athletic performance

INTRODUCTION

Caffeine is the world's most consumed psychoactive substance, naturally found in many plant species, including coffee, tea, and cocoa. Caffeine, which is added to many beverages such as energy drinks and whose consumption has increased day by day in the last two decades, is mostly consumed in the form of beverages such as coffee, soft drinks, and tea (1). In Western countries, approximately 90% of adults consume caffeine regularly, while daily caffeine consumption in US adult men and women is estimated to be 200 mg, according to 2009-2010 data (2, 3).

Caffeine is one of the most popular socially acceptable ergogenic supplements that has been used in athletic circles as an ergogenic aid or performance enhancer for years, because it is not doping and can be taken from natural sources. It is also a supplement with a long history of use for its ergogenic effects on performance. Caffeine intake has been very common among athletes, especially since 2004, when the World Anti-Doping Agency

was removed from the in competition prohibited substances list. For example, 74% of urine samples collected between 2004 and 2008 and analyzed as part of doping control contained caffeine (4). Given the inconsistent evidence from primary research examining the effects of caffeine on exercise performance, several research groups have explored this issue using meta-analytical methods (5-8) . While these meta-analyzes generally report the ergogenic effects of caffeine on exercise performance, current studies should not focus solely on the effect of caffeine on exercise performance; He suggested that attention should also be paid to cognitive performance, caffeine use dosage and intake forms, fat metabolism, combined intakes of caffeine, caffeine consumption habits and effects on dehydration. Although many studies are investigating the effects of caffeine on overall health and exercise performance, recent research has shown that caffeine not only affects exercise performance, but also metabolic disorders, cognitive performance, consumption amount and forms, fat metabolism, combined intakes, caffeine consumption habits, and dehydration. It emphasizes the need to focus on the effects of caffeine (5, 9).

Responses in the organism with caffeine intake may vary from person to person. A person's genetic structure, consumption amount, individual's performance goal, type of sport performed, placebo effect, and caffeine intake form can affect the result. In addition, the health effects of caffeine have long been a topic of interest, and as noted by extensive research, caffeine remains an important dietary component for public health. It has also become ubiquitous in the sports world, where there is intense interest to better understand the effect of caffeine on various exercise performance. Thus, caffeine has been the focus of attention in the field of ergogenic aids and sports supplement research in recent years.

The purpose of this review is to reveal many aspects of caffeine's effect on exercise performance. In this direction, the results of the research on aerobic/anaerobic performance, strength/power performance, consumption amount and time, combined forms, caffeine consumption habits, and dehydration were evaluated and suggestions were made on the subject.

METHOD

Within the scope of this review, previously published studies were scanned through "ELSEVIER Science Direct (SciVerse), Taylor & Francis, EBSCOhost-Academic Search Complete, PubMed and SpringerLink, Google Scholar" until January 2021, "caffeine and exercise" for search, the keywords "caffeine and aerobic performance", "caffeine and resistance exercises", "caffeine and anaerobic performance", "caffeine and cognitive performance", "caffeine and supplements", "caffeine and dehydration", "caffeine consumption forms", "caffeine and doping", "caffeine metabolism", "caffeine and fat metabolism", "caffeine and doping", and "caffeine and consuming habits" were used.

Caffeine Metabolism

Caffeine is a purine alkaloid containing the methyl group at the 1,3,7 position, also called trimethylxanthin, and has a stimulating effect on the central nervous system (CNS). As a food additive, it can be produced synthetically for use in dietary supplements and pharmaceutical preparations where synthetic caffeine is the same as intrinsic or plant-derived caffeine. It has been defined as the most commonly consumed pharmacologically active food in the World (10).

Most of the biological effects of caffeine at the levels reached during normal consumption are due to its antagonizing the adenosine receptors, particularly the A1 and A2A receptors, and to a lesser extent the A2B and A3 receptors. A1 and A2A adenosine receptors affect various mechanisms found in large areas of the brain that are involved in the regulation of sleep, arousal, and cognition. Therefore, it is not surprising that caffeine as an adenosine receptor antagonistcan alter physiological and mental states. Central adenosine receptors affected by typical caffeine exposure (11). Because the caffeine molecule is chemically similar to the adenosine molecule, it binds to adenosine receptors. Since adenosine receptors are related to sleep, sleep is not felt if caffeine is attached to the receptors instead of adenosine. The sleep-disturbing effect of caffeine is due to this antagonist mechanism.

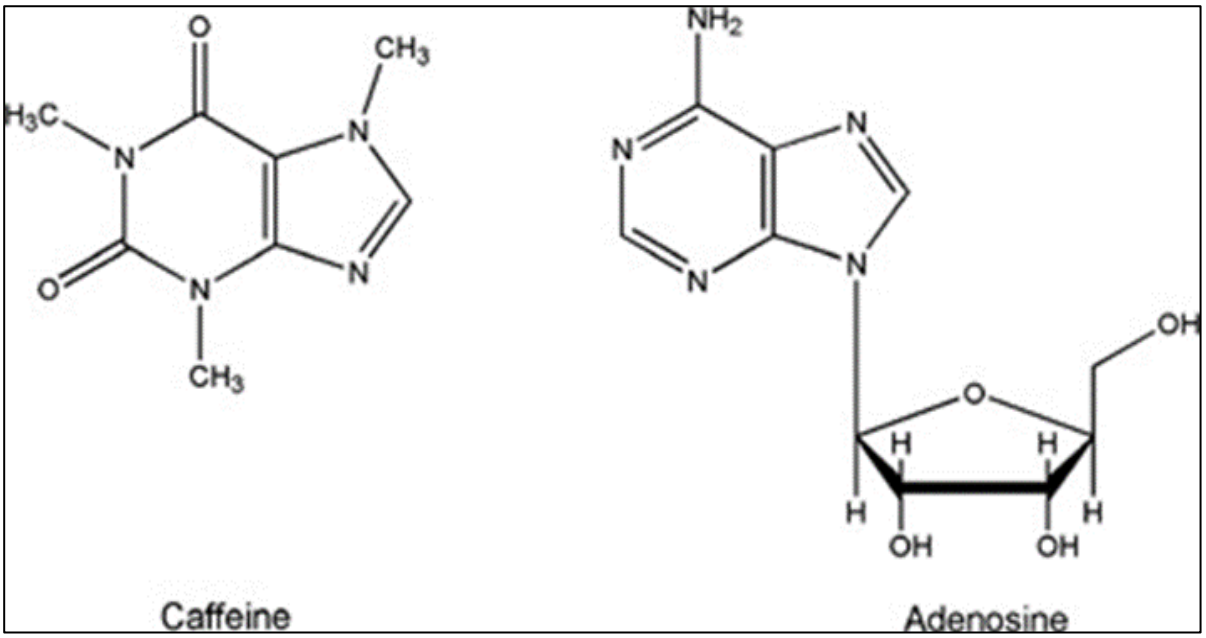

Figure 1. Chemical structures of caffeine and adenosine (12).

Caffeine is taken up and absorbed through food or synthetically. Once absorbed, it reaches all body cells. It then crosses the blood-brain barrier rapidly and is metabolized by the liver's P450 1A2 (CYP1A2) enzyme. Caffeine responses of individuals are different due to polymorphism in the CYP1A2 gene. After oral ingestion of caffeine, mostly in the form of coffee or tea, 99% is absorbed into the bloodstream from the gastrointestinal tract and peaks 30-60 minutes after eating. Caffeine absorption is between 45 and 80 minutes for caffeine-containing chewing gum, and 85-120 minutes for caffeine-containing capsules (13).

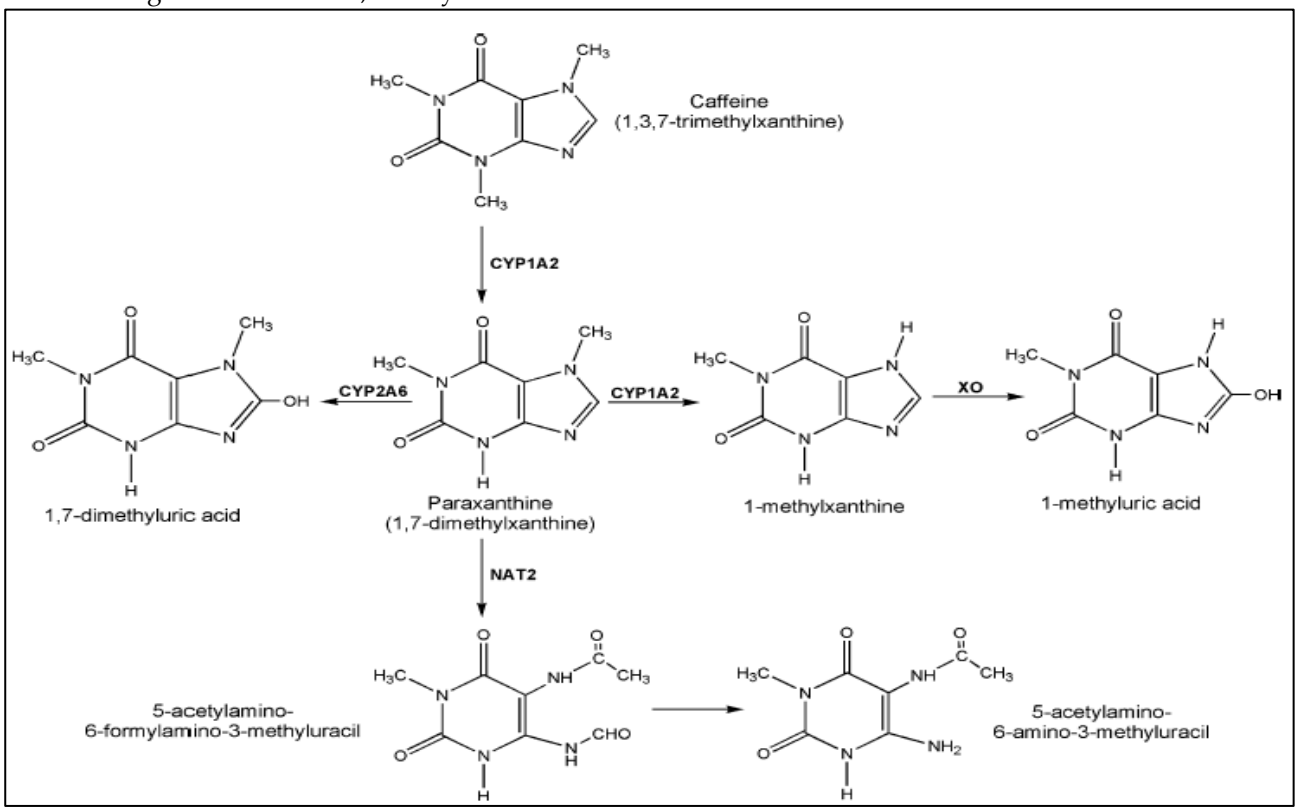

Figure 2. Main pathways in caffeine metabolism (12). Abbreviations: CYP1A2, cytochrome P450 1A2; CYP2A6, cytochrome P450 2A6; NAT2, N- acetyl transferase 2; XO, xanthine oxidase.

Table 1. Caffeine Amounts of Some Foods and Beverages

Food/Beverages	Amount	Caffeine (mg)
Cafe Latte /Cappuccino	200 mL	126
Filter Coffee / Black Coffee	200 mL	130
Espresso	200 mL	388
Nescafe	200 mL	62
Turkish Coffee	100 mL	58
Brewing Bag / Black Tea	100 mL	21
Green Tea	100 mL	15
Herbal Tea	240 mL	0
Redbull	250 mL	80
Energy Drinks	330 mL	100
Coffee With Milk	250 mL	158
Dark Chocolate	50 g	50
Hazelnut Chocolate	50 g	3
Chocolate Bar / Nougat	50 g	3
Chocolate Sauce	20 g	6
Chocolate Bar	50 g	9

Caffeine ergogenicity has effects on the muscle that can directly contribute. The most likely way that caffeine can benefit muscle contraction is through calcium ion (Ca2+) mobilization, which facilitates force generation by each motor unit (15-17). Fatigue caused by the gradual reduction of Ca2+ release can be alleviated after caffeine intake (17, 18). Similarly; Caffeine, partially increased sodium/potassium pump activity (Na+/K+) potentially increases the stimulation-contraction matching required for muscle contraction (19). Caffeine appears to use its effects in various parts of the body, but the most solid evidence suggests that the main target is in the CNS, which is now considered the primary mechanism by which caffeine alters mental and physical performance (20). It is believed that caffeine exerts its effects on the CNS through antagonism of adenosine receptors and leads to increases in neurotransmitter release, motor unit firing rates, and pain suppression (21-23). Adenosine is involved in numerous physiological processes and plays a very important role as a homeostatic regulator and neuromodulator in the nervous system. The main known effects of adenosine are; It is to reduce the concentration of many neurotransmitters in the CNS, including serotonin, dopamine, acetylcholine, norepinephrine, and glutamate. Having a molecular structure similar to adenosine, caffeine binds to adenosine receptors after ingestion and therefore increases the concentration of these neurotransmitters (24, 25). This has positive effects on mood, alertness, focus, and mental vitality in most, if not all individuals (26-28). Caffeine can be used effectively to manipulate our mental state. It is widely consumed in the form of coffee to get rid of sleepiness. People avoid coffee consumption when they do not want their sleep to be affected negatively.

Caffeine and Exercise

The ergogenic potential of caffeine has been extensively studied in the sports and exercise science literature dating back to 1907 (29). The effect of caffeine on exercise performance can be listed as follows (30).

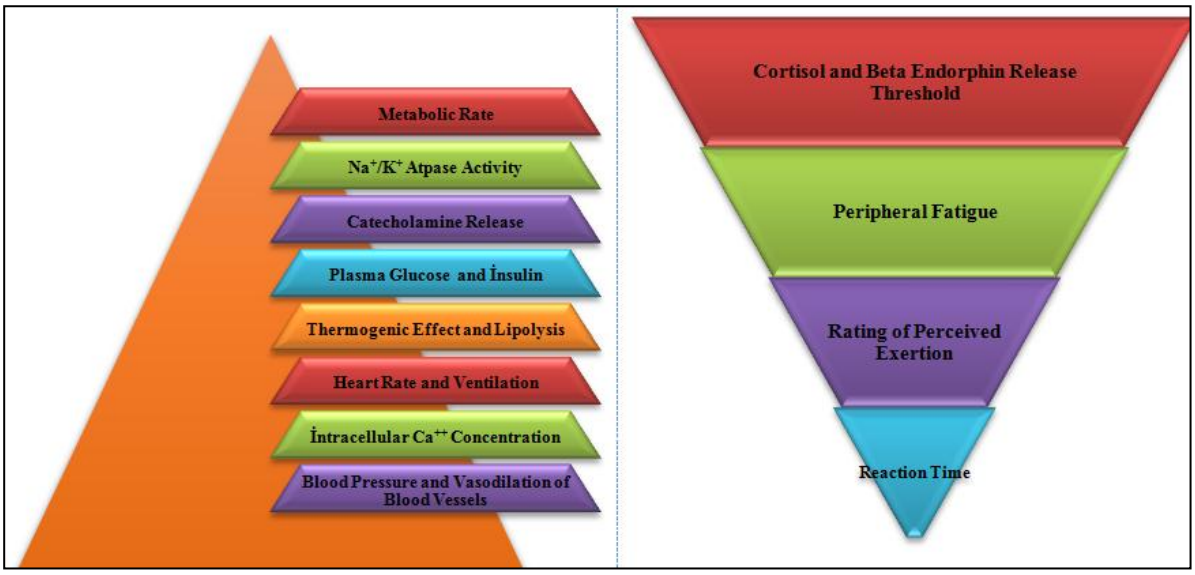

Figure 3. Caffeine and Performance Relationship. Δ: increased, ∇ : decreased

Effect of Caffeine on Aerobic Performance

Caffeine is an ergogenic aid preferred by athletes or active individuals in a wide variety of sports and activities involving aerobic endurance. A positive effect on performance has been proven in a variety of endurance sports, including cycling (31, 32), running (33, 34), cross-country skiing (35), and swimming (36).

Studies show that caffeine intake (eg, 3-9 mg / kg taken 30-90 minutes before exercise) can reduce carbohydrate use during exercise, thereby increasing endurance exercise capacity (37). In a study involving 8 trained cyclists and triathletes accustomed to consuming low doses of caffeine (≤300 mg / day), participants consumed beverages consisting of caffeine (5 mg / kg), instant coffee (5 mg/kg caffeine), instant decaffeinated coffee or placebo 1 h before exercise. The results of the study found that both caffeine (5 mg / kg) and coffee (5mg / kg caffeine) consumed 1 h before exercise could improve endurance exercise performance (38). In a study conducted on cyclists, it was determined that among those who consumed caffeinated coffee or decaffeinated coffee (6 mg / kg) 60 minutes before exercise, those who consumed caffeinated coffee had a positive effect on performance (39).

Many studies have shown that caffeine intake at the level of 3-6 mg / kg / day increases endurance by 2-4% (31, 32, 40, 41).

Effect of Caffeine on Anaerobic Performance

Anaerobic performance is a term of great importance for sports branches that are completed in a short time or require explosive force. Regular trainings cause an increase in the anaerobic performance of athletes. Athletes use a variety of ergogenic supplements to further increase anaerobic performance. Caffeine is of great importance in these ergogenic supplements.

In a study of 21 well-trained male participants, a gelatin capsule (30m; repeated at 35-second intervals) containing caffeine (5 mg / kg) and placebo (maltodextrin) taken 1 h before completing a multi-sprint trial was found to have an ergogenic effect on performance (42). In another study, it was determined that caffeine improves repetitive sprint performance but does not affect maximum strength and fatigue (43). In a study conducted by giving caffeine at a dose of 6 mg / kg to participants who are not trained in a particular sport, it was found that the maximal cycling speed of 2×60 seconds increased (44). In studies investigating the effect of caffeine given at the level of 5-6 mg / kg / day on anaerobic power in non-training individuals, it was found that performance did not change (45, 46) or increased (47).

Considering the studies that summarize the effectiveness of caffeine on short-term anaerobic exercises, it is seen that the use of caffeine in such exercises is less, and there is no consensus on the results. Therefore, it seems that more studies need to be performed on the relationship between caffeine and short-term exercise. In general, although the results are heterogeneous, it has been reported that caffeine supplementation at doses of 4-6 mg / kg on multiple and single sprint activities requiring high-intensity effort significantly increases performance in athletes with high training level while the same

positive effect was not observed in participant groups with low training level.

The Effect of Caffeine on Strength Performance

Strength development through resistance training is an important component of conditioning programs for both fitness and competitive sports and activities. The most common consumption form preferred by individuals with or without training in strength studies is caffeine taken at the level of 3-6 mg / kg (2-11 mg / kg) 90 minutes before exercise in the form of pills or capsules. Although several studies have been published by ISSN (International Society of Sports Nutrition) since 2010, investigating the effects of caffeine on strength performance (48), some uncertainties persist in the performance enhancing effect of caffeine in activities involving muscle endurance, strength, and power.

Table 2. Investigations examining the effects of caffeine on exercise performance

References	Participants	Exercise Protocol	Cafe Dose	Conclusion
Grgic J et al. (49)	Resistance trained male (n=22)	1RM barbell bench press and leg press and 60% at 1RM again until exhaustion	**6 mg / kg**	↑ The total weight removed during the 60% 1RM trial was 11% and 12% higher for bench press and leg press with caffeine compared to placebo but still did not reach significance. ↔ The perceived intensity was similar to caffeine versus placebo at the end of resistance exercise. ↔ Acute caffeine intake did not significantly alter muscle strength or endurance during intense bench press or leg press exercise.
Norum M. et al. (50)	Resistance trained female (n=15)	Squats, bench press, countermovement jumps (CMJ) until exhaustion at 60% 1RM	**4 mg / kg**	↑ *Caffeine significantly improved repetitions in squats and bench press to exhaustion compared to placebo. ↑ *Caffeine significantly increased CMJ height and strength.
Goldstein E. et al. (51)	Resistance trained female (n=15)	1RM barbell bench press and repeat until exhaustion at 60% 1RM	**6 mg / kg**	↑ A significantly higher bench press maximum was seen with caffeine at 60% 1RM repeats with no significant difference between conditions. ↑ Systolic blood pressure was significantly higher after exercise with caffeine.
Timmins TD and Saunders DH (52)	Resistance trained male (n=16)	Maximal voluntary contraction; The isokinetic peak torque of knee extensors, ankle plantar flexors, elbow flexors and wrist flexors was measured at an angular velocity of 60 ° / s.	**6 mg / kg**	↑ Caffeine increased the maximal voluntary contractile strength in resistance training men, regardless of the position of the muscle group. ↑ Although the improvement in peak torque increased according to muscle group size, its effect was not clear.
Woolf K. et al. (53)	High-level fitness male team athlete (n = 18)	Leg press, chest press ve wingate testi	**5 mg / kg**	↑ With caffeine, the more total weight was lifted on the chest press and a higher peak strength was achieved during the Wingate test. ↔ No difference was found between caffeine and placebo for average strength, minimum strength, and power drop (Wingate test) on leg press. ↑ Higher insulin and glucose concentrations were observed after exercise with caffeine. ↑ Systolic blood pressure was significantly higher after exercise with caffeine. ↔ No difference was found between caffeine and placebo for free fatty acid concentrations, plasma lactate concentrations, cortisol concentrations, heart rate, and perceived intensity.
Beck TW. et al. (54)	Resistance trained male (n=31)	1RM bench press power and time to exhaustion at a speed corresponding to 85% of VO2max	**201 mg (2.1-3 mg / kg)**	↔ It was observed that caffeine did not contribute to the exercises.
Wilk M. et al. (55)	Male bodybuilding with caffeine habits (n = 16)	1RM strength test, muscle endurance at 50% 1RM	**9-11 mg / kg**	↔ It was observed that high-dose acute caffeine supplementation did not increase muscle strength or muscle endurance in athletes with caffeine habits.
Trevino MA. et al. (56)	Recreatively active male (n = 13)	3 maximum isometric muscle movements of the elbow flexors	**5-10 mg / kg**	↔ It was observed that caffeine supplementation did not provide an ergogenic effect for elbow flexors during isometric muscle movements.

Astorino TA. et al.(38)	Resistance trained male (n=22)	1RM bench press and leg press, repeat until it is exhausted at 60% 1RM	**6 mg / kg**	↔	Bench press and leg press 1RM, there was no significant increase in caffeine-boosted participants.
Glaister M. et al.(42)	Well-trained male (n = 21)	Multiple sprint test consisting of 12×30 m straight-line sprints repeated at 35 second intervals	**5 mg / kg**	↑	Caffeine has been shown to have ergogenic properties with the potential to benefit performance in both single and multiple sprint sports.
Trexler ET. et al.(43)	Well-trained male (n = 21)	Single reps for leg press and bench press at 80% of 1RM and repetitions to fatigue at 1RM	**300 mg (powder) 303 mg (coffee)**	↑ ↔	It has been observed that caffeine can improve repetitive sprint performance. It was observed that caffeine did not affect repetitions for maximum strength and fatigue using both upper body and lower body exercises.
Crowe MJ. et al. (44)	Untrained male (n = 12), Untrained female (n = 5)	2 × 60 seconds maximal cycling	**6 mg / kg**	↓	It was observed that peak power was reached in a shorter time in the second of 2 × 60 seconds maximal cycling.
Collomp K. et al. (45)	Untrained male participating in non-specific sports activities only 2-3 h per week (n = 3), untrained female participating in non-specific sports activities only 2-3 h per week (n = 3)	30-second wingate test	**5 mg / kg**	↔	*Caffeine did not appear to cause a significant increase in performance for peak power or total work load.
Greer F. et al. (47)	Recreatively active male (n = 9)	30-second wingate test (2 separate sections, 4 minutes interval)	**6 mg / kg**	↓ ↔ ↔	The last two of the four wingate test showed a decrease in strength compared to the placebo. Caffeine did not appear to have a significant effect on blood lactate, O2 consumption, or aerobic additives at any time during the protocol. No ergogenic effects of caffeine on power output were observed during repetitive periods of short intense exercise.
Lorino AJ. et al. (46)	Untrained male (n = 16)	Agility run and 30-second Wingate test	**6 mg / kg**	↔	Caffeine did not seem to provide significantly better performance for agility running and the 30-second wingate test.

Bold text associated with reported trial outcomes; * delineates a significant change, ↔ = no improvement/change, ↑ = improved performance, ↓ = decreased, 1RM = repetitive maximal, VO_{2max} = maximum oxygen consumption

Forms of Caffeine

Although caffeine is often taken through beverages such as tea and coffee, it can be consumed in different forms to examine its effect on sports performance and to be consumed most beneficially. Caffeine in athletes; caffeinated bars and gels, caffeinated chewing gum, caffeinated energy drinks, caffeinated nasal and mouth aerosol sprays, and caffeinated mouthwashes.

Studies show that bars and gels containing 100 mg of caffeine improve cognitive function, exhaustion time, and time trial performance. Although plasma caffeine measurements are lacking in these studies, it can be assumed that the increases will mimic the findings obtained from caffeine tablet and coffee consumption (57-60). Since caffeinated bars and gels are key sources of caffeine for athletes during training and competition, and there are currently no studies examining female participants, more research is needed in this area. Studies show that caffeine in chewing gum at a dose of 200-300 mg is ergogenic when given before or during an endurance exercise in well-trained women and male cyclists (61). Current literature does not support the ergogenic effects of caffeine supplements administered in the form of energy drinks. However, additional studies are needed to examine the effectiveness of individual components of caffeinated energy drinks on performance (62).

The consumption of caffeine in the form of mouth and nasal sprays enables the stimulating physiological effect to begin very quickly. Caffeine is poured into the person's tongue in combination with a carrier and a breath freshener, as a liquid spray or directly into the person's tongue. It is rapidly absorbed from the intestinal buccal membrane. It has been suggested that caffeine mouthwash exerts its ergogenic effects by allowing caffeine molecules to bind to adenosine receptors in the mouth and inhibit adenosine competitively (63, 64). This interaction is thought to increase the permeability of the buccal mucosa and thus trigger caffeine absorption into the bloodstream (65). Another mechanism of action is mentioned to explain the performance benefits associated with caffeinated mouthwash. The oral cavity is decorated with bitter taste receptor cells, especially found in the oropharyngeal epithelium, and these have been shown to be activated when exposed to caffeine. It has been suggested that activation of these bitter taste receptors can activate taste neural pathways and ultimately stimulate brain regions associated with information processing and reward. Although it has been reported that caffeinated aerosol mouth and nasal sprays can stimulate nerves with direct brain connections and enter the blood through mucosal and pulmonary absorption, research on this condition is scarce (62).

The Effect of Caffeine on Cognitive Performance

For centuries, caffeine, usually taken in the form of coffee or tea, has been a popular tool for enhancing various aspects of mental or cognitive functions (28). In addition to exercise performance; Continuous cognitive function is also important because of the routine work requirements of caffeine. Although there is widespread scientific work on the behavioral effects of caffeine, some details regarding specific functional aspects remain controversial (66). While there is a general consensus that caffeine improves “lower” cognitive functions such as simple reaction time, the effects of caffeine on “higher” cognitive functions such as problem solving and decision making are often debated. This is partly because there are fewer published studies of higher-level cognitive function and the available ones differ greatly from the methods used (67).

Caffeine increases arousal in a dose-dependent manner; low doses can improve hedonic tone and reduce anxiety, while high doses can increase symptoms of anxiety, irritability, and tension (68). How caffeine affects performance depends in part on the level of arousal of the individuals studied, particularly the extent to which the participants were sleep deprived or how tired or well rested. One study evaluated the classic inverted-U hypothesis in terms of caffeine to what extent stimulation improves or impairs performance (69). According to the Yerkes-Dodson law, there is an empirical relationship between arousal and performance, such that low arousal is associated with poor performance, while increased physiological or mental arousal is associated with improved performance, but only to a range (70). When the arousal level increases too much, performance decreases. Thus, the individual's pre-dose arousal level before consuming caffeine will affect the effects observed (71). Giving a large dose of caffeine to a person who is seriously tired will improve performance because in this case caffeine promotes an appropriate level of arousal (i.e., caffeine advances the individual's stimulation towards the middle range of the Yerkes-Dodson curve). Conversely, giving the same dose to someone who is already well rested and highly aroused may decrease rather than improve performance because in this case caffeine produces an over-arousal state that will impair cognition according to the Yerkes-Dodson law (72).

Table 3. Investigations examining the effects of caffeine on cognitive performance

References	Participants	Cafe Dose		Conclusion
Brunyé TT. et al. (67)	University student male (n = 16) and female (n = 20)	100 mg 200 mg **400 mg**	↑ ↑ ↑	It was observed that caffeine improved participants' skills to use warning cues efficiently and to avoid the impact of information incompatible with the action. Caffeine has been shown to improve performance in tasks that require constant attention and attention. It has been observed that caffeine has different effects on visual attention networks as a function of dose, and these effects have implications for the interactions of caffeine, adenosine and dopamine in the brain areas that direct visual attention.
Hogervorst E. et al.(58)	Well-trained cyclist male (n = 24)	**100 mg**	↑ ↑	It was observed that caffeine increased speed in Rapid Visual Information Processing Tests. It was seen that complex cognitive ability increased significantly.
Antonio J. et al.(73)	In training men (n=11), in training women (n=9)	**4 mg/kg**	↓ ↑	The energy drinks psychomotor vigilance ensured a shorter average reaction time. Caffeine significantly improved psychomotor alertness performance, a constant attention task.
McLellan TM. et al. (74)	Soldier ((n=31)	**200 mg**	↑	Continuous alertness was maintained in the control, observation and exploratory vigilance task.
McLellan TM. et al. (75)	Soldier (n=20)	**600 mg**	↑	It was observed that the alertness increased.
Kamimori G. et al.(76)	Special Forces Operators (n=20)	**4×200 mg**	↑ ↔	It was observed that the response speed increased during sustained psychomotor speed, enhanced event perception, the number of correct responses to stimuli, and logical reasoning tests. No changes were observed in gun shooting.
Tikuisis P. et al.(77)	Soldier (n=20)	**400 mg** 100 mg	↑	There was an increase in the cognitive component of the gun shooting mission.
Zhang Y. et al.(78)	Fireman (n=10)	**400 mg**	↔	No changes were observed in perceived difficulty, mood reaction time, short-term memory and recall memory.
Share B. et al.(79)	Elite sniper male (n=7)	**2 mg / kg** **4 mg / kg**	↔	No difference was observed in shooting accuracy, response time, or target tracking time between groups.
Stuart GR. et al. (80)	Competitive Rugby players male (n=9)	**6 mg / kg**	↑	There was a significant increase in correct passing ability.
Karayigit, R. et al. (81)	Female athletes (n=17)	**3 mg / kg** **6 mg / kg**	↑	Caffeine has been shown to improve cognitive performance.
Khcharem A. et al.(82)	Recreational running (n=10)	**5 mg / kg**	↑ ↓	Caffeine was cognitively processed by applying the correct fine after complete sleep deprivation. Caffeine has been shown to affect cognitive performance by reacting after complete sleep deprivation.

Bold text associated with reported trial outcomes; * delineates a significant change, ↔ = no improvement/change, ↑ = improved performance/change, ↓ = decreased, 1RM = repetitive maximal, VO_{2max} = maximum oxygen consumption

Caffeine and Fat Metabolism

The list of supplements that claim to increase or improve fat metabolism is long; The most popular supplements include caffeine, carnitine, green tea, conjugated linoleic acid, forskolin, chromium, seaweed, and fucoxanthin (83). Much of the interest in caffeine's effects on metabolism stems from exercise physiology studies in the 1970s. Early research by Costill et al. Showed that taking caffeine (coffee and pure caffeine) before a workout significantly increases fat oxidation rates and performance (84). Essig et al. also reported a shift in substrate metabolism from carbohydrate to fat during exercise following caffeine intake, accompanied by a slight increase in serum plasma fatty acid concentrations (85). The theory is that caffeine activates fat and preserves muscle glycogen, resulting in increased performance. Later, these two effects separated from each other and it was reported that the ergogenic effect of caffeine was mostly due to central mechanisms. Thus, caffeine has been shown to increase sympathetic nervous system activity and release fatty acids from adipose and / or intramuscular stores. This mechanism, which occurs indirectly through increased adrenaline levels, has the potential to increase the availability of fatty acids for oxidation. Caffeine also has a direct effect on lipolysis. Acheson et al found that administration of high doses of caffeine (8 mg / kg) significantly increased the resting metabolic rate (RMR) [20 kJ / (m2*h)] within 3 h after eating (86). Dulloo et al. reported that even low doses of caffeine (100 mg) have the potential to cause a thermogenic effect at rest. Over a period of 150 minutes, RMR increased by 3-4% in both lean and obese individuals. In the same study, the RMR (8-11% increase) was further increased when caffeine was taken at repeated doses (2 h intervals over 12 h) (87). It is not known whether this increase is due to increased fat oxidation, increased carbohydrate oxidation, or both. It has been emphasized before that the finding that caffeine can increase fat oxidation is not new. Although there are a few studies that support this result, there are also studies showing that the cafe does not affect on fat oxidation. These results, on the other hand, spoil a general opinion on the subject. The different results can be explained by the exercise intensity or the participant population used in the studies.

Caffeine and Hydration

Dehydration refers to an imbalance in fluid dynamics (water and electrolyte balance) when fluid consumption fails to meet the needs of our body (88). In a study where participants exercised at 70-75% VO2max until their self-determined exhaustion, participants were given 5 mg / kg caffeine 2 h and half an h before exercise, followed by 2.5 mg / kg caffeine, respectively. There was no difference in dehydration in the caffeine group compared with placebo (89). In a study, just before running exercise, participants completed the 10-second mouthwash protocol with 300 mg of caffeine or placebo diluted in 25mL of water, and caffeine mouthwash did not change hydration status or sweat rate after a 10km run (90). In a study examining the effects of caffeine at different ambient temperatures (12 and 33°C), participants who performed endurance cycling exercises were provided 3 mg / kg of caffeine 60 minutes before and after exercise. Sweating rates differed between 12 and 33°C, but no difference was observed when comparing caffeine versus placebo (91). In addition, when the ISSN's review on caffeine and performance, published in 2010, was examined, it was observed that there was no change in urine and blood volume during the resting period, and the amount of sweat during exercise was not different in both cases (48). In a study of 50 men who drink coffee regularly, there was no difference in the volume of urine produced over 24 h, despite caffeine intake of 240 mg or more per day. In this study, participants consumed 4x200 ml of water and coffee containing 4 mg / kg of caffeine for 3 days (doses ranged from 204 to 453 mg of caffeine). Post-study data also revealed that there was no difference between the two groups for blood and urine markers of measured hydration level (92). Indeed, when caffeine intake is 200-450 mg or 2.5-4 mg / kg per day, there is no diuretic effect due to caffeine consumption. It should also be remembered that people who do not drink coffee regularly or have not had coffee for a certain period of time are more likely to temporarily respond to caffeine. On the other hand, regular caffeine intake develops a higher tolerance to the diuretic effect, even at higher doses.

The Effect of Caffeine Consumption Habit on Performance

Quantifying habitual caffeine intake is difficult to quantify, which is problematic for studies aiming to compare performance results following habitual caffeine intake with unconventional caffeine users. This concern is highlighted by reports that vary widely in the caffeine content of commonly consumed beverages. Taking into account the daily caffeine intake of all subjects enrolled in a given study is the standard procedure for a research protocol. The purpose of determining such dietary information is to determine whether caffeine consumption has an effect on performance and whether this result is different between a person who regularly consumes caffeine or not. Bell et al. Studied the effect of moderate doses of caffeine on subjects defined as the user (300 mg / day) and non-user (50 mg / day). The results showed an increase in performance for both groups; however, the

effect of supplementation lasted approximately three h longer in subjects identified as non-users (93). Similarly, in a study describing caffeine habits among participants, there was no statistical difference for VO2max between groups (participants participated in a boost exercise protocol), but there was a significant difference in ventilation and heart rate for people who did not habitually caffeine at rest (94). In addition, another study reported no significant difference between caffeine users and those who did not, except for an increase in plasma epinephrine during exercise for caffeine naïve subjects compared with placebo (95).

Optimal Timing of Caffeine Supplement

Because plasma caffeine levels typically peak within 60 minutes of intake (96, 97), the timing of caffeine consumption relative to exercise should be considered. In a study where a 40 km time trial performance was performed, participants were given 6 mg / kg of caffeine 1 h before or just before exercise. Caffeine consumed 60 minutes before exercise resulted in significant improvements in the 40 km trail performance. The ergogenic effect of caffeine was found to be unrelated to the highest concentration of caffeine in the blood at the start of endurance exercise (98). In a study in which caffeine was provided in the chewing gum at 75% VO2max 5 minutes, 60 minutes, and 120 minutes before 15 minutes of cycling exercise, caffeine applied in the chewing gum increased performance when applied immediately before, not 1 or 2 h before exercise (61). In a study conducted to examine the effect of caffeine supplementation on cycling performance of 3 km more, at what time of the day it occurred, it was observed that caffeine was more effective in exercise performed before 10:00 than in exercise performed after 10:00. The greater effectiveness of caffeine in the morning may be attributed to the higher activity of the CYP1A2 enzyme in the morning than in the evening (99). In a study to determine the optimal timing of caffeine intake, participants were provided with 6 mg / kg of caffeine 30 minutes, 60 minutes, and 120 minutes before exercise. Caffeine timing before exercise provided the most consistent ergogenic benefits 1 h earlier compared to other time points, especially compared to 2 h (100). One study in which 5 mg / kg of caffeine was provided 1 h, 3 h, and 6 h before exercise concluded that the increase in performance was seen only when caffeine was taken 1 and 3 h before (93). In a study by Cox et al., 6 mg / kg of caffeine was provided in capsule form 1 h before exercise and six doses of 1 mg / kg caffeine every 20 minutes during exercise, with the significant difference being achieved with caffeine taken before exercise (101). Unlike other studies, in a study in which low (100 mg) and medium (200 mg) doses of caffeine were provided towards the end of the exercise, both doses given late were found to improve performance (102). Studies conducted for the optimal timing of caffeine intake are inconsistent. The uncertainty of the results may be due to the form of caffeine used, the individual characteristics of the participants, and the different caffeine consumption habits.

Caffeine and Doping

The World Anti-Doping Agency (WADA) explains what substances considered doping are in its annual statement. Until 2004, caffeine was also an ergogenic aid that was considered among these substances. However, WADA removed caffeine from the prohibited list as of 2004. It has been shown that caffeine supplementation in the 3-6 mg / kg range in training athletes can significantly improve both endurance and high-intensity performance. The International Olympic Committee sets an allowable limit for 12 μg of caffeine per ml of urine (103, 104). Approximately one hour before the competition, the caffeine dose in the range of 9-13 mg / kg will reach the maximum urine concentration permitted for competition (103). However, it should be kept in mind that caffeine consumption and urine concentration are dependent on factors such as gender and body weight (105). Consuming 6-8 cups of coffee containing approximately 100 mg of caffeine per cup results in the maximum permissible urine concentration (104, 105). According to The National Collegiate Athletic Association, urine concentrations in excess of 15μg/ml after the competition are considered illegal (106). WADA, on the other hand, does not consider caffeine a ban, but has included it in the list of must-watch in athletic competition.

CONCLUSION

The scientific literature on caffeine supplements is extensive. It is clear that caffeine is indeed ergogenic for sports performance, but specific to the athlete's condition, the intensity, duration, and type of exercise. Therefore, after reviewing the available literature, the following conclusions can be drawn:

- Caffeine is one of the most preferred ergogenic supplements by athletes after being removed from the prohibited list by WADA as of 2004.

- Caffeine makes the person feel more vigorous thanks to the antagonist effect it creates with adenosine.

Most of the studies have used a protocol in which caffeine is taken 60 minutes before the performance to ensure optimal absorption.

• It has been observed that moderate (3-6 mg / kg) caffeine intake contributes to sports performance in strength / strength exercises and long-term exercises.

• In the studies conducted, caffeine; Its use in caffeinated bars and gels, caffeinated chewing gum, caffeinated energy drinks, caffeinated nasal and mouth aerosol sprays, and caffeinated mouthwashes have been shown to have additional benefit potential depending on the type of exercise.

• When the effect of caffeine on cognitive performance was examined, it was seen that 200-300 mg of caffeine consumption positively affected cognitive performance, improved psychomotor alertness reaction time, and mood.

• It has been observed that pre-exercise caffeine consumption supports fat metabolism and increases the use of fat as a substrate in energy metabolism, in addition to increasing the resting metabolic rate.

• Scientific literature suggests that 2.5-4 mg / kg caffeine intake does not cause diuresis, contrary to what is known.

• While recommending caffeine supplements to athletes, individual recommendations should be made, keeping in mind that caffeine consumption habits may affect the ergogenicity of caffeine.

• Caffeine supplementation at doses of 4-6 mg / kg on multiple and single sprint activities requiring high intensity efforts is suitable for use as it significantly increases performance in athletes with high training levels.

• Considering the positive effect of caffeine on fat metabolism, it is appropriate to use it before exercise in athletes who aim to lose weight and / or burn fat.

• The positive effects of caffeine supplementation on cognitive performance can be evaluated particularly in professions where cognitive alertness is important, such as military personnel or firemen.

• In future studies, the ergogenic effect of caffeine should be clarified by focusing on questions such as (I) what time of the day caffeine consumption affects caffeine ergogenicity, (II) what is the importance of genotype in terms of caffeine consumption, (III) what is the effect of age on caffeine ergogenicity, (IV) does caffeine ergogenicity vary according to athlete's training level.

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The Effect of Hand Anthropometric Variables on Grip Strength in Grip Elite Athletes and Non-Athletes

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Abstract

In this study, we aimed to determine the anthropometric variables that affect grip strength and to investigate how and to what extent these variables change grip strength in elite athletes and non-athletes. Totally, 74 subjects aged between 18 and 27 participated in this study in two groups including: elite athletes (n=32), and non-athletes (n=42). In our study, 26 hand anthropometric variables were measured on each subject's dominant hand. The selection of the anthropometric parameters was limited only to those that are considered to have an association with handgrip strength. Independent t-test or Mann-Whitney U Test was applied for group comparison. Stepwise multiple linear regression analysis was utilized and Backward selection procedure was also performed to identify the relationship between handgrip strength and anthropometric measurements. Results revealed that some anthropometric measurements of hand significantly higher in elite athlete group than non-athlete group in males and females ($p<0.05$). In conclusion, we found that some hand anthropometric parameters are different in the grip sports and non-athletes, but we cannot exactly determine whether specific sport activities affect these differences or the inherent characteristics of athletes lead them to these sports. Also the handgrip strength of hand related athletes was more than that of non-athletes. This may be because of hand anthropometric parameters. Actually, good positive correlation between handgrip strengths and anthropometric characteristics of hand in grip athletes showed the effect of hand anthropometry on handgrip strength in athletes who use their hands for grasping a ball or opponent.

Keywords: Anthropometry, Handgrip strength, Pinch strength.

Elit Sporcularda ve Sporcu Olmayan Bireylerde El Antropometrik Değişkenlerinin Kavrama Kuvveti Üzerine Etkisi

Özet

Bu çalışmada; kavrama kuvvetini etkileyen antropometrik değişkenleri belirlemeyi ve bu değişkenlerin elit sporcularda ve sporcu olmayan bireylerde kavrama kuvvetini nasıl ve ne ölçüde değiştirdiğini araştırmayı amaçladık. Çalışmaya yaşları 18-27 arasında değişen elit sporcular (n = 32) ve sporcu olmayanlar (n = 42) olmak üzere toplamda 74 denek katıldı. Çalışmamızda, 26 adet el antropometrik parametresi, her bir deneğin baskın elinden alındı. Antropometrik parametrelerin seçimi, yalnızca kavrama kuvveti ile bir ilişkisi olduğu düşünülen parametreler ile sınırlı olarak yapıldı. Grup karşılaştırmaları için bağımsız t-testi veya Mann-Whitney U Testi uygulandı. Aşamalı çoklu doğrusal regresyon analizi kullanıldı ve aynı zamanda, kavrama kuvveti ile antropometrik ölçümler arasındaki ilişkiyi belirlemek için Backward seçim prosedürü uygulandı. El ile ilgili bazı antropometrik ölçümlerin elit sporcu grubunda sporcu olmayan gruba göre erkek ve kadınlarda anlamlı olarak daha yüksek olduğu görüldü ($p <0.05$). Sonuç olarak, bazı el antropometrik parametrelerinin kavrama sporlarında ve sporcu olmayanlarda farklı olduğunu bulduk, ancak belirli spor faaliyetlerinin bu farklılıkları etkileyip etkilemediğini veya sporcuların içsel özelliklerinin onları bu sporlara yönlendirip yönlendirmediğini tam olarak belirleyemedik. Ayrıca el ile ilgili sporcuların kavrama gücü, sporcu olmayanlara göre daha fazlaydı. Bunun nedeni el antropometrik parametreleri olabileceği kanısındayız. Aslında, kavrama kuvveti ile sporcuların antropometrik değişkenleri arasındaki iyi pozitif korelasyon, ellerini bir topu veya rakibi kavramak için kullanan sporcularda el antropometrisinin el kavrama gücü üzerindeki etkisini göstermiştir.

Anahtar Kelimeler: Antropometri, El kavrama kuvveti, Parmak kavrama kuvveti.

INTRODUCTION

Anthropometric measurements are widely used to assess and predict performance in various sports. Anthropometric measurements and morphological characteristics play an important role in determining the success of a sportsperson. An athlete's anthropometric and physical characteristics may represent important prerequisites for successful participation in any given sport. Indeed, it can be assumed that an athlete's anthropometric characteristics can in some way influence his/her level of performance, at the same time helping to determine a suitable physique for a certain sport (21).

The human hand is unique in being free of habitual locomotor duty and devoted entirely to functions of manipulation. Its effectiveness in these activities is due to particular configuration of the bones and muscles which permits opposition of the pulp surface of the thumb to the corresponding surfaces of the other four finger tips in a firm grasp, together with a highly elaborated nervous control and sensitivity of the fingers (4).

Primarily adapted for reaching, grasping and manipulating, the hand functions include activities, such as pushing, adjusting objects, striking blows, and supporting the body in space (16). The grasping of an object is the outcome of simultaneous movements at several joints- transporting the hand to the object, pre-shaping the fingers into an appropriate grip and orienting the wrist. All these movements may differ widely but they all attend the same final purpose: to achieve a stable grasp for holding and manipulating the object. The literature related to the human hand is numerous and related to the structural issues and problems of mobility and forms of grasping (25). The role of the different hand anthropometric variables which produce different force is not well defined.

Handgrip strength is the maximal power of forceful voluntary flexion of all fingers under normal biokinetic conditions (5, 7, 11, 13, 26). Handgrip strength determines the muscular strength of an individual (7). It is a useful indicator of potential declines in physical mobility, cognitive status, health-related quality of life, general physical function and mortality risk (12). This strength is important for catching and throwing the object in different sport branches. In tennis, grip strength when holding a racket is very influential on the results of service punches. In the service stroke the grip strength is the dominant component. Because the greater the grip strength, the racket will not be released or thrown and the greater the power generated in making service punches. In this case it is seen that grip strength is a dominant factor in achieving service accuracy (1). Also, when the fingers are longer and hand surface variables greater than required for grasping an object, fingers will less widely spread, and grasping an object will become more efficient and less fatiguing (7, 24).

With regard to grasping an object, ball or opponent, all sports can be divided into two groups: grasping or grip sports and non-grip sports. In grip sports, like basketball and handball, the greater hand surface, the better the accuracy of the shot or throw. It can be proposed that athletes with greater hand surface also have greater handgrip strength (7, 24). Fallahi and Jadidian (7) stated that handgrip strength was significantly different between handgrip-related athletes and non-athletes. Also, approximately all hand anthropometric characteristics of grip athletes significantly correlated with handgrip strength, which indicates that these variables may have a positive effect on handgrip strength. Visnapuu and Jurimae (24) have indicated that some specific hand anthropometric parameters, especially finger lengths and perimeters, significantly correlated with maximal handgrip strength. Also Otterson and DeBeliso (18) in their study on non-grip athletes such as football players, have indicated that athletes who demonstrated higher ratios of HGS/BM (body mass) performed better in indicators of football performance.

In sports, strength is known to increase sporting success and performance. Especially, handgrip strength is the most important determinant. Handgrip strength is a physical trait that plays an important role providing effectiveness and efficiency during daily work and sports activities. Moreover, in terms of performance, handgrip is an important indicator in many sports (26). For example, during the sambo match, most of the time is spent on gripping the opponent's jacket (sambo uniform), and fighting for adequate grip usually results in high levels of fatigue in the forearms (23). Muscle strength and power are decisive in individual and team sports' successful performance (26).

We hypothesized that maximal handgrip strength is largely determined by hand anthropometric parameters. Assmann et al. stated that athletes displaying both-handedness, large upper forearm circumference as well as strong single pinch force might be promising candidates for the climbing sport, whereas traditional athletes who want to start climbing might benefit from a training which focuses on the upper forearm and pinch grip strength on both hands (3). Therefore, in the current study; we aimed to determine the anthropometric variables effecting the handgrip strength and to investigate how and to what extent these variables change the handgrip strength in grip athletes and non-athletes.

MATERIAL & METHOD

Participants

Totally, 74 subjects aged between 18 and 27 participated in this study in two groups including: handgrip related elite athletes (n=32), and non-athletes (n=42). Of participants, n=37 (50%) were males and n=37 (50%) were females. Congenital anomalies, previous upper limb operations, fractures and injuries that could affect hand were exclusion criteria. Informed consent was obtained from all participants, and the study was approved by the ethics committee of Kırşehir Ahi Evran University, Kırşehir, Turkey (Ethics Apporoval Number: 2019-07/82).

Handgrip related elite athletes (16 male, 16 female players) included basketball (5 male players), volleyball (5 female players), handball (7 male and 7 female players), tennis players (4 female players), and wrestlers (4 male players). An elite athlete defined as one who qualified for a national team at the senior level, or who was a member of a recruiting squad for that team (22). Handball players of both sexes were national players of professional clubs in the Turkish Super League. Basketball and volleyball players have national status in the youth category and are all professional club players. Tennis players were young national team players who participated in international tournaments (International Hitit Cup, International Çukurova Cup). The wrestlers are young national team athletes and have been awarded in top category oil wrestling tournaments. All athletes trained with the frequency as follows: national wrestlers, 8-10 sessions per week and approximately 12-15 hours; national handball, basketball, volleyball and tennis players, 5-6 sessions per week and approximately 7.5-9 hours. Non-athletes (21 male, 21 female) did not participate in any sports.

Anthropometric Measurements

Body height was recorded during inspiration using a stadiometer (to nearest 0.1cm, Seca Wall Mounted Stadiometer) and body weight was measured by digital standing scales (to nearest 0.1 kg, Beurer Glass Scale Removable Display GS 43) and body mass index (BMI) was calculated as the weight per (height)2 in kg/m2 as the general anthropometric variables. The subjects' hand anthropometric dimensions were measured using a digital sliding caliper (to nearest 0.01mm, Yıkoda Vernier Caliper 0-200mm accuracy 0.01mm Ruler Digital Calipers) and a plastic measuring tape.

The grip strength of dominant hand was measured using a standard adjustable digital handgrip dynamometer (Baseline Digital Smedley Hand Dynamometer). The handgrip strength was measured as follows: (a) Each subject was tested while sitting comfortably on a chair without arm rest, with his or her back leaned against the chair; (b) Each subject was instructed to sit with their hips and knees flexed at 90o, shoulders adducted and neutrally rotated, elbow flexed at 90o, forearm rotation at 0o, wrist between 0o and 30o_ of dorsiflexion and between 0o and 15o_ of ulnar deviation. Pinch strength was measured with pinchmeter (Jamar Digital Pinchmeter 50 LB) by tip (two-point) pinch, key (lateral) pinch, and palmar (three-jaw chuck) pinch. Tip pinch is thumb tip to index fingertip. Key pinch is thumb pad to lateral aspect of middle phalanx of index finger. Palmar pinch is thumb pad to pads of index and middle fingers (14). For each strength test the scores of three successive trials were recorded for dominant hand.

In this study, 26 hand variables were measured on each subject's dominant hand by following the standard procedure outlined by Pheasant (19) and Hall et al. (10). The selection of the anthropometric dimensions was limited only to those that are considered to have an association with handgrip strength.

Hand length (HL) of the dominant hand (the distance from the tip of the middle finger to the midline of the distal wrist crease when the forearm and hand are supinated on a table) (Figure 1b), hand breadth (HB) (the distance between the radial side of the second metacarpal joint to the ulnar side of the

fifth metacarpal joint) (Figure 1b), hand circumference (HC) (with the tape passing over metacarpal-phalangeal joints II and V, measure the-circumference of the –hand) (Figure 1c), wrist breadth (WB) (with the sliding caliper, measure the breadth of the wrist at the level of the wrist crease baseline) (Figure 1a), wrist circumference (WC) (with, the tape perpendicular to the long axis of the forearm, measure the circumference of the wrist at the level of the wrist crease) (Figure 1c), fist circumference (FC) (subject makes a tight fist with his/her thumb tucked against the middle phalanges of digits II and III. With the tape passing over the metacarpal-phalangeal joints of all five digits, measure the circumference, of the fist.) (Figure 2a), hand thickness (HT) (with the sliding caliper, measure the maximum thickness of the metacarpal-phalangeal joint of digit III.) (Figure 2b), hand depth (HD) (subject's dominant hand is extended with the thumb lying adjacent to the volar surface of digit II. With the sliding caliper, measure the maximum depth from the volar side of the thenar pad to the dorsal surface of the hand.) (Figure 2c), digit height (D1,2,3,4,5H) (the perpendicular distance from the wrist crease baseline to the midpoint of the tip of digit) (Figure 1b), hand crotch height (HC1,2,3,4H) (the perpendicular distance from the wrist crease baseline to the level of hand crotch) (Figure 1a), digit length (D1,2,3,4,5L) (the distance along the axis of digit from the midpoint of the tip of digit to the level of hand crotch.) (Figure 1b) (8).

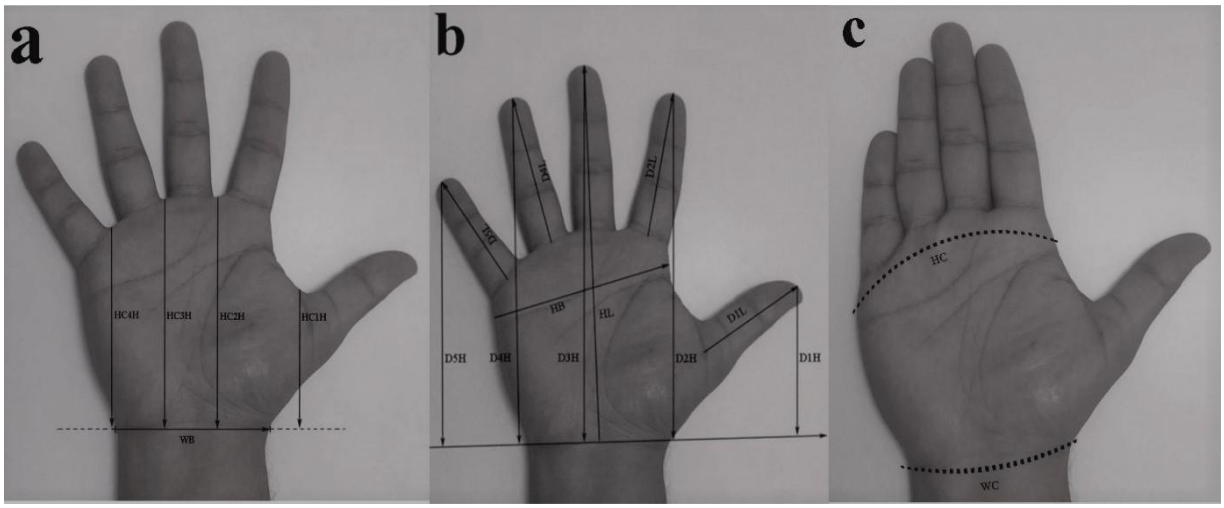

Figure 1. Anthropometric measurements of dominant hand. HL: Hand Length, HB: Hand Breadth, WB: Wrist Breadth, HC1,2,3,4H: Hand Crotch 1,2,3,4 Height, D1,2,3,4,5H: Digit 1,2,3,4,5 Height, HC: Hand Circumference, WC: Wrist Circumference.

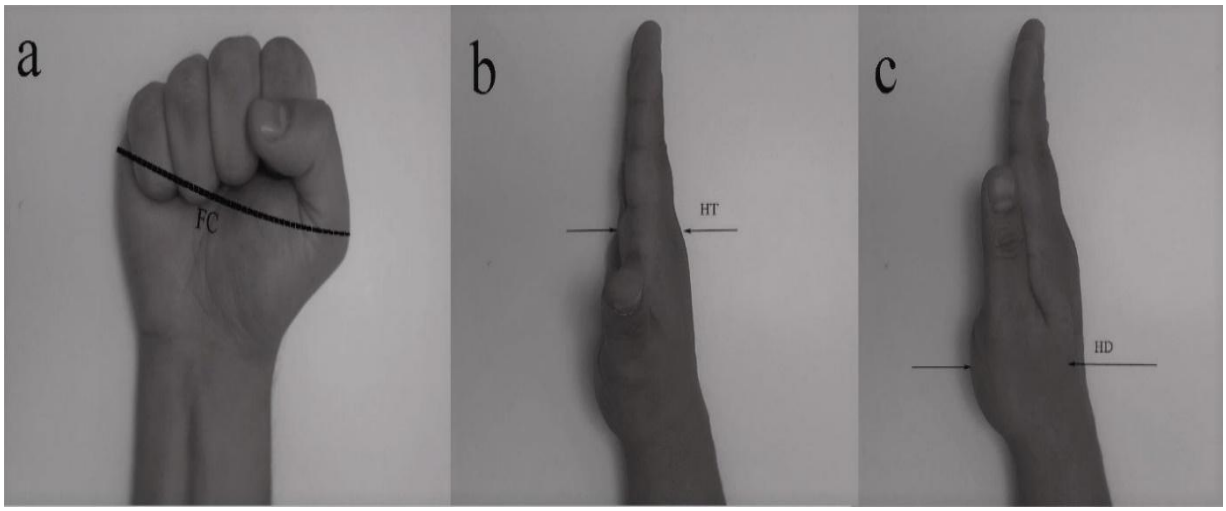

Figure 2. Anthropometric measurements of dominant hand. FC: Fist Circumference, HT: Hand Thickness, HD: Hand Depth.

Statistical Analysis

Numerical variables were reported as mean ± standard deviation; while categorical variables were described as frequency and percentage. Shapiro-Wilk Test was used for normality assumption. Independent Groups t-test was used for normally-distributed data, whereas Mann-Whitney U Test was applied non-normal distributed data for group comparisons. Mean ± standard deviation statistics were reported in case of performing Independent Group t-test, while median, minimum and maximum values were given when Mann-Whitney U Test is used for group comparison. Independent t-test or Mann-Whitney U Test was applied for group comparison. Stepwise multiple linear regression analysis was utilized and Backward selection procedure was also performed to identify the relationship between handgrip strength and anthropometric measurements. Multicollinearity was assessed via Variance Inflation Factor (VIF) values. Adjusted R2 measures were reported for determining regression models' validity. SPSS version 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) was used in all of the analyses. p-value ≤ 0.05 was considered as statistically significant.

RESULTS

43.2% of the participants were elite-athletes. Basic descriptive statistics were given in Table 1, 2. Results revealed that measurements of hand breadth, fist circumference, wrist circumference, wrist breadth, hand circumference, hand thickness, hand depth, digit 5 height, hand crotch 1 height, digit 1 length, tip pinch, key pinch and palmar pinch were significantly higher in elite-athlete group than non-athlete group in males ($p<0.05$), while hand length, handgrip strength, hand circumference, digit 1,2,3,4,5 heights, tip pinch, key pinch and palmar pinch significantly higher in female-elite athlete group than female non-athlete group ($p<0.05$) (Table 1 and Table 2).

Table 1. Group comparisons of anthropometric measurements in males (n=37)

Anthropometric Variable	Non-Athlete Group	Elite – Athlete Group	p-value
Height (m)	1.74 ± 0.01	1.78 ± 0.09	0.084
Weight (kg)	78.82 ± 16.69	85.26 ± 12.24	0.178
BMI (kg/m^2)	26.11 ± 5.52	26.92 ± 4.36	0.620
Age	20.67 ± 1.88	21.00 ± 2.73	0.860
Hand Length (HL) (mm)	184.99 ± 8.43	188.09 ± 8.98	0.294
Hand Breadth (HB) (mm)	84.10 ± 3.43	89.66 ± 4.16	<0.001
Hand-grip Strength (kg)	51.93 ± 5.05	55.43 ± 5.67	0.060
Fist Circumference (FC) (mm)	106.633 ± 6.084	105.674 ± 25.305	0.033
Wrist Circumference (WC) (mm)	68.6 ± 4.925	67.713 ± 16.035	0.022
Wrist Breadth (WB) (mm)	56.96 ± 3.64	60.54 ± 3.66	0.006
Hand Circumference (HC) (mm)	82.533 ± 3.925	81.739 ± 19.365	0.026
Hand Thickness (HT) (mm)	28.03 ± 2.13	29.86 ± 2.08	0.013
Hand Depth (HD) (mm)	50.49 ± 3.54	53.76 ± 4.15	0.017
Digit 1 Height (D1H) (mm)	74.20 ± 11.02	80.47 ± 11.36	0.101
Digit 2 Height (D2H) (mm)	172.30 ± 8.77	176.86 ± 9.48	0.145
Digit 3 Height (D3H) (mm)	187.12 ± 7.26	188.59 ± 8.13	0.574
Digit 4 Height (D4H) (mm)	175.07 ± 7.27	178.14 ± 9.51	0.268
Digit 5 Height (D5H) (mm)	142.05 ± 8.96	149.32 ± 10.36	0.032
Hand Crotch 1 Height (HC1H) (mm)	54.41 ± 8.47	60.66 ± 9.47	0.046
Hand Crotch 2 Height (HC2H) (mm)	108.44 ± 14.30	107.98 ± 4.88	0.887
Hand Crotch 3 Height (HC3H) (mm)	106.68 ± 5.95	107.81 ± 4.94	0.528
Hand Crotch 4 Height (HC4H) (mm)	94.98 ± 5.90	100.89 ± 21.66	0.311
Digit 1 Length (D1L) (mm)	64.94 ± 3.36	69.29 ± 4.81	0.002
Digit 2 Length (D2L) (mm)	72.22 ± 3.21	74.39 ± 4.58	0.121
Digit 3 Length (D3L) (mm)	79.71 ± 4.22	80.89 ± 5.40	0.481
Digit 4 Length (D4L) (mm)	74.28 ± 4.15	75.74 ± 4.62	0.329
Digit 5 Length (D5L) (mm)	61.02 ± 3.65	62.66 ± 3.63	0.182
Tip pinch (lbs)	16.54 ± 6.38	24.14 ± 6.17	0.001
Key pinch (lbs)	23.98 ± 7.68	35.00 ± 7.71	0.001
Palmar pinch (lbs)	24.02 ± 7.75	35.81 ± 7.29	<0.001

Table 2. Group comparisons of anthropometric measurements in females (n=37)

Anthropometric Variable	Non-Athlete Group	Elite – Athlete Group	p-value
Height(m)	1.64 ± 0.04	1.68 ± 0.05	0.085
Weight(kg)	59.83 ± 7.75	57.11 ± 4.83	0.229
BMI(kg/m²)	22.24 ± 2.92	20.29 ± 1.00	0.005
Age	20.41 ± 0.93	19.89 ± 0.93	0.157
Hand Length (HL) (mm)	171.96 ± 6.79	177.13 ± 5.69	0.048
Hand Breadth (HB) (mm)	74.19 ± 5.29	77.64 ± 3.23	0.075
Hand-grip Strength(kg)	27.24 ± 4.053	33.73 ± 3.79	<0.001
Fist Circumference (FC) (mm)	94 ± 8.705	96.556 ± 3.812	0.192
Wrist Circumference (WC) (mm)	61.926 ± 3.472	63 ± 2.236	0.541
Wrist Breadth (WB) (mm)	52.673 ± 5.807	52.519 ± 2.355	0.008
Hand Circumference (HC) (mm)	72.167 ± 4.401	76.556 ± 3.712	0.615
Hand Thickness (HT) (mm)	24.37 ± 2.27	25.81 ± 1.41	0.085
Hand Depth (HD) (mm)	189.67 ± 764.92	44.61 ± 3.57	0.577
Digit 1 Height (D1H) (mm)	77.64 ± 11.02	88.82 ± 13.66	0.018
Digit 2 Height (D2H) (mm)	162.43 ± 8.79	164.89 ± 7.32	0.457
Digit 3 Height (D3H) (mm)	171.96 ± 6.59	177.91 ± 6.18	0.023
Digit 4 Height (D4H) (mm)	162.47 ± 7.90	168.62 ± 5.93	0.040
Digit 5 Height (D5H) (mm)	130.29 ± 10.47	141.99 ± 9.19	0.005
Hand Crotch 1 Height (HC1H) (mm)	54.08 ± 5.47	56.24 ± 4.35	0.290
Hand Crotch 2 Height (HC2H) (mm)	97.06 ± 5.26	97.88 ± 3.21	0.664
Hand Crotch 3 Height (HC3H) (mm)	97.23 ± 5.08	100.69 ± 3.75	0.070
Hand Crotch 4 Height (HC4H) (mm)	85.82 ± 5.99	90.13 ± 5.50	0.065
Digit 1 Length (D1L) (mm)	60.25 ± 4.46	61.60 ± 4.64	0.439
Digit 2 Length (D2L) (mm)	69.51 ± 4.36	69.88 ±3.30	0.815
Digit 3 Length (D3L) (mm)	75.09 ± 3.44	76.28 ± 2.82	0.354
Digit 4 Length (D4L) (mm)	69.92 ± 3.90	70.32 ± 3.75	0.786
Digit 5 Length (D5L) (mm)	57.63 ± 3.76	58.63 ±3.91	0.496
Tip pinch (lbs)	9.47 ± 3.78	15.81 ± 5.32	<0.001
Key pinch (lbs)	14.96 ± 4.51	24.98 ± 6.97	<0.001
Palmar pinch (lbs)	14.77 ± 4.52	24.67 ± 6.74	<0.001

Four different stepwise multiple regression models for male non-athlete, male elite athlete, female non-athlete and female elite athlete groups were set to determine the effects of anthropometric measurements on handgrip strength. Also four different regression models were set to investigate the relationship between pinch strengths and handgrip strength. Multicollinearity was not observed in any of the regression models (VIF < 5 for all regression coefficients). Results were shown in following tables (Table 3 and Table 4).

Table 3. Regression analysis results for hand anthropometric variables.

Groups	Parameters	Unstandardized Coefficients	Standardized Coefficients	p-value	95% Confidence Interval for B		VIF
		B	**Beta**		**Lower Bound**	**Upper Bound**	
Male Non-Athletes	(Constant)	-89.674	-	< 0.001	-111.103	-68.245	-
	HB	0.889	0.515	< 0.001	0.514	1.264	2.866
	HT	1.223	0.281	0.009	0.320	2.127	2.610
	HC2H	0.256	0.175	0.028	0.029	0.483	1.466
Male Elite - Athletes	(Constant)	-60.26	-	< 0.001	-92.979	-27.542	-
	HB	0.987	0.605	< 0.001	0.624	1.350	1.109
	HC2H	0.244	0.243	0.033	0.021	0.468	1.109
Female Non-athletes	(Constant)	-95.104	-	< 0.001	-121.579	-68.630	-
	HC	1.306	0.684	< 0.001	0.966	1.645	1.165
	HC2H	0.314	0.268	0.004	0.106	0.522	1.165
Female Elite - Athletes	(Constant)	-79.427	-	< 0.001	-95.025	-63.828	-
	HB	0.96	0.587	< 0.001	0.646	1.275	2.714
	HT	1.538	0.361	< 0.001	0.718	2.358	2.714

HB: Hand Breadth, HT: Hand Thickness, HC2H: Hand Crotch 2 Height, VIF : Variance Inflation Factor

Table 4. Regression analysis results for pinch strengths.

Groups	Parameters	Unstandardized Coefficients	Standardized Coefficients	p-value	95% Confidence Interval for B		VIF
		B	**Beta**		**Lower Bound**	**Upper Bound**	
Male Non-athletes	(Constant)	20.871	-	< 0.001	14.891	26.85	-
	Tip Pinch	0.766	0.449	< 0.001	0.359	1.173	1.831
	Palmar Pinch	2.049	0.335	0.007	0.589	3.509	1.831
Male Elite Athletes	(Constant)	35.528	-	< 0.001	27.312	43.744	
	Key Pinch	0.658	0.286	0.059	-0.025	1.342	1.265
	Palmar Pinch	1.273	0.295	0.051	-0.006	2.553	1.265
Female Non-athletes	(Constant)	19.828	-	< 0.001	11.655	28.001	-
	Tip Pinch	0.571	0.29	0.05	0	1.141	1.358
	Palmar Pinch	2.459	0.304	0.04	0.115	4.804	1.358
Female Elite Athletes	(Constant)	13.096	-	< 0.001	7.969	18.224	-
	Tip Pinch	0.485	0.291	0.039	0.025	0.945	3.544
	Key Pinch	0.791	0.255	0.044	0.021	1.560	2.875
	Palmar Pinch	2.287	0.391	< 0.001	1.07	3.505	2.021

VIF: Variance Inflation Factor

Regression results suggested that hand breadth ($\beta = 0.889$; $p<0.05$), hand thickness ($\beta = 1.223$; $p<0.05$) and hand crotch 2 height ($\beta = 0.256$; $p<0.05$) measurements have statistically significant effects on handgrip strength in male non-athlete group while hand crotch 2 height ($\beta = 0.244$; $p<0.05$) and hand breadth ($\beta = 0.987$; $p<0.05$) measurements were found to be associated with handgrip strength in male elite athlete group. On the other hand, hand circumference ($\beta = 1.306$; $p<0.05$) and hand crotch 2 height ($\beta = 0.314$; $p<0.05$) measurements were observed to have a significant effect on handgrip strength in female non-athlete group; for female elite athlete group however hand breadth ($\beta = 0.960$; $p<0.05$) and hand thickness ($\beta = 1.538$; $p<0.05$) variables were found to be related with handgrip strength (Table 3). Positive correlation was found between hand crotch 2 height mesurements and handgrip strength in male and female non-athlete groups. In overall, hand breadth, hand crotch 2 height and hand thickness measurements in males; hand circumference, hand breadth, hand thickness and hand crotch 2 height measurements increases by and increase of handgrip strength in females ($p<0.05$) (Table 2). Furthermore, adjusted R2 values were calculated as 0.736 ($p<0.05$), 0.495 ($p<0.05$), 0.664 ($p<0.05$) and 0.803 ($p<0.05$) for male non-athlete, male elite athlete, female non-athlete and female elite athlete groups, respectively.

Regression analyses which identifies the relationship between tip pinch, key pinch, palmar pinch and handgrip strength had shown that tip pinch ($\beta = 0.766$; $p<0.05$) and palmar pinch ($\beta = 2.049$; $p<0.05$) in male non-athlete group; key pinch ($\beta = 0.658$; $p = 0.059$) and palmar pinch ($\beta = 1.273$; $p=0.051$) in male elite athlete group were found to be associated with handgrip strength. On the other hand, tip pinch ($\beta = 0.571$; $p=0.05$) and palmar pinch ($\beta = 2.459$; $p<0.05$) in female non-athlete group; tip pinch ($\beta = 0.485$; $p<0.05$), key pinch ($\beta = 0.791$; $p<0.05$) and palmar pinch ($\beta = 2.287$; $p<0.05$) were found to have statistically significant effects on handgrip strength in female elite athlete group (Table 4). Adjusted R2 values were calculated as 0.501 ($p<0.05$), 0.212 ($p<0.05$), 0.236 ($p<0.05$) and 0.690 ($p<0.05$) for male non-athlete, male elite athlete, female non-athlete and female elite athlete groups, respectively. Results showed that palmar pinch measurements were positively correlated in all groups, namely male non-athlete, male elite athlete, female non-athlete and female elite athlete groups. In addition to palmar pinch and tip pinch measurements also increases the handgrip strength in female non-athlete and female elite athlete groups ($p<0.05$). Key pinch measurements increases the handgrip strength in both male and female elite athletes.

DISCUSSION

The present study was conducted to investigate the effect of hand specific anthropometric measurements and pinch strengths on handgrip strength in grip elite athletes and non-athletes. On the contrary of Visnapuu and Jurimae's (24) study, the major conclusion drawn from this study that some spesific hand anthropometric parameters (Hand Breadth, Hand Thickness and Hand Crotch 2 Height), pinch strengths (tip, key and palmar) are

more important than general body anthropometric parameters (body height, weight, and BMI) in affecting handgrip strength in both hand related elite athletes and non-athletes. These variables may have a positive effect on handgrip strength. There are previous studies investigating the parameters affecting the handgrip strength. In these studies, it is mentioned that the effect of the parameters affecting the handgrip strength is positive. But none of these studies indicated the amount of effect. We believe that this amount of effect is so important for grassping in hand related sport branches.

Similar to Fallahi and Jadidian's (7) study, the handgrip strength of elite female athletes was significantly higher in our study than in the control group. Although the same result was found in male subjects, it was not statistically significant. In Fallahi and Jadidian's (7) study, all hand anthropometric characteristics of grip athletes significantly correlated with handgrip strength, which indicates that these variables may have a positive effect on handgrip strength. And they indicated that there was no significant difference in hand shape and palm length between the two groups. Also in their study, general body anthropometric characteristics (body height, body mass, lean body mass, and body fat content) were significantly different between the groups. They found other variables, especially palm width, middle finger length, forearm circumference and wrist circumference were significantly different between the groups. Their results showed that handgrip strength of athletes is greater than that of non-athletes. Also they found that finger lengths have a high positive correlation with handgrip strength of the dominant hand. They stated that hand shape did not correlate with handgrip strength in both groups, so it may not be significant in handgrip strength. And they indicated that hand shape, especially in this method, may not be a useful variable for comparing athletes, who have griping tasks, and nonathletes (7). In our study, we found that hand breadth, fist circumference, wrist circumference, wrist breadth, hand circumference, hand thickness, hand depth, digit 5 height, hand crotch 1 height, digit 1 length, tip pinch, key pinch and palmar pinch were significantly higher in elite-athlete group than non-athlete group in males ($p<0.05$), while hand length, handgrip strength, hand circumference, digit 1,3,4,5 heights, tip pinch, key pinch and palmar pinch significantly higher in female-elite athletes than female non-athletes ($p<0.05$).

Ruiz et al. (20) have stated that the optimal grip span was influenced by hand span in both genders. For males the optimal grip span can be derived from the equation $y = x/7.2 + 3.1$ cm, and for females from the equation $y = x/4 + 1.1$ cm. where y is the optimal grip span and x is the hand-span. Nicolay and Walker (17) have assesed the relationships between anthropometric variation and grip performance for 51 individuals, aged 18–33. They found a significant correlation of finger length with handgrip strength. According to Hager-ross and Schieber (9), investigating children at different ages, hand length and body weight accounted for most of the variability in grip strength.

Everett and Sills (6), in a study conducted on 400 individuals ranging in age from 14 to 29 years (less than 6 percent over 20 years of age), found that weight correlated the highest with handgrip strength, hand width had the second highest correlation with hand grip strength, while hand length and finger length ranked fourth and fifth respectively. Also they indicated that, height ranked third in the zero order correlations with handgrip strength. In the present study, we found that hand thickness correlated the highest with handgrip strength in female elite athletes ($\beta = 1.538$; $p<0.05$), hand circumference correlated the second with handgrip strength in female controls ($\beta = 1.306$; $p<0.05$), hand thickness correlated the third with handgrip strength in male control group ($\beta = 1.223$; $p<0.05$). Hand breadth correlated with handgrip strength in all groups except female control group. So we can say that hand breadth is an important predictor for grassping.

Mullerpatan et al. (15) investigated the normative data of handgrip and pinch strengths for healthy adults (18-30 age range). They found the handgrip strength 33.67 kg in males and 19.51 kg in females. In our study, we found this parameter 51.93 kg in male controls, 55.43 kg in male elite athletes, 27.24 kg in female controls and 33.73 kg in female elite athletes. In males, Mullerpatan et al. (15) found the tip, palmar and key pinch strengths 8.70 lbs, 14.37 lbs and 15.36 lbs respectively, in females, they found these parameters 7.16 lbs, 10.31 lbs and 10.69 lbs respectively. Mullerpatan et al. (15) reported lower data in terms of pinch strength compared to our study and literature (Table 1, 2) (2, 14, 27). The handgrip and pinch strengths in both non-athlete and elite athlete groups obtained in our study were completely consistent with the results of

Mathiowetz et al. (14), Angst et al. (2) and Westropp et al. (27).

In conclusion, we found that some hand anthropometric parameters are different in the grip sports and non-athletes, but we cannot exactly determine whether specific sport activities affect these differences or the inherent characteristics of athletes lead them to these sports. Also the handgrip strength of hand related athletes was more than that of non-athletes. This may be because of hand anthropometric parameters. Actually, good positive correlation between handgrip strengths and anthropometric characteristics of hand in grip athletes showed the effect of hand anthropometry on handgrip strength in athletes who use their hands for grasping a ball or opponent. Intercalarily, some of the hand anthropometric variables (hand breadth, hand circumference, hand thickness, hand depth, hand crotch height and pinch strengths) in athletes may be good predictors of handgrip strength. So, these findings may be useful in the process of sports talent identification in grip sports such as tennis, handball, basketball, volleyball and wrestling, as well as in other sports such as judo, climbing and sambo.

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The Effects of Regular Moderate Intensity Exercise on Oxidative Stress and Serum Prolidase Levels: A Comparative Study

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Abstract

Background:The effects of exercise on oxidation state is still a controversial topic. Additionally, the relation between exercise and serum levels of prolidase enzyme has not been reported so far. We aim to compare sedentary and physically active individuals regarding the levels of oxidative stress biomarkers and prolidase enzyme. Materials and Methods: Healthy individuals, 19-22 years old, were enrolled in this study, encompassing the exercise group (n=79) and the sedentary group (n=48). The serum levels of glutathione peroxidase (GPX), catalase, malondialdehyde, total antioxidant status (TAS), total oxidant status (TOS), and prolidase were assayed. Statistical analyses were applied to the findings. Results: The groups demonstrate insignificant difference regarding the serum GPX ($p=0.558$) and catalase ($p=0.628$) levels. The serum levels of malondialdehyde ($p<0.001$) and prolidase ($p<0.001$) are significantly higher in the exercise group and sedentary group than the other group, respectively. The TOS and TAS levels are considerably higher in the exercise group ($p=0.025$) and sedentary group ($p<0.001$) than the other group, respectively. Statistical analysis demonstrates significant relationship between the prolidase and TAS levels in the exercise group ($r=0.243$, $p=0.031$). Conclusion: The remarkably lower prolidase levels in the exercise group suggest decreased collagen turnover in physically active individuals. Oxidative stress appears to occur without compensation by enzymatic antioxidant mechanisms in young adults, involved in moderate intensity exercises. This study also indicates a correlation between the serum levels of prolidase and TAS in this population.

Keywords: Exercise, exopeptidase, free radical scavengers, malondialdehyde, oxidative stress

Düzenli Orta Düzey Egzersizin Oksidatif Stres ve Serum Prolidaz Düzeyleri Üzerindeki Etkileri: Karşılaştırmalı Bir Çalışma

Özet

Amaç: Egzersizin oksidasyon durumu üzerine etkileri halen tartışmalı bir konudur. Ayrıca egzersiz ile sreum prolidaz enzim düzeyleri arasındaki ilişki henüz bildirilmemiştir. Çalışmamızda fiziksel olarak aktif bireyler ile hareketsiz yaşam süren bireylerin oksidatif stres belirteçlerinin ve prolidaz enziminin düzeylerine göre karşılaştırılması amaçlanmıştır. Gereç ve Yöntem: On dokuz ile yirmi iki yaş aralığında ve sağlıklı olan bireyler çalışmaya dahil edildi. İki çalışma grubu oluşturuldu: Egzersiz yapan grup (n=79) ve egzersiz yapmayan grup (n=48). Katılımcılarda glutatyon peroksidaz (GPX), katalaz, malondialdehit, total antioksidan kapasite (TAK), total oksidan kapasite (TOK) ve prolidazın serum düzeyleri çalışıldı. Bulgular istatistiksel analize tabi tutuldu. Sonuç: Çalışma grupları arasında GPX ($p=0.558$) ve katalaz ($p=0.628$) düzeylerine göre istatistiksel anlamlı fark bulunmadı. Malondialdehit düzeyi egzersiz yapan grupta, prolidaz düzeyi egzersiz yapmayan grupta anlamlı düzeyde diğer gruba göre yüksekti ($p<0.001$). Egzersiz yapan gruptaki TOK düzeyinin yüksekliği ($p=0.025$), egzersiz yapmayan gruptaki TAK düzeyinin yüksekliği ($p<0.001$) istatistiksel olarak anlamlı idi. İkili korelasyon analizi sadece egzersiz yapan gruptaki prolidaz ve TAK düzeyleri arasında anlamlı ilişki gösterdi ($r=0.243$, $p=0.031$). Tartışma: Egzersiz yapan gruptaki belirgin prolidaz düzey düşüklüğü fiziksel olarak aktif bireylerde kollajen döngüsünün daha az olduğunu öne sürmektedir. Orta düzey egzersiz yapan genç yetişkinlerde oksidatif stresin, enzimatik antioksidan mekanizmanın telafisi olmaksızın meydana geldiği görünmektedir. Bu sonuçlar egzersiz yapan genç yetişkinlerde serum prolidaz ile TAK düzeyleri arasında anlamlı ilişki olduğunu işaret etmektedir.

Anahtar kelimeler: Egzersiz, ekzopeptidaz, serbest radikal temizleyicileri, malondialdehit, oksidatif stres

INTRODUCTION

Prolidase (EC. 3.4. 13.9) is a manganese dependent cytosolic exopeptidase, found in some strains of bacteria and in the various tissues of mammalians – particularly erythrocyte, kidney and intestinal mucosa (23). It cleaves iminodipeptides which contain proline or hydroxyproline at the C-terminal end (23,26). The enzyme has an important role in the collagen turnover and thus in the maintenance of connective tissues (5,23,26). Many studies have suggested the prolidase activity to be related to the oxidation state of the patients with various disorders (13,17-19,23). The changes in the serum prolidase levels of healthcare staff during the hospital shifts have even been reported (5). To the best of our knowledge, the effects of exercise on the serum levels of prolidase enzyme have not been reported in the literature so far.

Reactive oxygen species (ROS), chemically reactive molecules containing oxygen, are generated by the mitochondrial respiration of human cells (31). ROS deplete the plasma antioxidants, damage DNA and cause inflammatory response by modification of the biomolecules (5,13,17,18). ROS elimination is supposed to counterbalance the formation in healthy humans through the activity of antioxidant scavenger enzymes such as glutathione peroxidase (GPX) (EC 1.11.1.9) and catalase (EC 1.11.1.6) and endogenous non-enzymatic antioxidants such as albumin, bilirubin, and uric acid (15,33). Besides, exogenous antioxidant molecules including beta-carotene, vitamin C, vitamin E, and thiol compounds (e.g. glutathione) reinforce the elimination of ROS (15,33).

ROS become more abundant because of oxidative stress (OS). OS is defined as the loss of balance between the formation and the elimination of ROS, resulting in increased concentrations of these molecules, despite the counterbalance mechanisms of human metabolism (5,13,15,17,18,29). OS can occur due to endogenous causes (inflammation, infection, malignancy, excessive physical activity, and mental stress) as well as exogenous causes (smoking, alcohol, cooking, medication, and exposure to environmental pollutants and radiation) (29). The response of antioxidant defense mechanism (ADM) to exercise in terms of the levels of OS biomarkers can be variable (15). Although investigated by many researchers, the effects of regularly performed, moderate intensity exercises on OS with regard to enzymatic and non-enzymatic biomarkers are still among the controversial and relatively less studied topics (11,15,29,33). Moreover, the correlation between the biomarkers of OS and prolidase enzyme in young adults, who are involved in regular exercises, has not been reported yet. The present study was designed to compare sedentary individuals with individuals who regularly perform moderate intensity exercises, considering the serum levels of OS biomarkers as well as the serum levels of prolidase, in order to describe the effects of aforementioned levels of exercises on these biochemical parameters. The correlations between the serum levels of OS biomarkers and prolidase were analyzed as well.

MATERIALS AND METHODS

This prospective, cross-sectional, comparative study was conducted with the approval of the institutional review board (approval date: November 8, 2017; document number: 18) and in accordance with the ethical principles for medical research involving human subjects, as outlined in the Declaration of Helsinki. Before enrollment, all subjects, who volunteered to participate in this study, were informed and written consents were obtained from them. The students of Medical Faculty (MF) and Physical Training and Sports Faculty (PTSF) at the age of 19 to 22 were included in the study. The latter (PTSF) group comprised subjects who were regularly involved in various sportive activities (such as football, volleyball, tennis, swimming, etc.) in accordance with the curriculum of the faculty. The exclusion criteria were the presence of acute or chronic disease, history of previous or current tobacco use, alcohol consumption habit, any kind of medication or supplementation use. The students of MF performing regular exercise (i.e. participation in sports activity or any kind of exercise at least three hours per week) were excluded from the study as well. The samples were obtained in the period of March 2018 to June 2018.

All blood samples were drawn from the antecubital veins of the participants using sterile vacutainer needles following skin antiseptic preparation. After taking 5 mL of venous blood into the polypropylene tubes containing ethylenediaminetetraacetic acid and gentle mixing, the tubes were centrifuged at 4000 rpm for 15 minutes at 4 degrees Celsius. The supernatant plasma samples, obtained after the centrifugation

process, were stored in plastic tubes at -80 degrees Celsius until the samples were assayed for prolidase enzyme activity and OS biomarkers. Initially thawed at room temperature, the plasma samples were diluted 40-fold using 2.5 mmol/L Mn^{2+} and 40 mmol/L Trizma HCl buffer (pH 8.0) and incubated at 37 degrees Celsius for two hours. Thereafter, the reaction mixtures, consisting of 30 mmol/L gly-pro, 40 mmol/L Trizma HCl buffer (pH 8.0), and 100 µL of incubation serum in 1 mL, were incubated at 37 degrees Celsius for 30 minutes. The incubation reactions were ended with the addition of 0.5 mL 20% trichloroacetic acid solution. The supernatants were assayed for proline using the method described by Myara et al. (25), a modification of Chinard's method (8). All reagents used were of analytical grade and acquired from Sigma-Aldrich (St.Louis, Missouri, USA) and Merck (Darmstadt, Germany). The standard curve was used to calculate the concentrations of the samples. Intra-assay coefficient of variation was 4 for the samples.

Total oxidant status (TOS) and total antioxidant status (TAS) were measured utilizing the commercially available kits (REL Assay Diagnostics, Mega Tip, Gaziantep, Turkey) in a microplate reader (Thermo Scientific Multiskan FC, USA). The standard curve was used to calculate the concentrations of all unknown samples. The serum TOS and TAS levels are expressed in mmol/L.

The measurements of malondialdehyde (MDA) levels were in accordance with the method described by Ohkawa et al. (27) and were based on the measurement of thiobarbituric acid-malondialdehyde absorbance. The catalase enzyme activity was measured using the method described by Beutler (1). The serum MDA and catalase activity levels are expressed in nmol/ml and U/g hb, respectively.

In the presence of t-butyl hydroperoxide, glutathione oxidation to glutathione disulfide takes place with the activity of GPX enzyme. The procedure is based on the principle of quantification of the change of absorbance value at 340 nm wavelength reflecting oxidization of NADPH to NADP in the reaction which reduces glutathione disulfide to glutathione by the glutathione reductase enzyme (EC 1.6.4.2) catalysis (2). The serum GPX activity levels are expressed in U/g hb.

The statistical analyses were performed using IBM SPSS version 22.0 for Windows (IBM Corp., Armonk, NY, USA) to investigate the differences between the study groups. Shapiro-Wilk test demonstrated normal distribution of the data. For the multiple group and two independent group comparisons, one-way analysis of variance (ANOVA) and independent samples t test were performed, respectively. Scheffe test and Tamhane T2 test were utilized for the pairwise post-hoc testing. The relation between the quantitative variables was investigated using Pearson's correlation analysis. The distribution of the categorical variables was evaluated using Chi-square test and exact test. The statistical parameters are expressed in mean ± standard error of the mean (SEM), percentage (%) and frequency (n). Statistical significance was considered for p values less than 0.05.

RESULTS

The demographic features of the study groups (MF students in the sedentary group and PTSF students in the exercise group) are depicted in Table 1. The mean serum GPX level of the sedentary group is higher than that of the exercise group and the mean serum catalase level of the exercise group is higher than that of the sedentary group (Table 2). However, the differences are trivial ($p=0.628$ for the mean catalase levels and $p=0.558$ for the mean GPX levels). The differences between the study groups are considerable in terms of the mean serum MDA and prolidase levels ($p<0.001$ for both comparisons). The former and the latter parameters are greater in the exercise group and the sedentary group, respectively. The mean serum TOS level of the exercise group is considerably high compared to that of the sedentary group ($p=0.025$). Conversely, the mean serum TAS level of the sedentary group is remarkably high compared to that of the exercise group ($p<0.001$), as shown in Table 2.

The analyses of the biochemical parameters by the pairwise comparison of the study groups within the genders are depicted in Table 3. The mean serum GPX levels of female ($p=0.737$) and male ($p=0.708$) subgroups do not demonstrate any remarkable difference when the sedentary and the exercise groups are compared. The differences between the study groups are trivial regarding the mean serum catalase levels of female ($p=0.306$) and male ($p=0.472$) subgroups. The mean serum MDA levels of the exercise group are significantly high compared to the sedentary group, both for female ($p=0.004$) and male ($p<0.001$) subgroups. On the other hand, the mean serum prolidase levels of the

sedentary group are significantly high compared to the exercise group, both for female (p=0.001) and male (p<0.001) subgroups. The mean serum TAS levels of the sedentary group are higher than that of the exercise group with considerable difference regarding female (p=0.005) and male (p=0.001) subgroups. The significance levels of differences between the study groups regarding the mean serum TOS levels within the genders are quite dissimilar. The male subgroup of the exercise group have considerably greater mean serum TOS level than the male subgroup of the sedentary group (p=0.018) while the mean serum level of female subgroup of the exercise group is higher than that of the sedentary group with minor difference (p=0.359). The mean levels of the OS biomarkers and prolidase were also compared between the genders within the study groups and no considerable differences could be identified between the genders, as shown in Table 3.

The multiple comparisons of the gender-based subgroups depict insignificant difference regarding the mean serum levels of GPX (p=0.943), catalase (p=0.591), and TOS (p=0.086) (Table 4). On the other hand, the mean serum levels of prolidase and TAS in the female and male subgroups of the sedentary group are considerably high compared to the female and male subgroups of the exercise group (p<0.001 for the comparisons of the mean prolidase and TAS levels). The mean serum levels of MDA in the female and male subgroups of the exercise group are considerably greater than that of the female and male subgroups of the sedentary group (p=0.001).

The bivariate correlation analyses between the mean levels of prolidase enzyme and OS parameters (prolidase – GPX: r=0.191, p=0.194; prolidase – catalase: r=-0.244, p=0.095; prolidase – MDA: r=-0.073, p=0.623; prolidase – TOS: r=-0.019, p=0.898; and prolidase – TAS: r=-0.251, p=0.085) do not reveal any significant correlation in the sedentary group. The analyses do not demonstrate any significant correlation between the mean levels of prolidase and GPX (r=0.141, p=0.215), catalase (r=0.174, p=0.124), MDA (r=-0.024, p=0.832), and TOS (r=0.103, p=0.366) in the exercise group as well. On the other hand, the analysis demonstrates positive correlation with statistical significance between the mean levels of prolidase and TAS in the exercise group (r=0.243, p=0.031).

DISCUSSION

ADM protects human body against the harmful effects of the natural byproducts – ROS – which are generated by the metabolic processes (11,15,29,33). The antioxidant scavenger enzymes, essential component of the defense mechanism, continually buffer ROS (10). A decline in the antioxidant enzyme levels is expected after exercise bouts. However, previous researches on the relation between exercise and the OS biomarkers report equivocal results for the enzyme level changes in terms of magnitude and direction of the change, either increase or decrease (11,15,33). The mean serum levels of GPX and catalase levels are higher in the sedentary group and the exercise group with no significant differences in the present study, respectively. While the findings of this study are contradictory to the concept of adaptation of human metabolism to chronic exercise, which depends on the hypothetical upregulation of enzymatic ADM (24), these findings are in line with those of Kanaley and Ji (21), Chang et al. (7), and Tauler et al. (32).

MDA is a product and a biomarker of the lipid peroxidation (5,7,11,15,21,24,29,32,33). The measurement of MDA levels is one of the most used assays to evaluate the oxidative damage, induced by physical activity (9). Discordant results have been reported in the studies investigating the relation between exercise and the MDA levels (11,15). Besides, numerous studies mention no significant difference in the MDA levels, even after high intensity exercises (15). The present study contrarily notifies remarkably high mean serum MDA level in the exercise group in comparison to the sedentary group, supporting the hypothesis of increased MDA formation with exercise (20). Like the findings of the present study, a study on the oxidative stress levels in sedentary individuals and judokas mentions considerably high mean plasma MDA levels in the latter compared to the former with regard to measurements at rest (11). Another study, comparing the mean MDA levels between handball players and sedentary participants, also demonstrates significantly greater values in the former than those found in the latter (30).

The measurement of TAS indicates the sum of antioxidant capacity of the body, thus eliminating the need for demanding measurement of various antioxidant enzymes and molecules (6). The measurement of TOS, on the other hand, indicates the sum of oxidation state of the body (14).

Numerous studies in the literature compare TAS levels between physically active and inactive individuals. Those studies mention significant difference in favor of physically active groups regarding the higher TAS levels of those groups (3,11,15,16). Improved antioxidant capacity in physically active individuals despite exposure to exercise induced ROS has been explained by the hypothetical compensatory increase in the ADM activity (11,15,24).

The results of the present study are unlike those of aforementioned studies with regard to significantly high mean TAS level in the sedentary group compared to the exercise group. Conversely, the mean TOS level of the sedentary group was significantly lower than that of the exercise group, consistent with the mean levels of TAS. In addition to no significant difference between the two study groups in terms of the antioxidant enzyme levels, the remarkably lower mean level of TAS in the latter group compared to the former group is also contradictory to the hypothesis of adaptive increase in ADM activity against exercise induced OS (11,15,24).

The discordance between the present study and some of those studies mentioned above in regard to the measurements of OS biomarkers may be explained by the differences in the study designs and the exercise programs of the participants (i.e. the duration of aerobic and anaerobic exercises) as well as the relatively low intensity of exercises of physically active group involved in this study compared to the studies including elite athletes (9,11,15).

Many studies investigate the gender-specific differences in oxidation state secondary to pathological conditions (4). Moreover, those studies notify equivocal results for the disease states (34). Although estrogen is reported to have antioxidant feature (22), some studies conducted on sedentary participants (4) as well as physically active participants (28,34) do not support the knowledge of antioxidant feature of estrogen. The present study, which includes healthy participants with sedentary and physically active lifestyle, also indicates no significant gender-specific difference regarding the levels of non-enzymatic and enzymatic OS biomarkers.

Prolidase, an essential enzyme for collagen recycling, has been investigated in numerous researches (5,13,17-19,23,26). Most of them studied the prolidase activity levels in various disorders (12,13,17-19,23,26). On the other hand, Buyukhatipoglu et al. investigated the relation between oxidation state and prolidase enzyme levels in healthy, non-smoking healthcare staff and non-healthcare staff (5). They report notable increase in serum prolidase levels in the former group, encountering stressful situations during the working hours, in contrast to trivial difference in the latter group, presumably free of stressful situations at the same period (5). However, the authors do not compare the prolidase levels between the two groups (5). Based on the search of the literature, the present study, which reports significantly high prolidase levels in sedentary group compared to exercise group, is the first investigation comparing sedentary as well as physically active young adults in terms of serum prolidase levels. The rationale behind the lower prolidase enzyme activity in the exercise group can be the need for the preservation of structural integrity of collagen containing tissues to achieve better physical performance.

Prolidase activity level has been shown to associate with oxidative stress in patients diagnosed with various disorders (13,18,19) as well as malignancies (17). The reported changes in prolidase activity levels due to the diseases are ambigious (23). Buyukhatipoglu et al. mention negative correlation between TAS and serum prolidase levels with no significant difference, both in healthcare staff and non-healthcare staff (5). The results of the present study indicate negative correlation with no significant difference between the mean prolidase level and TAS level in the sedentary group as well. On the other hand, the positive correlation with significance, found between the mean prolidase level and TAS level in the exercise group, is contradictory to the findings of the research conducted by Buyukhatipoglu et al. (5). The latter finding appears to suggest a relationship between the two parameters, particularly in physically active young individuals.

The strengths of the present study are the gender-specific comparisons of OS biomarker and prolidase activity levels as well as the analysis of the correlation between the former and the latter. The weaknesses of the present study are the relatively limited number of the participants in the study groups (particularly the small number of the male participants in the sedentary group), the diversity of the sports in which the subjects of the physically

active group involved, and the lack of measurements of non-enzymatic antioxidant levels.

To conclude, the results of the present study do not support the hypothesis of gender-specific difference in young, healthy adults with physically active and sedentary lifestyles considering OS biomarkers. The remarkably low levels of prolidase activity in the exercise group compared to those in the sedentary group suggest decreased collagen turnover in the former. OS appears to occur with no associated compensatory increase in the antioxidant enzyme activities in young adults who regularly perform moderate intensity exercises. This study also indicates a correlation between the serum levels of prolidase and TAS in this population, but further studies are seemingly required for deeper insight into the topic.

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Conflict of interest statement

The authors declare that there are no conflicts of interest.

Table 1. The demographic features and pairwise comparison of the study groups.

		Sedentary group (n=48)	Exercise group (n=79)	p
Age (mean ± SEM) [year]		21.04 ± 0.2	20.61 ± 0.18	0.119
Height (mean ± SEM) [cm]		167.15 ± 1.23	170.76 ± 0.9	0.017*
Weight (mean ± SEM) [kg]		60.33 ± 1.35	63.05 ± 1.13	0.131
BMI (mean ± SEM) [kg/m²]		21.53 ± 0.36	21.49 ± 0.26	0.929
Genders	**Female [n (%)]**	34 (70.8)	42 (53.2)	0.049*
	Male [n (%)]	14 (29.2)	37 (46.8)	

Independent samples t test; Chi-square test; * Statistically significant difference ($p<0.05$) BMI: body-mass index, SEM: standard error of the mean

Table 2. The biochemical parameters and pairwise comparison of the study groups.

	Sedentary group (n=48)	Exercise group (n=79)	p
GPX (mean ± SEM) [U/g hb]	893.59 ± 82.96	851.68 ± 32.98	0.558
Catalase (mean ± SEM) [U/g hb]	32.46 ± 2.75	34.01 ± 1.84	0.628
MDA (mean ± SEM) [nmol/mL]	6.04 ± 0.19	7.83 ± 0.31	<0.001*
Prolidase (mean ± SEM) [U/mg prot.]	26.15 ± 1.97	10.7 ± 0.8	<0.001*
TOS (mean ± SEM) [mmol/L]	21.14 ± 3.43	31.31 ± 2.87	0.025*
TAS (mean ± SEM) [mmol/L]	0.79 ± 0.08	0.41 ± 0.04	<0.001*

Independent samples t test; * Statistically significant difference ($p<0.05$)
GPX: glutathione peroxidase, MDA: malondialdehyde, SEM: standard error of the mean, TAS: total antioxidant status, TOS: total oxidant status

Table 3. Gender and study group based pairwise comparisons of the study groups and genders regarding biochemical parameters, respectively.

		Genders		
		Female (n=76)	**Male (n=51)**	**p**
GPX (mean ± SEM) [U/g hb]	**SG**	900.31 ± 108.12	877.27 ± 114.96	0.901
	EG	863.05 ± 47.48	838.77 ± 45.91	0.716
	p	0.737	0.708	
Catalase (mean ± SEM) [U/g hb]	**SG**	30.42 ± 2.91	37.43 ± 6.19	0.25
	EG	34.53 ± 2.71	33.42 ± 2.49	0.766
	p	0.306	0.472	
MDA (mean ± SEM) [nmol/mL]	**SG**	6.02 ± 0.24	6.09 ± 0.28	0.873
	EG	7.96 ± 0.54	7.69 ± 0.25	0.667
	p	0.004*	<0.001*	
Prolidase (mean ± SEM) [U/mg prot.]	**SG**	24.17 ± 1.66	30.98 ± 5.32	0.116
	EG	11.88 ± 1.19	9.37 ± 1.02	0.119
	p	0.001*	<0.001*	
TOS (mean ± SEM) [mmol/L]	**SG**	22.74 ± 4.29	17.25 ± 5.56	0.474
	EG	28.33 ± 4.2	34.7 ± 3.85	0.271
	p	0.359	0.018*	
TAS (mean ± SEM) [mmol/L]	**SG**	0.78 ± 0.1	0.81 ± 0.16	0.883
	EG	0.43 ± 0.08	0.38 ± 0.04	0.503
	p	0.005*	0.001*	

Independent samples t test; * Statistically significant difference (p<0.05) EG: exercise group, GPX: glutathione peroxidase, MDA: malondialdehyde, SEM: standard error of the mean, SG: sedentary group, TAS: total antioxidant status, TOS: total oxidant status

Table 4. Multiple comparisons of gender based subgroups regarding biochemical parameters.

Biochemical Parameters	**Sedentary - female group (n=34)**	**Sedentary - male group (n=14)**	**Exercise - female group (n=42)**	**Exercise - male group (n=37)**	**p**
GPX (mean ± SEM) [U/g hb]	900.31 ± 108.12	877.27 ± 114.96	863.05 ± 47.48	838.77 ± 45.91	0.943
Catalase (mean ± SEM) [U/g hb]	30.42 ± 2.91	37.43 ± 6.19	34.53 ± 2.71	33.42 ± 2.49	0.591
MDA (mean ± SEM)[nmol/mL]	6.02 ± 0.24[c,d]	6.09 ± 0.28[c,d]	7.96 ± 0.54[a,b]	7.69 ± 0.25[a,b]	0.001*
Prolidase (mean ± SEM) [U/mg prot.]	24.17 ± 1.66[c,d]	30.98 ± 5.32[c,d]	11.88 ± 1.19[a,b]	9.37 ± 1.02[a,b]	<0.001*
TOS (mean ± SEM) [mmol/L]	22.74 ± 4.29	17.25 ± 5.56	28.33 ± 4.2	34.70 ± 3.85	0.086
TAS (mean ± SEM) [mmol/L]	0.78 ± 0.1[c,d]	0.81 ± 0.16[c,d]	0.43 ± 0.08[a,b]	0.38 ± 0.04[a,b]	<0.001*

One way anova, Post-hoc, Scheffe test, Tamhane T2 Test; * Statistically significant difference (p<0.05).
[a] Statistically significant difference with sedentary - female group; [b] Statistically significant difference with sedentary - male group; [c] Statistically significant difference with exercise - female group; [d] Statistically significant difference with exercise - male group
GPX: glutathione peroxidase, MDA: malondialdehyde, SEM: standard error of the mean, TAS: total antioxidant status, TOS: total oxidant status

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