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CONTENTS

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EDITORIAL

Dear JESSM Readers,

I feel very excited and honoured to assume the role of editor of the JESSM. It is a distinct pleasure to write this editorial note to the you as incoming editor of JESSM. This is the time and place to thank Dr. Erkan Faruk ŞİRİN for his excellent work as outgoing editor of JESSM.

This first issue of 2021 contains four research papers and one review paper from different studying areas of sport sciences covering a range of topics. We extend our heartfelt thanks to our reviewers for undertaking this process, providing meaningful comments to authors and maintaining the quality of Sports Science Association.

A quality journal can exist only with quality reviews. I hope we can continue to count on each one of you you have benefited from the conscientious reviews of professionals colleagues in the past, present and future, and I am looking forward to your collaboration.

Dr. Funda KOÇAK

Editor in Chief JESSM

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REVIEW

The Effect of Resistance Exercises on Testosterone

Abdusselam TURGUT [1]
Serhat VAROL [2]
Atakan YAZICI [2]
Mehmet GUNAY [2]

[1] Faculty of Sport Sciences, Hitit University, Corum, Turkey.

[2] Faculty of Sport Sciences, Gazi University, Ankara, Turkey

Corresponding author: A. Turgut

e-mail: abdusselamturgut@gmail.com

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Abstract

Metabolism rearranges metabolic activities in order to adapt to internal or external stresses to which it is exposed. Since training creates a stress in the body, it triggers the adaptation process of the metabolism. However, activities such as endurance or strength training initiate different adaptation processes on the metabolism. The aim of our study is to examine the acute and chronic effects of resistance exercises on testosterone. For this purpose, a search with the English language limitation was made in Google Scholar, PubMed and EBSCO databases from the studies conducted before September 2020. Only studies in English language were included and articles only were cited in our study. When the studies were examined, it was emphasized that in order for resistance exercises to increase the testosterone hormone acutely or chronically, the training must be of sufficient volume and high intensity. However, it was seen that metabolism gives high testosterone responses especially to hypertrophy type resistance exercises. In addition, increases in testosterone vary depending on whether the training program is aimed at large muscle groups, the use of free weights or functional exercises, the priority of training large muscle groups in training programs, low body fat percentage, and the average young age of the research group.

Keyword: Resistance exercise, testosterone, hormone.

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INTRODUCTION

Resistance exercise is a training method used in both athletes and the non-athletic population to achieve muscle hypertrophy and improve performance (power, strength, endurance) (Crewther et al., 2016). Resistance exercise, also called strength and weight training, involves the voluntary contraction of the muscles against an external resistance. This resistance might also be the one created by body weight as it is in jumping, training with free weights, using exercise machines etc. (Riachy et al., 2020).

Strength development and muscle hypertrophy depend on the type and intensity of the load as well as the volume of strength training the athlete performs (Ahtiainen et al., 2003). The volume of training is the sum of the total number of repetitions performed multiplied by the resistance used. The volume of training is influenced by the number of sets, repetitions and exercises performed, as well as the training frequency (intensity) (Riberio et al., 2016). Exercise volume can be increased or decreased by changing the number of exercises per session, the number of repetitions per set, or the number of sets per exercise (Ratemes et al., 2002).

Resistance exercises are stated to increase hormonal concentrations in circulation. (Adebero et al., 2020). Hormone regulation becomes more important for muscle hypertrophy and strength development, especially in athletes with a long and intense training history (Ahtiainen et al., 2003).

One of the hormones that vary depending on resistance exercises is testosterone (Fry and Lohnes, 2010; Rahimi et al., 2010). Testosterone is an anabolic and androgenic hormone produced by the testicles in men (O'Leary and Hackney, 2014). Anabolic hormones stimulate muscle protein synthesis (Bush et al., 2003). Therefore, resistance exercises increase muscle strength and hypertrophy (Hansen et al., 2001). However, the increase in testosterone concentration of resistance exercises are affected by the number of sets in a training (Gotshalk et al., 1997), the number of repetitions of the exercises (Bottaro et al., 2009), the training volume (Spiering et al., 2008), and the differences in the rest periods between the sets (Bottora et al., 2009).

The aim of our study is to examine the studies in the literature on the effects of resistance exercises on testosterone, and to collect the effects of different training protocols on testosterone in a single source. For this purpose, first of all, testosterone physiology will be explained. The next part includes the review of the previous studies. Finally, the testosterone responses of different resistance exercise programs will be discussed.

The Physiology of Testosterone

Testosterone (17 β-hydroxy-4-androsten-3-one) is a 0.288 kD C_{19} steroid hormone produced from cholesterol through a series of transformations catalyzed by specific enzymes. Each step of the T synthesis is shown in Figure 1. This process takes approximately 20-30 minutes from start to end product (Vingren et al., 2010). While T is produced in Leydig interstitial cells (testicles) in men, it is produced in the ovaries in women. In addition, a small amount of T is produced in the adrenal glands (Casanova et al., 2020). T is an anabolic hormone that causes the activation of many important anabolic processes including increases in transcription, translation, signaling enzymes, and structural proteins. Although the physiological effects of exercise on T were not adequately determined, transient elevations in

T may be important for strength development, hypertrophy (Hooper et al., 2017; Mangine et al., 2018), and the psychological preparation of an athlete for a competition (Casto and Edwards, 2016).

Acute Testosterone Response to Resistance Exercises

Human metabolism gives different testosterone responses for different training variables. In many studies, it was observed that testosterone increased acutely. Baker et al. (2006) examined the effects of resistance training on 24 young, middle-aged and old men who were physically inactive. The resistance exercise protocol, consisting of 6 exercises that work the legs, chest, back and shoulder muscles, was applied on 3 sets and it was found that testosterone increased acutely in the blood samples taken. It was observed that testosterone increased not only with resistance exercises that work the whole body, but also with resistance exercises that work one area. In a study, 5 sets of 10 repetitions of leg press exercises were applied and it was concluded that testosterone increased acutely (Ahtianien et al., 2003). There are other studies in the literature that used only one exercise for the leg muscles. In the study conducted by Ahtianien et al. (2004), it was observed that testosterone increased as a result of the applied squat exercise protocol. In another study, it was observed that testosterone increased as a result of the squat protocol applied to the research group (Fry and Lohnes, 2010). Similarly, positive testosterone responses were obtained in protocols that were applied to the leg muscles in which more than one exercise was used. Ahtianien et al. (2011a) applied a training on 8 adult strong and trained males which included 5x 10 RM leg press (leg push), 2 minutes rest, 4x 10 RM squats (squat) training and, as a result, it was found that testosterone increased acutely following the training session. In addition, studies were carried out with similar protocols for upper body exercises as well. In the study of Charro et al. (2010) applied on 10 experienced men; bench press, pec-deck and decline bench press exercises were used. As a result, it was found that testosterone increased acutely.

When the literature was examined, it was seen that different types of training cause different testosterone responses. In a study, strength (8 sets of 6 reps, maximum 45% 1 repetition [1RM], 3-minute rest periods, ballistic movements), hypertrophy (10 sets of 10 reps, 75% 1RM, 2-minute rest periods, controlled movements) or maximal strength (6 sets of 4 repetitions, 88% 1RM, 4-minute rest periods, explosion purposes) exercise protocols were applied. It was found that testosterone increased acutely in blood samples taken after exercises. However, the study emphasized that the testosterone responses given by the hypertrophy training protocol were greater when compared to other protocols (Crewther et al., 2008). In another study comparing protocols of strongman training, hypertrophy training and the combination of these two trainings; testosterone test results of all groups were found to be significant in the blood samples taken before and after the training. Hypertrophy training protocol gave a greater testosterone response compared to other protocols (Ghigiarelli et al., 2013). In another study comparing the effects of hypertrophy and maximal strength training protocols, while testosterone increased in both protocols, hypertophy training resulted in higher testosterone responses than maximal strength training (Vilanueva et al., 2012). In their study, McCaulley et al. (2009) concluded that hypertrophy training results in more testosterone responses compared to power and strength training.

Apart from the widely used resistance exercise techniques, the effects of functional exercises on testosterone were also examined. In the study conducted by Beaven et al. (2011),

from the blood samples taken right after the squat exercise together with box squats or jump squats exercises, testosterone was found to increase acutely. In another study, the effects of standard resistance exercise training, strongman training and combat sports specific strength training were compared. It was found that the test results of groups that did strongman and combat type resistance exercises had higher values compared to the other groups (Gaviglio et al., 2015).

The physiological effects of different exercises that train the same area may vary. Shaner et al. (2014) examined the effects of 6 sets of 10 repetitions of squats and leg press exercises in their study in 2014. As a result, it was found that testosterone increased acutely in both groups. However, squat exercise was found to respond more to testosterone compared to leg press.

Although the applied training program is the same, the order of the exercises used also causes different testosterone responses. In a study, the effects of two training protocols were examined. One of these protocols included a training starting from small muscle groups (SMG) to large muscle groups (LMG), and the other was from LMG to SMG. As a result, it was determined that testosterone increased acutely in both groups. In addition, the LMG-SMG protocol resulted in a higher increase in testosterone level compared to the SMG-LMG protocol. (Sheikholeslami-Vatani et al., 2016).

Rest periods used between sets are effective on testosterone. In their study in 2010, Rahimi et al. (2010) examined the effects of the same resistance exercise program with the resting times of 60 seconds, 90 seconds and 120 seconds between sets. As a result, all three training protocols were found to raise testosterone acutely. In the study, it was stated that testosterone responses decreased from a 120 seconds rest period to a 60 seconds rest period.

Different training volumes affect the level of testosterone released. Spiering et al. (2009) examined the effects of knee extension and knee extension + upper body resistance exercises in their study in 2009 on 6 men aged 26 ± 4 years, with heights of 176 ± 5 cm and body weight of 75.8 ± 11.4 kg. As a result, it was found that knee extension exercise alone did not cause a significant change on testosterone, but knee extension + upper body resistance exercises increased testosterone. In addition, testosterone responses of similar volume training programs are similar. In their study conducted in 2009, Uchida et al. examined the effects of 5 different bench training protocols with set/weight (50-75-90-100-110% of 1TM) / maximum number of repetitions in the same training volume. As a result, it was found that all protocols increased testosterone except the protocol applied with 50% of 1 TM load. The study emphasized that the effects of similar volume trainings were the same.

Body fat ratio also affects the resistance exercise response. Rubin et al. (2015) examined the acute effects of resistance exercises in their study on 10 obese men with 36.2 ± 4.03% body fat and 10 athletic male volunteers with body fat percentage of 12.7 ± 2.9. As a result, it was found that testosterone increased acutely in both groups. However, the study emphasized that the group with low body fat percentage had higher testosterone responses. There are also other studies in the literature supporting that body fat percentage decreases testosterone response (Sheikholeslami-Vatani et al., 2016).

Chronic Testosterone Response to Resistance Exercises

When the literature is examined, it can be seen that there are different results about

chronic testosterone response to resistance exercises applied for a long time. In some studies, it is emphasized that resistance exercises have no effect on testosterone chronically.

In 2001, Hansen et al. studied the effects of 9-week (2 days / week) arm protocol and arm + leg protocol resistance exercises in their study on 16 male volunteers without training history. No significant difference was found between the test results before and after the protocol.

In their study, Mitchell et al. (2013) examined the effects of a 16-week (4 days / week) resistance exercise program on 23 men aged 24 ± 3 years, with height of 177 ± 8 cm and body weight of 84.1 ± 16.9 kg. No significant difference was found between the test results before and after the protocol.

In their study in 2006, Sallinen et al. (2006) examined the effects of a 21-week (2 days / week) resistance exercise program on 51 elderly women between the ages of 49-74. As a result, although the testosterone values of the research group increased in the first half of the study, no significant difference was found in the measurements at the end of the study.

In the study conducted by Ahtianien et al. (2003) on 8 strength-power athletes and 8 active men in 2003, the effects of a 21-week (2 days / week) resistance exercise program were examined. No significant difference was found between the test results before and after the protocol.

In the research conducted by Ahtianien et al. (2005) on 8 strength-power athletes and 8 active men in 2005, the effects of the 6-month resistance exercise program were examined. No significant difference was found between the test results before and after the protocol.

In 2016, Riberio et al. (2016) examined the effects of 31-week traditional resistance training and pyramidal resistance training in their study on 25 women aged 67.6 ± 5.1 years, having 65.9 ± 11.1 kg body weight and 154.7 ± 5.8 cm height. No significant difference was found between the test results before and after the protocol.

In a study conducted by Ahtianien et al. (2015) on 5 young adult men aged 28 ± 3 years and 8 elderly men aged 70 ± 2 years in 2015, the effects of a 12-month (2 days / week) resistance exercise program were examined. No significant difference was found between the test results before and after the protocol.

In some studies, it was concluded that resistance exercises chronically increase testosterone.

Mangine et al. (2018) examined the effects of 5-week (1 day / week) high-intensity functional resistance exercises in their study on 5 male and 5 female volunteers in 2018. There was a significant difference between the test results before and after the protocol.

The effects of the 8-week (3 days / week) resistance exercise program were examined by Arazi et al. (2012) on 8 middle-aged men aged 49.7 ± 2.1 years and 10 young men aged 21.2 ± 2.2 years. There was a significant difference between the test results before and after the protocol. It was also noted that middle-aged men react differently to resistance exercises compared to young men.

Crewther et al. (2016) conducted an 8-week (3 days / week) full body and split body resistance exercise program on 24 male volunteers aged 29.8 ± 6.8 years, with height of 179.5 ±

7.9 cm and body weight of 92.9 ± 12.2 kg. There was a significant difference between the test results before and after the protocol. In addition, the split body protocol increased testosterone more compared to the full body protocol.

Schwanbeck et al. (2020) conducted a study on 20 male and 26 female volunteers between the ages of 18-30, examining the effects of resistance exercise programs applied with free weights (2 days training/1 day rest) and exercise machines for 8 weeks. There was a significant difference between the test results before and after the protocol. In addition, the group that trained with free weights had higher testosterone responses.

In the study of Mangine et al. (2016) conducted on 26 men with resistance exercise experience, the effects of high volume protocol and high intensity protocol resistance exercises for a 9-week period (4 days / week) were examined. There was a significant difference between the test results before and after the protocol. Furthermore, increased testosterone levels were associated with hypertrophy training. Rønnestad et al. (2011) examined the effects of an 11-week (2 days / week) resistance exercise program in their study on 9 male volunteers. There was a significant difference between the test results before and after the protocol. Roberts et al. (2013) examined the effects of 12-week (3 days / week) full body resistance exercises on 36 obese adults aged between18-35. There was a significant difference between the test results before and after the protocol. Moradi (2015)'s study on 21 obese men was examined the effects of a 20-week (3 days / week) resistance exercise program. There was a significant difference between the test results before and after the protocol.

CONCLUSION

The release of some hormones increases in response to the stress caused by resistance exercises on metabolism. One of these hormones is testosterone. Testosterone is a hormone that is directly associated with sports performance, especially because of its association with muscle building and strength. In our study, acute and chronic testosterone responses of resistance exercises were examined. When the studies were examined, it was emphasized that the training applied to increase the testosterone acutely should be of sufficient volume and the exercise should be at a high intensity. Besides, it was seen that metabolism gives high testosterone responses especially to hypertrophy type resistance exercises. Furthermore, it was determined that acute increases in testosterone vary depending on whether the training program is aimed at large muscle groups, the use of free weights or functional exercises, the priority of large muscle groups in training programs, and low body fat percentage.

Different results emerged in studies about chronic testosterone responses of resistance exercises. In some of the studies, no changes in testosterone levels were observed chronically. Researchers state that this is due to the training program that is used to train small muscle groups, the nutrition program, the adaptation of metabolism to the training program and the high average age of the research group. There are also studies stating that resistance exercises chronically increase testosterone release. The researchers argue that the reasons for this increase in testosterone levels are due to the decreased body fat percentage, increased muscle mass, the volume of training used, the low average age of the research group and the use of free weights.

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ORIGINAL RESEARCH

Views of Academic Staff of Physical Education and Sports School on Distance Education in the Period of Pandemic COVID-19

Meryem ALTUN EKİZ [1]
Murat ATASOY [2]

[1]School of Physical Education and Sport, Hatay Mustafa Kemal University, Hatay, Turkey.

[2]School of Physical Education and Sport, Kırşehir Ahi Evran University, Kırşehir, Turkey.

Corresponding author: M. Altun Ekiz

e-mail: mrymltn@hotmail.com

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Abstract

The period of Pandemic COVID-19 has removed students and academic staff from face-to-face education. In this study, the view of academic staff off physical education and sports school for distance education, which started to be given during the pandemic period, were examined. Case study pattern, one of the qualitative research methods, was used in the research. The data were collected virtually by interview method. The interview form consists of 13 structured questions prepared by the researcher and checked by the measurement and evaluation experts. The group of the study consists of 15 academic staff, 3 of whom are female and 12 of which are male, selected by convenience sampling that is one of the purposeful sampling method, working at Kırşehir Ahi Evran University School of Physical Education and Sports. Descriptive and content analysis method was used to analyze the data. The data summarized and interpreted through descriptive analysis were coded and categories were created. In the scope of the research; Academic staff and students were faced with a system in which formal education was provided through distance education for the first time throughout the country. In order to make sense of this new situation and ensure its adaptation, the academic staff, who are the executives of educational services in universities, should continue their communication with students.

Keyword: Covid-19, pandemic, distance education, academic staff

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INTRODUCTION

COVID-19 is a virus that usually survives for several hours on a smooth surface, although temperature and humidity allow for several days. Disinfectants containing continuous heat, ether, 75% alcohol, chlorine for 30 minutes can disable the new coronavirus. These viruses can be transmitted orally and spread mainly through droplets. The incubation period of the virus is from 1 to 14 days (Zou, 2020). In the durability study, SARS-CoV-2 is more stable than plastic and cardboard on plastic and stainless steel surface and up to 72 hours live virus has been detected after application to these viruses (Neeltje van Doremalen, 2020). The most common symptoms of COVID 19 are fever (87.9%), cough (67.7%), fatigue (38.1%), while diarrhea (3.7%) and vomiting (5.0%) are less common (Guan et al., 2020). The time from the onset of symptoms to the development of acute respiratory distress syndrome was only 9 days among the first patients with COVID-19 infection (Huang and Wang, 2020).

COVID 19, which is transmitted through the respiratory tract, first appeared in Wuhan, China in December 2019 and has spread to many countries of the world, including our country. Covid-19 by the first detected case of the Republic of Turkey Ministry of Health in Turkey are described in March 10, 2020. The first virus-related death in the country occurred on March 15, 2020. For this reason, universities have been on holiday for 3 weeks after March 16 with the decision of the Presidency and the Higher Education Institution. Pandemic in Turkey, tourism, social, economic, political, economic, administrative, legal, military, causing many important effects and consequences of religious and educational fields has led to taking radical decisions. The social isolation call repeated by the Ministry of Health through various channels is made with the slogan "Life fits home" (YÖK, 2020).

It is difficult to make long-term plans in times of crisis like pandemic. The Covid-19 pandemic is also one of these crisis periods. In this process, universities had to start distance education processes for all courses (Durak, 2020). In accordance with the philosophy of lifelong learning, universities have carried out studies to provide individuals with independent education from time and place (Kaçan and Gelen, 2020). In order to develop a positive response towards distance education; courses should be in online (live) environment, and distance education environments should be designed in which teachers and students can communicate and technical problems are minimized (Altun-Ekiz, 2020).

According to Aras and Karakaya (2020) detailed training should be given to academic staff for the effective establishment and implementation of distance education in the field of sports sciences. Support of university administrations is important in completing the harmonization processes of academic staff, raising awareness of students and establishing the necessary infrastructure of the institution. Because it is thought that distance education will have an important contribution to the increase and development of the quality of sports education institutions and universities (Aras and Karakaya, 2020).

While education in primary, secondary and high schools in the country in the field of education is suspended; Spring term courses were canceled at all universities and exams were postponed. Due to the decisions of the Presidency of the Higher Education Council and the tendency of the administration of the universities to give courses in formal education through distance education, the necessary preparations were made and the courses were continued with distance education. Exams were also collected as remote homework and projects. Based

on this, in this study, the wiev of academic staff of Physical Education Sports School in the period of Pandemic COVID-19 about distance education were examined.

METHOD

Research Model

In this study, Case Study Pattern and Interview technique, which is one of the qualitative research methods, was used. Case studies are a research pattern in which the researcher analyzes a situation, often a program, event, action, process or one or more individuals in depth (Creswell, 2014). Interview: Individual or focus group interview (structured, semi-structured, unstructured) is an effective method of data collection to confirm observation and document data and to learn the perceptions, reactions and experiences of the individuals participating in the research (Yıldırım and Şimşek, 2013).

Research Group

The study group of the research consists of 15 academic staff, 3 of them are women, and 12 of them are men selected by the convenience sampling that is one of the purposeful sampling method working at Kırşehir Ahi Evran University School of Physical Education and Sports. Purposeful sampling: Qualitative research can usually be carried out in detail with small samples that are purposefully selected, sometimes even with a single (f=1) sample (Patton, 2014). Ethics committee approval was obtained from Kırşehir Ahi Evran University for this study (04.03.2021, Decision Number: 2021/1).

Data Collection Tools

The data were collected using the interview method. A virtual interview was held with the academic staff determined by the purposeful sampling method. A structured interview form consisting of 13 questions developed by the researcher was used in the study. The questions were checked by assessment and evaluation experts. Research questions are as follows;

1. Did you give distance education before the pandemic Covid-19?

2.Which distance education tools do you use?

3. Which method did you do the midterm exams?

4. How did distance education contribute to students?

5. Has the measurement and evaluation of student success been carried out in distance education systems in a healthy way?

6. Is distance education suitable for theoretical and practical lessons?

7. Do you think that the lessons given in distance education are as efficient as face-to-face education?

8. Have you had trouble adapting to distance education?

9. Would you like to use distance education after the Covid-19 period is over?

10. Do you think that distance education will be common even if the effects of the Covid-19 period have passed?

11. Do you think that the transition from distance to education improves your teaching capacity?

12. Do you find that universities have switched to distance education during the Covid-19 period?

13. You can write your thoughts about the distance education process that you experienced due to Covid-19 period.

Data Analysis

"Descriptive and Content Analysis" methods were used in the analysis of the data. The data summarized and interpreted through descriptive analysis were placed in categories that were coded and created. The reason for choosing content analysis is to ensure that conceptual connections are established in explaining the relationship between the data collected and the objectives of the method in question (Büyüköztürk, 2013). The analysis was completed by editing the themes and codes and interpreting the findings. As a result of the analysis of the collected data related to the research questions, the data collection was terminated when the themes started to repeat each other (Yıldırım and Şimşek, 2013). The reliability formula suggested by Miles and Huberman (1994) (Reliability = Consensus / (Consensus + Disagreement) × 100) was used for the reliability calculation of the study. As a result of the analysis, the reliability rate was found to be 85%. In addition, direct quotations, another reliability criterion, are included.

FINDINGS

Table 1. Demographic information of the participants

Participants' Codes	Gender	Age	Professional Experience	Title
P1	Male	50	26	Lecturer
P2	Male	47	12	Assoc. Prof
P3	Famele	42	22	Assoc. Prof.
P4	Male	27	1	Research Asst. Dr.
P5	Male	45	19	Asst. Prof.
P6	Male	45	20	Asst. Prof.
P7	Male	50	25	Lecturer
P8	Male	43	2	Lecturer
P9	Male	40	12	Lecturer
P10	Male	30	1	Research Asst. Dr.
P11	Male	53	31	Lecturer
P12	Male	41	13	Assoc. Prof.
P13	Famele	34	8	Asst. Prof.
P14	Male	36	10	Asst. Prof.
P15	Famele	34	13	Asst. Prof.

		Frequency
Did you give distance education before COVID-19?	Yes	4
	No	11
What distance education tools do you use?	Document upload and live lesson (synchronous)	12
	Live lesson	2
	Video recording	3
Which method did you do the midterm exams?	Uploading homework	14
	I did not exam	1

*Multiple options can be marked

According to the gender variable of the participants, 3 are women and 12 are men. The age of the participants is between 27-50. Their professional experience is at least 1 and at most 31 years. While 4 of the participants gave distance education before Covid-19, 11 of them did not have distance education experience. Participants were asked "Which distance learning tool do you use?" They gave the answers to document loading and live lesson (f=12), live lesson (f=2), video recording (f=3). "Which method did you do midterm exams?" They gave the answer to the question of loading homework (f=14), I did not take the exam (f=1).

Table 2. Categories, codes and frequency values for students' contributions to distance education

Categories	Codes	Frequency
Contributions of distance education to student	Use of technology	2
	Time and space independence	3
	It strengthened their willpower	1
	No contribution	3
	They learned the continuity of education in any situation	3
	Made an economic contribution	3
	Saving time	1
	They did not go away from the lessons	1
	Literature review gained	1
	They had a different experience	1
	Total	19

"What contribution did distance education provide to students?" was asked to academic staff. The categories, codes and frequency values created for this question are given in Table 3. As seen in the table, the differences given by the academic staff were determined. Some of the answers given by the academic staff participating in the research regarding this question are as follows:

P1: *Distance education showed students primarily that the use of technology also works outside of social media. It also showed that education and training could continue simultaneously in such epidemic periods and necessity but by providing space independence.*

P2: *They continued their education under difficult conditions and strengthened their will.* P4: *They learned about the continuity of education in any situation, how the right to education can continue in case of a possible crisis, and how they can continue to improve themselves without losing motivation and adaptation under any circumstances.* P9: *I think that with this application, students are often convinced that participating in the learning process can be done without requiring physical assets. In this way, students generally made their own decisions to attend classes by acting with their own inner motivations. Through distance education, students also reviewed their technology knowledge.*

P3: *I don't think it makes a great contribution scientifically. Because my attendance was very low. In addition, I think there are students who do not attend the class for a short period of time just because the name appears in the system.* P7*: I don't think it contributes.* P8*: I think that it is not very productive for students because of the fact that distance education is not compulsory to continue and the assessment and evaluation system cannot be performed properly.*

P5: *I think the most important contribution of distance education to students is economic. They didn't spend much money and listened to the lessons more comfortably.* P6*: I think it contributes financially. Especially students coming from outside the city did not have to bear the cost of living in another city. I don't think it contributes extra in terms of education. On the contrary, they were not properly trained. Because both teacher-student interaction and student-student interaction did not*

occur.

Table 3. Categories, codes and frequency values for measurement and evaluation of student success in distance education systems

Categories	Codes	Frequency
Measurement and evaluation	Couldn't be done healthy	14
	Made healthy	1
	Total	15

"Could measurement and evaluation of student success be made in distance education systems in a healthy way?" was asked to academic staff. As seen in the table, the majority of the academic staff *(f=14)* stated that measurement and evaluation *could not be done in a healthy*. Some of the answers given by the academic staff participating in the research regarding this question are as follows:

P1: *Because of the pandemic, the homework was generally incomplete as the students scan their homework on the internet and use the resources they can access. For this reason, a healthy assessment could not be made since there was no healthy homework. Because in a healthy assessment, most of the students would have failed.* P5: *I don't think it's very healthy. Because the lesson hours were short, limited topics could be explained. It is not known how students do their homework because they are tested by homework. We don't know if they did it themselves or did they get help from others.* P9: *Since the distance education system has been put into practice for the first time, I think there are some problems in this regard. Assessment and evaluation activities conducted through homework may have pushed some students to do these homework using the unqualified information available on the Internet. I think that only when measuring and evaluating through homework can cause problems in terms of validity and reliability in the long term when it does not take responsibility for learning on students.* P**1**0: *I am of the opinion that measurement and evaluation are carried out in a healthy way with a graded scoring key.*

Table 4. Categories, codes and frequency values for the suitability of the lessons given for distance education

Categories	Codes	Frequency
Whether the lessons are suitable for distance education or not	Suitable for theoretical lessons	10
	Partially suitable for theoretical lessons	5
	Not suitable for practiced lessons	13
	Suitable for practiced lessons	2
	Total	30

"Is distance education suitable for theoretical and practical lessons?" was asked to academic staff. The answers given for this question were used as expressions such as *suitable for theoretical lessons (f=10), partially suitable for theoretical lessons (f=5), not suitable for practiced lessons (f=13), and suitable for practiced lessons (f=2).* Some of the answers given by the academic staff participating in the research regarding this question are as follows:

P1: *I think it is not appropriate as the application process cannot be done in distance education. But I think it is appropriate in theoretical lessons and provided that the duration of the lesson is done. Many universities in the world carry out their master's and doctorate programs by doing distance education in this way.* P5: *I think it is suitable for theoretical lessons. It is no different from the classroom environment. But it is not efficient for practiced lessons. Adequate efficiency cannot be obtained especially in technical fields. It was enough for the lessons I taught.* P9: *I think that the suitability of the lessons given in parallel with the distance opportunities provided by the distance education portal should*

be evaluated. In my opinion, while theoretical lessons can be taught more effectively through distance education, I think that the appropriateness of the infrastructure of the present portal should be questioned in our applied lessons which mainly include behavioral philosophy and psychomotor learning.

P10: *Practiced and theoretical lessons can be done online. However, I think that the practiced lessons should be given face to face for 1-2 weeks.* P12: *In theoretical lessons, if distance education lesson hour is increased in the system (60 min. or more). It is not enough to give the essence of practiced lessons. There must be practice in the field.* P13: *Not suitable for practiced lessons, partly suitable for theoretical lessons. Because the theoretical lectures I gave required discussion and question and answer.*

Table 5. Do you think that the lessons given in distance education are as efficient as face-to-face education? categories, codes and frequency values for the question

Categories	Codes	Frequency
Whether distance education is efficient	Distance education is inefficient	13
	There have been cases when it is more efficient or less efficient.	1
	Efficient for theoretical lessons, inefficient for practical lessons	1
Total		

As can be seen in Table 5, the majority *(f=13)* stated that *distance education is inefficient.* Some of the answers given by the academic staff participating in the research regarding this question are as follows:

P1: *It cannot replace face to face education. Because the classroom atmosphere is not in this application. I do not think that education and teaching will be successful without seeing the student face to face, inhaling the same atmosphere, perceiving the student's attitude towards the lesson and the teacher, and not seeing the student's gestures and facial expressions. I do not recommend this practice especially in teacher education.* P9: *I think that distance education is still under development. In my view, the distance education portals as they are in the current form mostly require the student to take responsibility for their own learning, as it minimizes physical classroom management. This can sometimes reduce the efficiency of distance education.* P14: *I do not think. We do not know if they are listening to us because we cannot see the students. There is no mutual interaction.*

Table 6. Have you had difficulty in adapting to distance education? categories, codes and frequency values for the question

Categories	Codes	Frequency
Adapting to distance education	I had no difficulty	12
	I had difficulty	3
	Total	15

As can be seen in Table 6, the majority of respondents *(f=12)* stated that they did not experience any difficulties. Some of the answers given by the academic staff participating in the research regarding this question are as follows:

P1: *Since I am not a stranger to practice, I did not have serious difficulties. But trying to fit the lesson in 30 minutes for 2 or 3 hours in the program caused problems in terms of subject and duration. I had no difficulty in using technology and distance education.* P9: *Thanks to the user-friendly interface provided by our university, I had no difficulty in adapting.* P12: *In general, I did not know what I could do in the beginning. I had reservations about getting to the level of the student and understanding the*

lesson. But I adapted in the coming period.

P8: *The long lesson preparation of thelesson materials and the shorter lesson hours caused me difficulty in adapting to distance education.* P13: *had a hard time at first. Giving detailed training about the system. I learned most about the system after the classes and exams were over.*

Table 7. Would you like to use distance education after the Covid-19 period is over? categories, codes and frequency values for the question

Categories	Codes	Frequency
Whether to continue distance education	Yes, I would like to use	8
	No, I do not want to	7
	Total	15

As can be seen in table 7, in the responses given, *f=7* of the participants stated that they did not want to use it and *f=8* of the participants wanted to use it after the Covid-19 period was over. Some of the answers given by the academic staff participating in the research regarding this question are as follows:

P1: I *am in favor of using it in some cases, as it provides technological competence and space independence for students and teachers. However, all lessons are not suitable for education.* P2: *Yes, I would like to use it. I would like to use distance education about missing topics, extra information and topics determined in line with students' wishes.* P4: *Yes I would. Because it is a more comfortable method both for the student and for us. It will also be better in terms of students' participation in the lesson, especially for graduate and doctorate lessons.* P8: *I think distance education has now entered our lives. I would like to use it in the future. I think it will be very useful for students who have a dual career in our field, for example, who have difficulties in attending classes. P13: No. Because there are no vehicles with sufficient equipment.*

Table 8. Do you think that distance education will become widespread even if the effects of Covid-19 period have passed? categories, codes and frequency values for the question

Categories	Codes	Frequency
Whether distance education has become widespread or not	Yes	14
	No	1
	Total	15

As can be seen in Table 8, the majority of respondents think that distance learning will become widespread even if the effects of the Covid-19 period have passed. Some of the answers given by the academic staff participating in the research regarding this question are as follows:

P1: *At least I think it will continue as pilot lessons and practices. Because many universities were caught unprepared for distance education, they faced a lack of infrastructure. I think that preparations will be made in order not to encounter such situations again and such practices will continue for the continuity of distance education.* P4: *Yes, I think The new world order and developing technology direct humanity towards this direction. Efficiency of technology and machinery will change human life especially in our world where Industry 4.0 is experienced. Covid-19 style epidemics will continue to be seen in our world in the next period.* P9: *Absolutely. Already before the virus, online education opportunities were improving day by day. Now we are convinced that this is a requirement. I think that new technologies will make the process easier and distance education will start to be used more effectively.*

Table 9. Do you think that the process of transition to distance education improves your teaching capacity? categories, codes and frequency values for the question

Categories	Codes	Frequency
Whether distance education improves teaching capacity or not.	Yes	7
	No	8
	Total	15

As seen in Table 9, in the answers given, *f=7* of the participants think that distance education does not improve their teaching capacity, while *f=8* think that they improve. Some of the answers given by the academic staff participating in the research regarding this question are as follows:

P1: *I don't think it has contributed much to me. In addition, the opportunities are limited, the limitation in student attendance has caused my enthusiasm in this practice.* P3: *Yeah I think. Because science and knowledge are in the process of constant change and development. In this direction, I developed my slides and topics.* P9: *I think being able to use distance education is knowing a new teaching way. So I think I have improved my capacity in this regard.* P5: *No. In this regard, the classroom environment is an environment that needs more attention and attention for the teacher. Therefore, the classroom environment is more important in the context of lesson preparation.*

Table 10. Do you find positive that universities have switched to distance education during the Covid-19 period? categories, codes and frequency values for the question

Categories	Codes	Frequency
Whether the transition to distance education is positive or not.	Yes	14
	No	1
	Total	15

Table 11. The Views of the participants regarding the distance education process due to Covid-19 period

P1: *It is necessary to know what distance education is first and you want to take part in this distance education. You have to decide this. Distance education in education by letter. In the job of open education, it is distant education to load the whole load to the student by uploading distance education or asynchronous material. If you want to make synchronous lessons using technology, you must first create your infrastructure, your own software, and provide the necessary support to academic staff. I am going to distance education. You will not be doing this with orders such as apply it like this. You need to have a mobile device and it needs training. Administrators need to find solutions to these problems.*
P3: *I wish the lesson time would be longer. 30 minutes is not enough for one lesson. Also, whether the attendance is continuous or not can be statistically recorded. In addition, the time and day of the lesson can be determined by the instructors. Without time limitation. For example, we should be able to teach at 9 in the evening.*
P5: *What can be done to eliminate the suffering of students who cannot participate in distance education is very important. This needs to be fixed. It should be ensured that the lesson hours are longer. More effective exam systems need to be developed to evaluate students.*
P8: *I think that teachers should be prepared beforehand for distance education. I also think that some students are not able to participate healthily because they are conscious of distance education or have difficulty in reaching the system. I think that the distance education and measurement and evaluation process should be started in this way by establishing strong infrastructures beforehand.*
P9: *The distance education method is ideally a useful tool in education and training. However, determining the needs of students and lecturers (physical, knowledge) will play a direct role in more effective functioning of this process. For example, one of the difficulties I experienced in the process was that some of the students did not have a computer or internet connection. Some lecturers also had difficulty uploading videos or delivering other materials to students.*

P10: *I can say that systematic failures affect the process negatively, even if the number of participants is small and partial.*
P11: *The system started late, there was indecision.*
P12: *Students should be prevented from adding after the assignment date, some additions can be made to the students. Because the student appears in the system in the class, but the rate of attendance and answering the questions remains very low.*
P14**:** *Lesson duration and assessment criteria should be updated.*

As can be seen in table 10, in the responses given, the majority of the participants find that universities have switched to distance education in the Covid-19 period. Some of the answers given by the academic staff participating in the research regarding this question are as follows:

P1: *Not all universities were able to go to distance education. Uploading homework and documents is not remote education. The number of universities that can perform synchronous education was limited. Normally distance education is not suitable for all lessons and all. I do not consider it positive except in cases of necessity.* P5: *Yes, it was very positive. I think it was a nice process in the sense that our university has infrastructure and students are not victims. I think that by eliminating some deficiencies, more effective distance education can be implemented in the future.* P9: *Absolutely. It is pleasing that this new pedagogy is practiced in such an environment, although there are some problems. It will also be very useful for our university to start this process by closely following the current developments and to perfect the future distance education applications.* P13: *Positive. Because little interaction and communication between students and academic staff continued. They were not victims.*

DISCUSSION AND CONCLUSION

The age of the participants is between 27-50. Their professional experience is at least 1 and at most 31 years. While 4 of the participants gave distance education before Covid-19, 11 of them did not have distance education experience. Participants were asked *"Which distance learning tool do you use?"* They gave the answers to *document loading and live lesson (f=12), live lesson (f=2), video recording (f=3). "Which method did you do midterm exams?"* They gave the answer to the question of *loading homework (f=14), I did not take the exam (f=1). "What contribution did distance education provide to students?"* was directed to academic staff. Differences given by the academic staff were determined. These are: *Use of technology (f=2), time and space independence (f=3), it strengthened their willpower (f=1), no contribution (f=3), they learned the continuity of education in any situation (f=3), made an economic (f=3), contribution saving time (f=1), they did not go away from the lessons (f=1), literature review gained (f=1), they had a different experience (f=1). "Could measurement and evaluation of student success be made in distance education systems in a healthy way?"* was directed to academic staff. the majority of the academic staff *(f=14)* stated that measurement and evaluation *could not be done in a healthy*. *"Is distance education suitable for theoretical and practical lessons?"* was directed to academic staff. The answers given for this question were used as expressions such as *suitable for theoretical lessons (f=10), partially suitable for theoretical lessons (f=5), not suitable for practiced lessons (f=13), and suitable for practiced lessons (f=2).* The majority of the participants *(f=13)* stated that *distance education is inefficient.* The majority of the participants *(N=2)* stated that they *did not experience any difficulties*. In the responses given, *f=7* of the participants stated that they did not want to use it and *f=8* of the participants wanted to use it after the Covid-19 period was over. The majority of the participants think that distance learning will become widespread even if the effects of the

Covid-19 period have passed. In the answers given, *f=7* of the participants think that distance education does not improve their teaching capacity, while *f=8* think that they improve.

Durak et al. (2020) 19 Covid-pandemic period examined in the study by distance education system of universities in Turkey; although the Higher Education Council recommended that the courses be processed synchronously, they stated that the number of universities that can carry out all their courses synchronously is only six, and most of the universities are trying to manage the processes through the previously established learning management system (f=29) and live course software (f=24). Approximately half of the universities followed the course attendance of the students. Participants stated that the education of academic staff in the preparation process of distance education was the most difficult situation. In the study, it was observed that all of the universities in Covid-19 process provided training to the instructors about distance education systems (presenting user manual and / or video).

In the studies of Aras and Karakaya (2020); it is stated that more than half of the academic staff have knowledge about distance education and some of them have no knowledge. Some academic staff stated that distance education will create problems and will not be useful. In the opinions they stated about managing their courses with distance education, it was seen that some academic staff did not want to carry out distance education. However, it was determined that the majority could also be in theoretical lessons and would benefit. They stated that the lessons to be given by distance education will eliminate the problem of time, place and material among the benefits that they will provide for themselves and their students. They stated that the benefits of applying for distance education courses in sports sciences will not save time, and will not hinder theoretical courses and education of national athletes. They reported that, as disadvantages, they would create problems such as difficulties in interaction and not understanding the lessons.

As a result of the Kurnaz and Serçemeli (2020) research, it was observed that academicians did not adopt the distance education system too much and did not experience any problems in terms of their self-efficacy regarding the use of the system. Lack of mutual interaction between students and instructors, failure to present theory and practice together, were determined as negative factors related to distance education in accounting lessons. As a result, it is suggested that blended education methods, which adopt both traditional and distance education methods together, would be more effective in accounting education. Serçemeli and Kurnaz (2020) stated that it is very important for all students to have sufficient access to the internet in terms of applicability of the distance education method using internet and video recordings. When students' perspectives on distance education are analyzed, it is seen that they view this approach negatively. He suggested that at this point, both the advantages of traditional methods and the advantages of distance education methods should be blended together.

In the study, Altun-Ekiz (2020) examined the opinions of the students of physical education and sports school about distance education during the quarantine period; The majority of the participants' opinions on the processes and outcomes of distance education are ineffective. It is a positive reaction that it can be watched regardless of time and place. There are also students who cannot continue regularly due to various problems. Participants stated that they are inefficient for practice lessons, efficient for theoretical lessons and that they are

not very happy about this situation in terms of lack of mutual communication. It has been noticed that factors such as lack of question-answer in distance education, problems in entering the system cause negative reactions.

In Kurtüncü and Kurt (2020)'s studies, most of the students stated that both theory and applied lessons would be insufficient with distance education, they did not think of suspend the study the school, but they thought the school would extend. Problems experienced; "Problems in distance education infrastructure", "not facing education", "limitation of possibilities", "mood caused by the pandemic" and "test anxiety". Solution suggestions are; It has been themed as "improving the distance education infrastructure", "using web-based additional applications", "assigning homework instead of exams" and "accelerated program". In this process, it is recommended to constantly update the distance infrastructure systems of universities for theory courses, to create opportunities for students with limited opportunities, and to repeat the applied courses in an accelerated manner in the next period.

Aktaş et al. (2020) as a result of the study, which examined the attitudes of sports science students towards distance education in isolation days caused by COVID-19 virus; It was determined that the students wanted to follow their lessons remotely due to this process but they did not increase the competence of the exams made with the distance education system and they did not want distance education under normal conditions. It is also determined that the lecturers support the student in this process.

Kaletepe et al. (2020) How do teacher candidates view synchronous distance education? In their studies, it was determined that the majority of prospective teachers attended the classes via mobile phones and used a fixed internet line. It was understood that the method they found most useful in synchronous lessons was oral presentations, in general, pre-service teachers had negative attitudes towards synchronous lessons, they were reluctant to provide online distance education in the future, they did not believe themselves enough and they did not believe that online lessons were the future.

In the scope of the research; the quality and effects of distance education services offered by the Higher Education Council to universities during the pandemic period were investigated in line with the opinions of the instructors, and the following conclusions and suggestions were reached: Academic staff and students were faced with a system in which formal education was provided through distance education for the first time throughout the country. In order to make sense of this new situation and ensure its adaptation, the academic staff, who are the executives of educational services in universities, should continue their communication with students. It is thought that a positive communication process that academic staff will create with their students will facilitate achieving the desired educational goals. Distance education and similar learning technologies have now become a reality of our age. We have witnessed that some stakeholders towards distance education have negative perspectives such as "Is education at a distance?", "I am against distance education." It is wrong to completely refuse distance education. In terms of learning outcomes, distance education should be studied to be as effective as face-to-face education. It is necessary to understand the advantages and disadvantages of both types of education correctly. Therefore, the process should be planned meticulously and factors that may affect learning should not be ignored.

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ORIGINAL RESEARCH

The Effect of TRX Suspension Training on Physical Capacity of Young Sedentaries

Serkan PANCAR [1]
Hüseyin TOPÇU [2]
Ramiz ARABACI [2]
Tonguç VARDAR [2]

[1]Faculty of Sport Sciences, Aksaray University, Aksaray, Turkey

[2]Faculty of Sports Sciences, Uludag University, Bursa, Turkey

Corresponding author: S. Pancar

e-mail: sdpancar@gmail.com

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Abstract

The aim of the study was to investigate the effect of of suspension training on speed, flexibility, jump and strength of sedertary young men. *Methods:* A total of 30 male, who do not do regular physical activity, volunteered to participate in this study. Participants' mean age, height and weight and standard deviation are 18.41±1.25 year, 170.83 ± 4.61 cm, 69.88 ± 3.17 kg, respectively. The participates were randomly divided into two groups as the Control Group (CG-n: 15) and the Total Resistance Exercises group (TRX-n: 15). TRX training protocols were applied to the participants as 8 weeks, 3 days/week, 45 minutes/day. All performance tests and training protocols in the study were applied in a synthetic floor gym with a temperature of 20-24°C for 8 weeks. Flexibility, strength (plank), speed (30 m) and vertical jump performances of the participants were evaluated before (pre-test) and after (post-test) the training. *Results:* In the post-test comparisons of the TRX group and the CG, no difference was found in the speed and vertical jump performances (p>,05). However, a significant difference was found in favor of the TRX group in flexibility and strenght performances (p<,05). *Conlusion*: 8 weeks of TRX suspension training is thought to improve physical performance in sedentary young men.

Keyword: Physical fitness, strength, suspension training, TRX.

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INTRODUCTION

Physical inactivity causes many diseases, especially heart diseases (Birinci et al., 2019). Exercise has many positive effects. These are hormonal, physiological and physical effects supported by studies (Paşaoğlu et al., 2019; Kirişçioğlu et al., 2019; Özdal et al., 2019; Özer et al., 2017; Vural et al., 2019). Despite these, people do not spare time for exercise. One of the most important reasons for not participating in physical activity is the inability to enjoy the activity. One possible way to increase the number of individuals participating in regular physical activity is to avoid traditional exercises and to participate in new methods that are easier to do and enjoy (Birinci et al., 2020; Smith et al., 2016). In addition to traditional methods, there are different methods such as bosu ball and pilates (Anderson & Behm, 2004; Santana et al., 2007). Total Resistance Exercises (TRX) has recently been added among these training models (Bettendorf, 2010; Gaetz et al., 2014).

TRX is a new type of exercise that has been increasingly used recently. Although it is performed using only body weight, it has been shown in studies that it improves strength, balance, flexibility and trunk stability at the same time. TRX uses the resistance created by the user's own body weight against gravity to create the physical stress necessary to develop and maintain health and fitness (Bettendorf, 2010; Çavlan, 2017; Dawes, 2017). TRX training is started to use for rehabilitation purposes by physiotherapists, athlete health clinics. It is also used in military unit training, sports halls, exercise studios and similar places. It is frequently used as a method by which professional and amateur athletes can apply a functional exercise method that they add to their training programs (Melrose & Dawes, 2015).

It allows movements to be performed in 3 different planes by using a band (Fitness Anywhere, LLC., 2011) In addition, it provides the opportunity to change the joint angles originating from the unstable plane and to adjust the intensity of the exercise (Melrose & Dawes, 2015). TRX has been reported to have a very functional structure that is used to improve strength, endurance, balance, coordination, flexibility and core stability (Wibowo & Fathir, 2017). When studies are examined, it has been determined that it increases coordination, maintains and improves posture, strengthens ligaments (Pastucha et al., 2012), and increases strength development (Carbonnier & Martinsson, 2012). In addition, it has been revealed that strength studies performed with TRX contribute to performance improvement and are also associated with health (Carbonnier & Martinsson, 2012; Pastucha et al., 2012).

TRX can be used almost anywhere by anyone, regardless of age, gender, education level, by diversifying exercise (Smith et al., 2016). According to the literature review we conducted, this training model, which is very new, focused on the elderly, professional athletes and rehabilitation studies (Mohamed, 2016). However, it is seen that the study examining the effect of TRX in sedentary individuals is quite limited. The aim of the study was to investigate the effect of suspension training on speed, flexibility, jump and strength of young sedanters.

METHOD

One week before the tests and training protocols started, the tests and training protocols to be applied in the study were introduced, the study was explained to each participant and the volunteer consent form was signed. Two days after the introductory week, the participants completed all the tests in the study at one-day intervals. During the tests and

training protocols, the participants were not involved in any other physical activity or training. Each of the participants was randomly divided into TRX group (TRX) and control group (CG). Speed, strength (plank), flexibility and vertical jump performances of the participants before (Pre-test) and after (Post-test) training protocol were determined. All performance tests and training protocols in the study were applied in a synthetic floor gym with a temperature of 20-24°C. Participants were encouraged to perform at their maximum during the tests. Participants were asked to maintain their normal dietary intake during the study, not to consume any ergogenic supplements and alcohol, and to maintain their sleep patterns. Participants stopped food intake (except water) 2 hours before testing and training. Before the tests, a general warming protocol lasting 15 minutes was applied to the participants. Flexibility, vertical jump, speed and strength tests were applied respectively after warming up. Two days after the pre-tests were completed, training protocols were applied to the participants as 8 weeks, 3 days / week, 45 minutes / day. During this period, the participants in the CG did not engage in any physical activity. The tests were repeated in the same way 2 days after the training protocols were completed.

Subject

Thirty male volunteers who do not do regular physical activity participated in our study. Participants' mean age, height and weight and standard deviation are 18.41±1.25 year, 170.83 ± 4.61 cm, 69.88 ± 3.17 kg, respectively. Participants were informed about the tests and training protocols.

TRX Protocol

5 different training programs with different exercises, repetitions and rest periods (Total Body, Core, Leg and Hip, Chest and Back, Arm and Shoulder) were planned for 8 weeks (Table 1). The angles that the participants could do a maximum of 10 repetitions in each movement were determined and they were made to do this in their training sessions while applying the movements according to the Vectorial resistance principle (Fitness Anywhere, LLC., 2011). In all exercise programs, 5 minutes of warm-up and 5 minutes of stretching exercises were performed at the beginning of each session. The training program and the applied movements are shown in Table 1 in detail.

Table 1. TRX Protocol

Week	Weekly Training Days (Number)	Training Time (min.)	Number of Sets	Number of Repetitions	Rest Between Sets (sec.)
1-8. Week	3	30	2	10	45
	Monday		**Wednesday**		**Friday**
Week 1	Total Body		Core Leg and Hip		Chest and Back Arm and Shoulder
Week 2	Arm and Shoulder Leg and Hip		Core Chest and Back		Total Body
Week 3	Arm and Shoulder Core		Leg and Hip Chest and Back		Total Body
Week 4	Total Body Core		Leg and Hip Arm and Shoulder		Chest and Back Stretching

Week 5	Chest and Back Leg and Hip	Total Body	Arm and Shoulder Core
Week 6	Arm and Shoulder Leg and Hip	Core Chest and Back	Total Body
Week 7	Total Body	Core Leg and Hip	Chest and Back Arm and Shoulder
Week 8	Chest and Back Leg and Hip	Total Body	Arm and Shoulder Core

Muscle Group	**Movements**	
Total Body	TRX Low Row TRX Triceps Press TRX Cycle Jump TRX Biceps Curl TRX Y Fly TRX Squat TRX Chest Press Mountain Climber TRX Lunge	TRX Hip Press TRX Hamstring Curl TRX Crunch TRX Side Plank TRX Chest Stretch TRX Half-Kneeling Hip Flexor Stretch TRX Low Back Stretch
Leg and Hip	TRX Hip Press TRX Hamstring Curl TRX Lunge	TRX Single Leg Squat TRX Cycle Jump TRX Squat
Core	TRX Resisted Torso Rotation TRX Crunch TRX Side Plank	TRX Pike TRX Mountain Climber TRX Leg Lowering
Arm and Shoulder	TRX Biceps Curl TRX Triceps Press TRX Y Fly	TRX Clutch Curl TRX Triceps Press Reverse Grip TRX W Fly
Chest and Back	TRX Chest Press TRX Clock Press TRX Chest Fly	TRX Low Row TRX Mıd Row TRX High Row

Performance Tests

Vertical Jumping

The vertical jump performance sensitivity of the participants was measured by using an electronic timing mat (Newtest Powertimer 300, Finland). It was measured 2 times, 30 seconds apart and the best scores were recorded (Alvurdu et al., 2019).

Speed Test

A wireless 2-door Sinar brand photocell device was used to measure the 30 meters speed of the participants. It was measured 2 times, 3 minutes apart, and the best scores were recorded (Topcu & Arabaci, 2017).

Sit-Reach Test

Sit-and-reach flexibility bench was used to measure flexibility. The participant sits on the floor and stretches his legs, rests his soles on the front face of the coffee table, stretches his arms as far as possible on the metric panel on the upper surface of the coffee table, and waits for two seconds at the last point where his toes touch. The last point touched on the metric panel is determined and saved. It was measured 2 times, 30 seconds apart and the best scores were saved in centimeters (Mihriay, 2020).

Strength Test (Plank Test)

While participants lying face down, only the elbows and toes were allowed to come into contact with the mat. The participant was asked to raise their torso from the ground. The test was terminated if they did not correct the position distortions in more than three seconds. The total time remaining in the appropriate position was used for analysis (Ünver et al,. 2020).

Statistical Analysis

SPSS 24 package program (Windows, Chicago, Illinois, USA) was used for data analysis. The distribution of normality was done by using the Shapiro Wilk test (p>,05). In group comparison dependent t test and between groups comparison independent t test was performed. The level of significance was determined as p <,05.

Results

Table 2. T-test results for dependent groups regarding the difference in pre-test and post-test scores of the TRX group

Test	N	X	SD	t	p
Pre-test Jump	15	34,47	6,77	-1,84	,086
Post-test Jump	15	36,20	7,41		
Pre-test Speed	15	4,56	,25	1,42	,178
Post-test Speed	15	4,54	,25		
Pre-test Flexibility	15	26,40	6,81	-7,31	**,000**
Post-test Flexibility	15	29,46	6,61		
Pre-test strength	15	135,60	69,40	-16,70	**,000**
Post-test strength	15	172,00	64,68		

When Table 2 is examined, no significant difference was found between the jump and speed test pre-test and post-test scores of the TRX group (p> .05). A significant difference was found between the flexibility and strength test pre-test and post-test scores of the group (t = -7.31, p <, 05; t = -16.70, p <, 05). While the average flexibility pre-test scores of the TRX group was 26.40, the average post-test scores were 29.46. While the average of power test pre-test scores is 135.60, the average of post-test scores is 172.00. The numerical difference between them was found significant in favor of the posttest scores. This finding can be interpreted as the training program applied to the TRX group improved the flexibility and strength parameters.

Table 3.T-test results for dependent groups regarding the difference in pre-post-test scores of the CG.

Test	N	X	SD	t	p
Pre-test Jump	15	35,07	7,46	-2,086	,056
Post-test Jump	15	35,60	7,51		
Pre-test Speed	15	4,67	,27	-,193	,849
Post-test Speed	15	4,68	,20		
Pre-test Flexibility	15	20,60	8,50	-,202	,843
Post-test Flexibility	15	20,67	8,31		
Pre-test strength	15	115,40	72,46	1,344	,200
Post-test strength	15	113,13	67,54		

When Table 3 is examined, there was no significant difference in jump, speed, flexibility and strength pre-post-test comparisons in the CG (p>, 05).

Table 4. Independent sample t test results regarding the difference in pre-test and post-test scores by groups

Test	Group	N	X	SD	t	p
Post-test Jump	TRX	15	36,20	7,41	,22	,827
	CG	15	35,60	7,51		
Post-test strength	TRX	15	172	64,69	2,43	**,021**
	CG	15	113,13	67,54		
Post-test Speed	TRX	15	4,54	,256	-1,36	,186
	CG	15	4,67	,267		
Post-test Flexibility	TRX	15	29,47	6,61	3,21	**,003**
	CG	15	20,67	8,31		

When Table 4 is examined, there is significant difference between strenght post-test scores between the groups in favor of the TRX group (t = 2,438, p <, 05). The average strenght post-test scores of the TRX group were 172.00, while the average post-test scores of the CG were 113.13. Flexibility test post-test scores between the groups showed a significant difference in favor of the TRX group (t = 3.209, p <, 05). While the flexibility post-test scores of the TRX group were 29.47, the CG post-test scores were 20.66. This finding can be interpreted as the experimental procedure applied to the TRX group improved the strength and flexibility parameters.

DISCUSSION

In this study, the effect of 8-week TRX training on flexibility, strength, speed and vertical jump in sedentary young men was investigated. In line with the findings, it was observed that those in the TRX group improved significantly in flexibility and strength data compared to the CG, while no difference was found between the groups in speed and

explosive power.

There are quite a limited number of studies investigating the effects of TRX on flexibility, jump, speed and power parameters in the literature. Smith et al. (2016) found that 8-week TRX suspension program implementation had no effect on flexibility performance. In our study, it was found that the TRX group showed better flexibility performance than the CG and there was a significant difference between them. It is seen that the average age of the subject group in the study is higher than the average age of the individuals in our study. It is known that the flexibility feature decreases as the age progresses. Therefore, it can be thought that the difference between studies is due to the average age.

Tomljanovic et al. (2011) compared the effects of a 5-week TRX with a 5-week traditional resistance exercise program. They found that the jump performance of the group doing the TRX exercise was significantly higher than the group that did traditional resistance exercise. Similarly, Şenol and Gulmez (2017) found a significant difference in the TRX group values when the vertical jump pre-test and post-test values were compared. Nalbant and Kınık (2018) found a positive effect on explosive force in a study in which they examined the effect of 6 weeks of exercise with 20 basketball players. In our study, no statistically significant difference was found in the vertical jump and speed performances between the groups. It can be thought that the different results among the studies resulted from the difference in exercise program, duration and physical levels of the subject groups.

When the studies are examined, it is seen that TRX training focuses more on the effect of posture and core stabilization. McGill et al. (2014) reports that the core stabilization muscles of TRX push-up positions are activated at the highest level. Byrne et al. (2014) examined muscle activation in the TRX and standard bridge position. It demonstrated that the instability presented in the TRX suspension system resulted in a significant increase in abdominal muscle group activation compared to the standard bridging group. Ghervan (2012) found that TRX training in professional athletes increased pull-up performance and contributed to development in the core region. Smith et al. (2016) found that TRX improved pull-up performance and endurance. The result we found in this study coincides with all the research findings examined. In all studies, it is shown that instability that occurs during exercise with TRX provides core muscle activation and as a result muscle development.

We believe that a broader study of the effectiveness of TRX exercises will contribute to science in improving the physical condition of individuals who are both healthy, disabled or in need of rehabilitation. As a result, it is tought that TRX training increase physical performance sedentary individuals.

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ORIGINAL RESEARCH

The Comparison of Trail Making Test Scores of Open and Closed Skill Sports Athletes

Onur TOKGOZ [1]
Nimet Hasil KORKMAZ [1]
Serkan PANCAR [2]

[1] Uludag University, Faculty of Sports Science, Bursa, Turkey.

[2] Aksaray University, Faculty of Sports Sciences, Aksaray, Turkey.

Corresponding author: O. Tokgöz

e-mail: onurtokgoz16@gmail.com

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Abstract

The aim of this research was to compare the Trail Making Test (TMT) scores of open and closed skills sports' athletes. Total of 85 volunteers who are footballers, track and field athletes and sedentary participated. Participants performed the short form of International Physical Activity Questionnaire (IPAQ) and TMT (A/B). The statistical package program "SPSS 22.0" was used to analyze the data. In the analysis of categorical data, independent-t test and one-way analysis of variance were used to examine the statistical difference between independent groups. Correlations between continuous variables were performed using Pearson's corelation analysis. There was no statistically significant difference between the TMT score of footballers and track and field athletes ($p>0.05$). While there was no statistically significant difference between the metabolic equivalent (MET) levels of football players and track and field athletes ($p<0.05$), the MET levels of both groups were significantly higher than those of sedentary group ($p>0.05$). As a result, there was no difference between open skill athletes (footballers) and closed-skill athletes (track and field athlete) in terms of motor processing speed, attention, number sorting (form A) and task-switch, cognitive flexibility, functioning memory, visual scanning (form B) skills.

Keyword: Open skilled, closed skill, Trail Making Test.

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INTRODUCTION

Although optimum performance in sport is associated with physical performance, cognitive abilities of athletes can determine the level of performance. Cognitive processes such as decision-making, problem-solving, cognitive flexibility in response to sudden and ever-changing situations, focused attention, and inhibition control determine the level of executive functions that athletes will be able to process and take many stimuli under time pressure (Krenn et al., 2018; Miyake et al., 2000; Vestberg et al., 2017).

Executive functions which are controlled by frontal lobe of the brain are influence by such varies like physical activity (Deslandes et al., 2009; Kvalø et al., 2017) age (Harada and Triebel, 2013), nutrition (Thodarkathai, 2018; Richard et al., 2018), sleep (Kasenova et al., 2017), smoking (Yolton et al., 2004) alcohol (Evert et al., 1995), athletes level and training year (Cona et.al, 2015; Hygiene et al., 2015; Lundgren et al., 2016; Paşaoğlu et al., 2019) and the type of sport skill (Di Russo et al., 2010; Jacobson and Matthaeus, 2014; Wang et al., 2013).

In recent years many stuedies revealed that participation in physical activity effects executive functions such as working memory, attention, mental flexibility in addition to academic achievement. (Davis et al., 2011; Kashihar et al., 2009; Niederer et al., 2011; Xiong, Li and Tao, 2017). Sport-related physical activities that require coordinating and problem-solving are known to activate brain regions used to control high-grade cognitive processes (Best, 2010; Diamond and Lee, 2011; Zhao et al., 2016).

It is reported that more cognitive functions are needed in branches that require the ability to adapt to situations where environmental factors change frequently and abruptly like basketball, football, and tennis than in branches where similar conditions are constantly repeated like athletics and swimming (Bianco Di Russo et al., 2017; Voss et al., 2010; Alvurdu et.al., 2019). The sport branches which require complex cognitive functions such as strategic thinking, process information from an opponent and the ball, intuition, spatial perception need open skills. But predictable, repetitive movements and continuous similar changes require closed skills (Wang, 2013).

Wang et al. (2013) revealed that tennis players are more successful in inhibition control skills than swimmers and sedanters. It is thought that open skill athletes' cognitive functions such as problem-solving and inhibition control (Jacobson and Mattheus, 2014), visual attention, decision making-and motor skills (Taddei et al., 2012) are better than closed skill athletes and sedentary. Yu et al. (2017) indicated that badminton athletes are better than swimmers in their ability to use initiative to create new conditions or change the course of existing conditions, whether positive or negative. When these data are evaluated, the higher the cognitive demands in the sport branch, the higher the cognitive skills of the athletes. Athletes are seen to be more likely to restore and transfer these skills when practicing cognitive tasks that are not related to sport. Particularly sports that require strategic thinking and problem solving have high demands on inhibition, working memory and mental flexibility. It is well known that demands open skill athletes must adapt to variable changing situations in order to react to teammate's movement, decision and behavior. In this respect, the athletes of this branch should perform better in TMT than the athletes who perform stationary and predetermined tasks with repetitive movements. In this study, it aimed to compare TMT performance of athletes' in sports branches involving open and closed skills.

METHOD

Participations

Sample of this research were composed of 85 voluntary participants. Sample was made up 30 footballers, 25 track and field athletes, 30 sedentary. Footballers were in an amateur team in Bursa, (age:20.23 ± 2.34 years, height:172.73 ± 8.89 cm, weight: 66.20 ± 9.68 kg), track and field athletes from Turkey Olympic Preparation Center who performs in different branches such as sprint, long distance, high jump, javelin throw, put (age:19.58 ±. 2.4 years, height: 176.62 ± 7.89 cm, weight 66.55 ± 9.99 kg) and 30 sedentary students (age: 20.31 ± 4.83 years, height: 169.16 ± 8.05 cm, weight 65.74 ± 8.47 kg) from Uludag University in Bursa (Table 1). Participants stated that not smoke or drink alcohol, while athletes declared and confirmed that they had been actively engaged in sports for the past two years Our study was produced from master thesis and approved by the Ethics Committee of Bursa Uludag University with decision number 2019-2/14 dated 29.01.2019.

Table 1. General characteristics of participants

Variables	Football (n=30)	Track and Field (n=25)	Sedentary (n=30)
Age (year)	20.23 ± 2.34	19.58 ± 2.24	20.31 ± 4.83
Height (cm)	172.73 ± 8.89	176.62 ± 7.89	169.16 ± 8.05
Weight (kg)	66.20 ± 9.68	66.55 ± 9.99	65.74 ± 8.47
MET	5019.83 ± 4060.35	6897.86 ± 3042.54	2732.70 ± 2433.05
BMI (kg/m²)	22.05 ± 2.30	21.34 ± 1.98	23.04 ± 2.47

Procedure

Participants performed The TMT A/B and IPAQ short form were applied at Uludag University Faculty of Sports Sciences on the same day and time to the participants who were divided into three groups such as footballers (open skill group), track and field athletes (closed skill group) and sedentary (control group). Before the test day participants avoided from severe physical activity for at least 24 hours and sleepless. Participants were also asked to refrain caffeine, nicotine and alcohol for at least 12 h before testing. Participants performed the TMT (A/B) and IPAQ in between 09.00-10.00 am. The temperature of the test room was kept at 24 ^{0}C (degrees celcius) and lightened sufficiently. Each participant performed on comfortable chair and a suitable table. Before applied the test, sample of the TMT A and B was performed by researchers. Standard procedures were used for TMT; if a participant made an error by reaching an incorrect target, it was immediately called to his/her attention with instructions to proceed from the point where the mistake occurred. A second research assistant who independently timed and/or tracked errors observed the evaluation; participants were not aware that they were being observed. The duration of the participants during the application was measured with an electronic hand stopwatch (Casio Hs-70w-1DF-Japan) with a precision of 0.01 seconds. After TMT was completed, all participants were administered the IPAQ brief form to determine the physical activity level of the volunteers at the same time.

The participants' body weights were measured with a digital scale with a sensitivity of 0.1 kg. Height lengths were measured with electronic height measuring equipment with

sensitivity of 0.01 cm. Participants were asked to go barefoot to the measuring device. The measurements were performed with the participants ' heads in an upright position, their soles in a straight position on the scale, their knees stretched, their heels in contact with each other, and the body in an upright position.

Trail Making Test A/B

Developed by Reitan (1958), it is a test that can be applied on paper. It consists of two forms A and B. Section A contains numbers scattered on paper from 1 to 25. Form a assesses attention, visual scanning, motor speed and coordination. In Form B, there are numbers 1 through 13 on the paper and letters A through L. Participants are asked to combine numbers and letters on paper in the form of 1-a,2-B,3-C respectively. Form B also assesses cognitive flexibility and functioning memory in addition to form A.

IPAQ

The survey consists of 7 questions and 4 separate sections and consists of sections bar FA-related questions that have been conducted at least 10 minutes in the last 7 days. It is stated that it is appropriate to apply to adults in the 18-69 age range. 7 days in the survey with how many days and how long for each day;

A) heavy physical activities (HVA),
B) medium intensity physical activities (MIPA),
C) walking is determined (Y).

The last question is, on a daily basis, still (sitting, lying, etc.) time spent is determined.

Statistical Analysis

The statistical package program "SPSS22.0" was used to analyze the data. In the analysis of categorical data, statistical difference between independent groups was examined; Independent t test, one-way variance analysis, correlation between continuous variables, Pearson correlation analysis.

RESULTS

TMT A form completion time was 24.08 ± 9.15 SEC in football players, 23.97 ± 10.96 seconds in track and field athletes and 23.13 ± 7.52 seconds in sedanters and there was no statistically significant difference between groups ($p>0.05$). When completion times of TMT B form were examined, the difference was 69.84±35.55 seconds in footballers, 57.08±22.58 seconds in track and field athletes and 49.95±27.78 seconds in sedanters and statistically significant difference was found between groups ($p<0.05$). There was a statistically significant difference between football and sedentary groups in TMT B form completion time ($p<0.05$). However, there was no statistically significant difference compared to other groups ($p>0.05$), (Table 2).

Table 2. Participants TMT A and B Form Durations

Variable	Group	*N*	X	*SD*	*F*	*p*
A Duration	Football	30	24,08	9,15	,096	0,91
	Track and Field	25	23,97	10,96		
	Sedentary	30	23,13	7,52		
B Duration	Football	30	69,84	35,55	3,625	0,03
	Track and Field	25	57,08	22,58		
	Sedentary	30	49,95	27,78		

There was no statistically significant difference between footballers and track and field athletes (p>0.05), (Table 2).

Table 3. Participants' MET levels

Variables	Groups	*A.D.*	S.E.	*p*
MET	Football – Track and Field	-1878,03	844,49	0,09
	Football – Track and Field	2287,12*	830,52	**0,02***
	Football – Track and Field	4165,15*	837,76	**0,00***

AD: Average Difference SE: Standart Error

There was no statistically significant difference between the MET values of football and track and field athlete groups (p>0.05). However, statistically significant difference was found between football and sedentary and athletics and sedentary groups (p<0.05), (Table 3).

Table 4. Relationship between MET levels and TMT performances of participants

Variables	*TMT*	*N*	*R*	*p*
MET	A Duration	85	-0,036	0,74
	B Duration		0,166	0,12

There was no statistically significant correlation between the participants' MET levels and TMT Division A completion time and Division B completion time (p>0.05), (Table 4).

DISCUSSION

In this study, the TMT performance of open skill (football) and closed skill (track and field athletes) was compared. Open skill sport which involves suddenly and frequently changing external factors that are difficult to foresee is expected to be more effect cognitive functions than closed skill sport which involves predictable situations and enviromental factors. Many studies revealed that the performance of open skill athletes in executive function is better than that closed skill athletes. Krenn et.al (2018) found that open skill athletes' reaction time and working memory performances were better than closed skill athletes'. Wang et.al (2013) found that tennis players who are open skill athletes have better

reaction time performance compared to swimmers and sedanters. Jacobson and Matthaeus (2014) examined the impact of different sports branches on executive function performance by 54 participants and found that open skill athletes were more successful in problem solving skills compared to closed skill athletes. Chen et.al (2019) used fMRI to monitor brain activities of prefrontal lobe executive functions of middle-aged people. Sample divided three groups as open skill exercise, closed skill exercise and irregular exercise. After 3 month, they showed that open skill exercise group had higher neural activation in inferior frontal gyrus, talamus and hippocampus during working memory task compared to closed skill group.

It is well documented that open skill athletes good at decision-making under time pressure, to quickly locate opponents or teammates and objects around them, and to use their bodies to manipulate the movements of opponents and objects. But controversially the published literature, Ting-Yu et.al (2017) showed that both open and closed skill athletes. were better at visual spatial intelligence, attention, reaction time and memory skills than sedentary-while no significant differences were found between skill types.

In conclusion, this study presented similar results with Ting-Yu et al. there was no statistically significant difference between open skill players and closed skill athletes in terms of motor processing speed, visual scanning, attention, number sorting (Form A) and set changing ability, cognitive flexibility, functioning memory (Form B) based on visual scanning ability. The fact that athletes are closer to the elite level than footballers may have affected these results. In addition, football is generally preferred by lower socio-cultural communities. Insufficient alphabet knowledge and reading habits of football players who came from these communities can be caused in these results.

Experimental qualitative studies on large and homogeneous sample in term of athlete's level and training age can clearly expose open or closed skill sport's effects on cognitive abilities. Also the addition of more cognitive predictor tests in future studies will be important to assess the complex structure of cognitive processes. Cognitive function tests can be specified for the open or closed skill branches to well identify what is the cognitive requirements of sport branches are.

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ORIGINAL RESEARCH

The Effect of Different Passive Rest Periods on Submaximal Running Performance

Kadir KESKİN[1]
Yakup Zühtü BİRİNCİ[2]
Hüseyin TOPÇU[2]
Serkan PANCAR[3]

[1]Gazi University, Faculty of Sports Science, Ankara, Turkey
[2]Uludag University, Faculty of Sports Science, Bursa, Turkey
[3]Aksaray University, Faculty of Sport Sciences, Aksaray, Turkey

Corresponding author: K. Keskin

e-mail: kadirkeskinn94@gmail.com

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Abstract

The aim of this study was to examine the effects of different passive rest periods after the dynamic warm-up protocol on submaximal running performance. A total of 16 male volunteers who are physical activity for recreational purposes 2-3 days a week participated. The average age of the participants was 21.17 ± 2.21 years, their average height was 174.27 ± 3.41 cm, and their average body weight was 72.15 ± 4.78 kg. The participates were randomly divided into three groups (IAWarm-up n=5, 10min n=5, 20min=n=6). Submaximal heart rates of the participants were determined using the Karvonen formula. Two-way analysis of variance was used for repeated measurements in the analysis of the data. When comparisons between groups could not be achieved, analysis was made with Greenhouse-Geisser outputs. When differences were detected between groups, Bonferroni post-hoc test was used for multiple comparisons. As a result, different passive rest periods after the dynamic warm-up protocol affect the submaximal running performance. It is seen that submaximal running performance worsens as the passive rest period gets longer. Immediately after exercise and when the passive waiting time was up to 10 minutes, there was no significant difference in submaximal running performance, while significant decreases were found in performance when it was 20 minutes.

Keyword: Passive cooldown, submaximal performance, warm-up, rest interval

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INTRODUCTION

Warm-up practices are commonly used before exercise, mainly aiming to increase body temperature, cardiovascular system activity (Camargo et al., 2020) and accelerate metabolism (Pagaduan et al., 2012). Warm-up increases muscle flexibility (Faigenbaum et al., 2006; O'Sullivan et al., 2009), balance (Erkut et al., 2016), sprint (Zmijewski et al., 2020; Marinho et al., 2017), agility (Fradkin et al., 2010), endurance (Zourdos et al., 2012; Barnes et al., 2015; Wei et al., 2020) and strength performance (Park et al., 2018; McCrary et al., 2015) and prevents sports injuries (Bizzini et al., 2013; Adelsberger et al., 2014; Amako et al., 2003; Soligard et al., 2008).

When the literature on warm-up practices is examined, it is seen that the focus is mainly on comparing different warm-up protocols (static and dynamic) (Chaouachi et al., 2010; Incoming 2010; Zmijewski et al., 2020; Kendall, 2017; Pagaduan et al., 2012; McMillian. et al., 2006; Merino-Marban et al., 2021; Samson et al., 2012). However, it is known that the effects of warm-up on performance are not only dependent on the warm-up protocol. It should be kept in mind that it is influenced by variables such as the amount of increase in body temperature, the duration and the intensity of warm-up, the time between warm-up and exercise performance, and the type of exercise (Bishop, 2002; Bishop, 2003; Zochowski et al., 2007). The passive rest period between warm-up and performance may vary depending on the intensity and kinematics of the exercise. While the effects of passive waiting time on performance after warm-up up are not clearly understood, passive rest periods given after warm-up are concentrated in the range of 5-10 minutes in studies (Stewart et al., 1998; Gregson et al., 2002; Gregson et al., 2005; Yanaoka et al., 2018). However the extension of the waiting period may adversely affect the physical performance. The passive rest period given for exercises that require short duration, high intensity and high power output is especially important for the renewal of creatine phosphate stores (Bishop, 2003). However, although a period of up to 20 minutes is needed to fully regenerate creatine phosphate stores (McMahon et al., 2002), it has been reported that the intramuscular temperature decreases significantly during the 15-20 minute passive rest period (Saltin et al., 1968; Mohr. et al., 2004). The passive rest period given before exercises at the submaximal level should be planned that prevents the return of oxygen consumption (VO2) to a resting state, since it does not adversely affect performance (Özyener et al., 2001). Passive rest for 5 minutes after general warm-up did not adversely affect maximal running performance (90% VO2 max.) (Yamaguchi et al., 2019), passive rest applied for 12 minutes after general warm-up negatively affected flexibility performance, but at 40 m. It does not have a negative effect on sprint performance (Favero et al., 2009), 3 minutes passive rest period after warm-up does not affect the performance of squat and bench press (80% 1 MT) (Ribeiro et al., 2020), passive applied in 5 and 15 minutes It is reported that resting periods do not significantly affect anaerobic performance (Poprzecki et al., 2007). Considering that environment and body temperature affect performance (No et al., 2016; Wiecha et al., 2010; Zhao et al., 2013; Racinais et al., 2005), failure to monitor environmental and body temperature is an important deficiency in terms of studies. However, in the studies examined, it is seen that the variables of environment and body temperature, which may directly affect the study findings, were not monitoried. Therefore, monitoring the environment and body temperature in our study are the strengths of this study.

In the literature, there appears to be no consensus on the optimal passive rest time after warm-up for exercise performance (Bishop 2003; Zochowski et al., 2007; Poprzecki et al., 2007;

West et al., 2013). Thus, the aim of this study was to examine the effects of different passive rest periods after the dynamic warm-up protocol on submaximal running performance.

METHOD

The study was carried out by crossover design with 3 trials. Participants were randomly divided into 3 groups (IAWarm-up = 5, 10min = 5, 20min = 6). All groups applied different passive waiting times (immediately after, 10 and 20 minutes passive waiting) during each trial week. Trials were carried out with an interval of 7 days.

Participants

A total of 16 male volunteers who were studying at Gazi University, Faculty of Sport Sciences, engaged in recreational physical activity 2-3 days a week and had no health problems participated in this study. The average age of the participants was 21.17 ± 2.21 years, their average height was 174.27 ± 3.41 cm, and their average body weight was 72.15 ± 4.78 kg.

Room and Body Temperature

Participants carried out all the trials in the indoor sports hall with a temperature of 24-25 degrees. Body temperatures of the participants were measured immediately after the exercise, 10 and 20 minutes after using the NEC A15 brand non-contact thermometer.

Dynamic Warm-up Protocol

In the last 1 minute of the 10-minute jogging run, the athletes ran and skipped by turning their arms to the front and back and opening and closing them in turn. Then they were made to run sideways by spreading their legs in different directions. Then they were asked to squat (10 times) and double-leg forward leaps (10 times). Then they were asked to perform stretching movements, which lasted a total of 10 minutes. These consist of Rising Torso Twist, Squat, Walking lunge / Twist, Frankestein walk, Alternating high kicks, Alternating Toe touch, Butt Kicks (Jung, Lee and Lee, 2018).

Heart Rate

Participants were kept in the lying position for 10 minutes and their resting heart rates were recorded. Heart rate Polar brand M430 band was placed on the lower part of the sternum after moistening beforehand (Mizugaki et al., 2021).

Submaximal Running Speed

Before starting the study, the target heartbeat intervals of 80% intensity of the participants were calculated using the Karvonen method described below (She et al., 2015).

Formula: Target Heart Rate = (Maximum Heart Rate-Resting Heart Rate) x (80%) + Resting Heart Rate

Two weeks before starting the study, a test was carried out to determine the speed of the treadmill that would correspond to the heartbeat intervals determined according to the Karvonen method. During the test, Polar M430 brand band and dynamic brand treadmill were used to monitor heart rate. Participants started to run at a 1% incline, 8 km / h running speed on the treadmill. Every 3 minutes the speed was increased by 1 km / h. Participants were allowed to run until they reached the specified heart rate range. During the test, the heart rate of the participants was monitored and the treadmill speed corresponding to the target heart rate was determined.

Submaximal Running Test

Participants started the submaximal running test after warm-up on the day of the test. Their heartbeats were continuously monitored to enable them to run at a previously determined heart rate of 80% (Peltonen et al., 199). They were provided to run at the determined intensity on the treadmill. Participants were encouraged to perform high during the test, and the time to run out was determined as the total running time.

Statistical Analysis

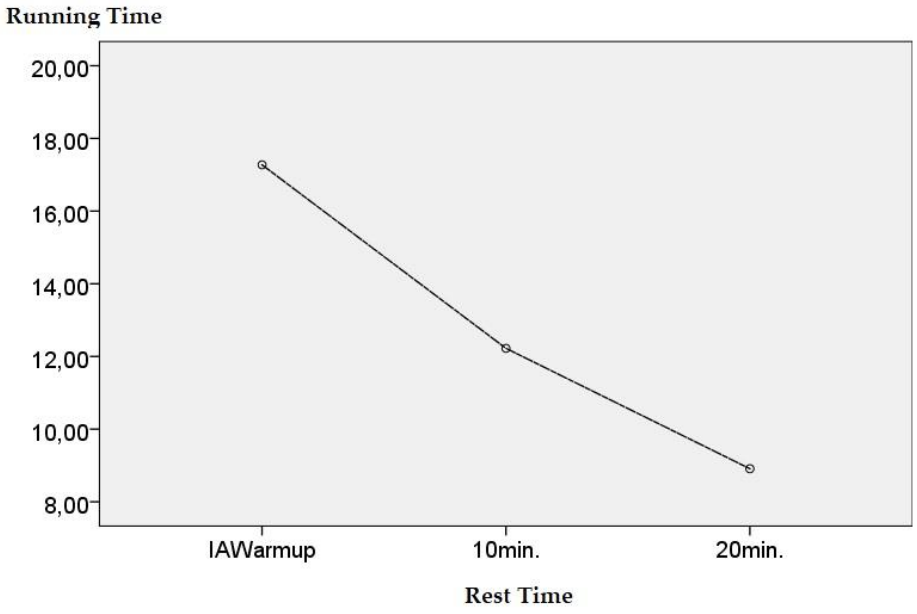
SPSS 24 package program (Windows, Chicago, Illinois, USA) was used in all statistical analyzes. Two-way analysis of variance was used for repeated measures in the analysis of the data. When sphericity could not be achieved in comparisons between groups, Greenhouse-Geisser outputs were analyzed. When differences between groups were detected, Bonferroni post-hoc test was used for multiple comparisons. Significance level was tested as 0.05.

RESULTS

Room and Body Temperature

The 3 trials applied to the participants were carried out at similar room temperature (24-25 C^{o}). Body temperatures were measured immediately after warming, 10 minutes and 20 minutes later. In order to prevent a decrease in body temperature due to environmental temperature during the passive waiting period, they were provided with tracksuits. In the comparison, no statistically significant difference was found between the 3 trials in terms of body temperature ($p > 0.05$).

Submaskismal Running Performance



In the comparison of running times with one-way analysis of variance, there was no significant difference between the IAWarm-up group and the 10-minute passive group, while a statistically significant difference was found between the IAWarm-up group and the passive waiting group for 20 minutes and the groups waiting passive for 10 minutes to 20 minutes ($p < 0.05$).

DISCUSSION

In this study, the effects of different passive rest periods applied after the dynamic warm-up protocol on submaximal running performance were investigated. As a result of the study, it was found that there was no significant difference in submaximal running performance immediately after exercise and when the passive waiting time was up to 10 minutes, while there was a significant decrease in performance when it was 20 minutes.

Our study shows that different passive rest periods applied after general warm-up affect submaximal running performance. It has been observed that submaximal running performance is positively affected when performed immediately after warm-up. Although there was no significant difference between 10 minutes of passive waiting and immediately after warm-up, a decrease in performance was detected. In addition, when performed after 20 minutes of passive rest period, a statistically significant decrease in performance was determined.

When the literature is reviewed, there are studies reporting that warm-up practices do not affect endurance running performance positively (Zourdos et al., 2017; Zourdos et al., 2012, Wilson et al., 2010). However, Yamaguchi et al. (2007) reported that a 5-minute passive rest period after 15 minutes of general warm-up and dynamic stretching negatively affected maximal aerobic performance. Wei et al., (2020) differently reported that a 10-minute passive rest period after general warm-up plus plyometric exercise practices positively affected running economy. Burnley et al., (2005) reported that a 10-minute passive rest period after 10-12 minutes of moderate-intensity warm-up has a positive effect on performance. Bailey et al., (2009) also reported that 9-12 minutes of passive application after 6 minutes of high-intensity application. It has been reported that rest periods improve performance, but a 3-minute passive rest period negatively affects performance. Andzel et al. (1976) showed that passive rest periods applied as 30 seconds and 60 seconds after dynamic warm-up positively affect submaximal performance.

The effect of the dynamic warm-up protocol on submaximal running performance may be due to the increase in body temperature, it may also occur by reducing the oxygen deficit that occurs at the beginning of the exercise and enabling anaerobic metabolism to be active in the later stages of performance (Bishop, 2003). Although pre-exercise dynamic warm-up does not significantly alter oxygen consumption during exercise, it can lead to a higher VO_2 value at the beginning of performance than at rest. However, the prolongation of the warm-up time and the rest period and the excessive warming intensity and thus causing fatigue may adversely affect the submaximal performance. In addition, it should not be ignored that the positive effect of warming may disappear in cases where the rest period exceeds 5 minutes for medium and long-term performance.

CONCLUSION

According to the results of our study, different passive rest periods after the dynamic warm-up protocol affect the submaximal running performance. It is seen that submaximal running performance is negatively affected as the passive rest period increases. Immediately after exercise and when the passive waiting time is up to 10 minutes, there is no significant difference in submaximal running performance, while it can be said that there is a significant decrease in performance when it is 20 minutes.

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