African Educational Research Journal
Vol. 8(2), pp. 280-285, June 2020
DOI: 10.30918/AERJ.82.20.062
ISSN: 2354-2160
Full Length Research Paper

Comparison of endurance, fatigue, and heart rate shifts of students of physical education department who participate and do not participate in sports and recreational activities

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Accepted 27 May, 2020

ABSTRACT

The aim of this study is to compare the endurance, fatigue, and heart rate shifts of physical education students who participate and do not participate in sports and recreational activities. The sample of the study consisted of 54 volunteer male students who participated in recreational activities and 50 volunteers who did not participate in recreational activities at Mersin University in the 2019-2020 academic year. After determining the physical properties of the participants, through the endurance test on the test battery designed by FIFA, their anaerobic endurance levels, fatigue levels after the fatigue protocol, and resting, warm-up, and exercise heart rates using the polar watch were measured. Independent-samples t-test used for binary comparisons was used to calculate the data of the research. According to the findings of the research, it was found that endurance, perceived fatigue, and heart rate shifts of the students who participated in recreational activities differed from those who did not participate in recreational activities ($p < 0.05$). The results of this study show that those participating in recreational activities are older, taller and overweight. Besides, the endurance and fatigue levels of those participating in recreational activities are significantly higher. The resting heart rate, warm-up heart rate and post-fatigue heart rate numbers of those participating in recreational activities are significantly better than those who do not participate. As a result, the high number and high intensity of exertion exhibited at the maximum level in recreational activities or training cause a differentiation in some variables. It is thought that the shifts differ in parallel with the character of the game and the level of the participants. Participating in recreational activities and training is expected to positively affect students' endurance, fatigue levels, and heart rates as well as reduce negative health risk factors that may occur in later years.

Keywords: Recreation, endurance, fatigue, heart rate, physical education.

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INTRODUCTION

The importance of active living for a healthy life and of mobility for a better quality of life has been demonstrated in many scientific studies. Individuals need free time and recreational activities to get rid of stress, monotony, and chaos (Coruh, 2013). In addition, as a result of preferring recreational activities for healthy active living, obesity can be prevented, smoking is reduced, the mental health of the individual is positively affected and plays an active role in raising a healthy and conscious individual (Ishee, 2003). As a result of the researches, it has been revealed that the number of people who prefer sports activities for recreation purposes is higher than the number of people participating in other recreational activities. The rate of preferring to participate actively in sports activities in leisure times is so high due to the personal and social characteristics of the sport. In addition, the convenience of participation in sports activities and feeling comfortable, free, and fit in sports activities are among

these factors. Recreational sports appeal to individuals from every age group and have types of preferences that can respond to every taste and wish. Recreational sports are also preferred by people as they possess particular positive features that help people socialize, ensure social unity, and provide a healthy life for individuals (Sahin and Kocabulut, 2014).

The concept of endurance is the ability of the whole organism to resist fatigue in long-lasting sports exercises and to sustain loads of high intensity for a long time (Sevim 2002). Some types of endurance are aerobic endurance, anaerobic endurance, and short, medium, and long term endurance. Endurance training methods are classified as continuity method, interval method, repetition method, and competition method (Demir, 1991). In other words, endurance means continuing the activity with or without muscle fatigue at given exercise intensity. Endurance is considered one of the most important elements of the performance. Studies involving long-term exercises with low intensity are generally related to endurance (Ergen, 2002). Anaerobic endurance is to sustain any sportive activity by taking advantage of the energy stores in the body in fast, dynamic, and maximal loads (Serin, 2015; Sevim, 2002).

Fatigue is a very complex concept that includes both physiological and psychological factors. Therefore, fatigue cannot be considered as a single concept or process. On the contrary, it is feeling involving more than one role and various components both in the central nervous system and in the muscle (McKenna, 2003). Resulting from this complex process, fatigue reduces the strength and power ability of the muscles. With increasing workload, the level of muscle and blood lactate increases. Buffering of lactate accumulation increases the excretion of CO_2 from the lungs. Muscle fatigue occurs due to a decrease in pH (pH = 6.4) (Jonathan and Euan, 1997). As a result of the studies, it is seen that calcium, decreasing pH, and the accumulation of lactic acid have a great role in the occurrence of muscle fatigue. Besides, increased ammonia accumulation in the muscles, decreased muscle glycogen, decreased oxygen due to insufficient blood flow, increased core temperature, and decreased ATP-PC appear to have an impact on fatigue (Sahin, 2001). Returning to normal after fatigue and exertion is accepted as the preliminary values of exercise and fitness (Ozturk and Olaru, 2004).

Heart rate is the number of times a person's heart beats per minute. The resting heart rate ranges from 60 to 85 beats per minute. Heart rate varies under the influence of sympathetic and parasympathetic nervous systems originating from the cardiac centre in the medulla oblongata (Acharya et al., 2004; Ergen, 1992). Low resting heart rate is good for athletes and health. The chronic effect of training causes decreases heart rate and increases in heart rate volume (Cetin, 2000). Exercises are also known to be useful in regulating body composition, resting heart rate, and blood pressure (Kandeydi and Ergen, 1984).

Considering all these, conscious participation in sports activities creates positive effects on the organism for the development of healthy generations. The aim of this research is to compare the levels of endurance, fatigue, and heart rates of physical education students who participate and do not participate in sports and recreational activities.

MATERIALS AND METHODS

Subjects

A total of 104 male students with an average age, height (cm) and body weight (kg) of 22.36 ± 2.99 years, 175 ± 0.08 cm and 69.82 ± 7.52 kg, respectively, participated in the study voluntarily. Photocell, meter, slalom poles, cone, and polar watch were used in the measurements. The height (m) and body weight (kg) measurements of the athletes participating in the study were carried out using an electronic scale (Professional Sport Technologies, Sport Expert). Before the study, the subjects were given detailed information about the study and the Declaration of Helsinki of the World Medical Association was read to the subjects. A document was signed by the subjects regarding voluntary participation.

Tests

Anaerobic endurance test

3-corner running test measures anaerobic endurance. The heart rate of the athletes is recorded before starting the test. The athlete takes the starting at the starting point. With the ready to start whistle, the athlete runs to the first flagpole at a distance of 80 m and turns around the flagpole, runs to the second flagpole at a distance of 20 m (82.4 m) and turns around the flagpole and runs to the fourth flagpole at the starting point (82.4 m) and runs around the flagpole and runs to the fourth flagpole and finishes the test. After the run, heart rates are recorded. Measurements are evaluated in seconds (Figure 1) (Rosch et al., 2000; Taskin, 2009; Serin, 2019).

Fatigue protocol

Bruce protocol was applied on the treadmill (T150 Cosmed S.r.l., Italy) to cause fatigue. After 3 minutes of warm-up at 0% slope and 1,161 km/h, the exercise was started with the first level of the protocol as 1.7 mph (2.7 km/h) and a 10% slope. Every 3 min, the slope was increased by 2% and speed by 2.5 mph (Bruce, 1972). A 15-point Borg scale (Borg, 1970) and a heart rate monitor (Polar Electro Inc., Finland) were used to determine the

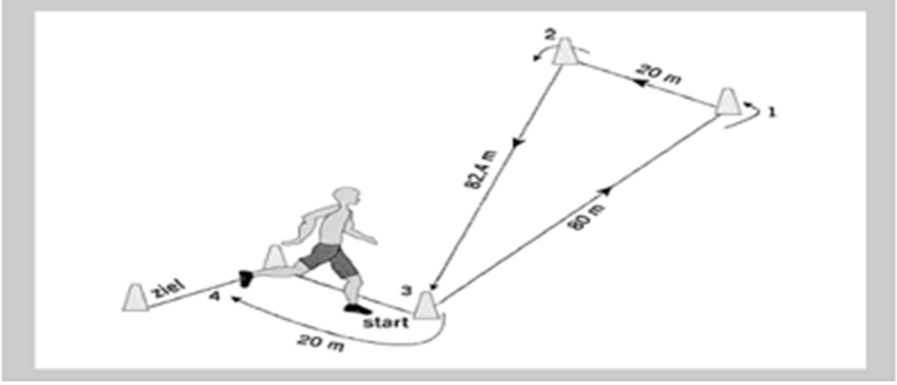

Figure 1. Three corner running test (Rosch et al., 2000; Taskin, 2009; Serin, 2019).

level of effort (RPE) perceived during exercise. The protocol was terminated when subjects reached to the voluntary burnout level.

Measurement of the heart rate

After resting, warm-up and fatigue of the participants, the heart rate was recorded with a heart rate monitor (RS 800, Polar Vantage NV, Polar Electro Oy, Finland) at 5-second intervals. Before the study, the chest strap of the heart rate monitor was placed on the participant's chest and the heart rate was recorded on the monitor.

Data analysis

The analysis of the collected data was done in a computer environment using SPSS 21 statistics program. Average values of age, height and weight, standard deviations, and minimum and maximum values were determined. Independent-samples t-test was used for binary comparisons. The significance level of 0.05 was taken into account in the relationships and differences between the variables.

RESULTS

This section includes the findings of the study and interpretation of the findings obtained in light of the data. In this context, the comparison of some physical characteristics, resting heart rate, warm-up heart rate, fatigue heart rate, anaerobic endurance and Borg scale values of the students who participated and did not participate in sports and recreational activities are shown in the tables.

Descriptive characteristics of the students participating in the research are given in Table 1. A total of 104 university students participated in the study. Average values of age, height (cm) and body weight (kg) of the participants are 22.36 ± 2.99 years, 175 ± 0.08 cm and 69.82 ± 7.52 kg, respectively.

Age, height and body weights were compared according to the students' participation in sports recreational activities (Table 2). According to the results of the analysis, the average scores of students participating in recreational activities ($\bar{X}$ = 22.98) were found to be significantly higher than the average of students who did not participate in activities ($\bar{X}$ = 21.68) in terms of age. This difference is in favor of students participating in recreational activities ($p < 0.05$).

When the height values of the students were analysed, the average scores of the students who did not participate in the activities ($\bar{X}$ = 1.72) were found to be significantly lower than those of the students participating in the activities ($\bar{X}$ = 1.78). This difference is in favor of the students participating in the activities ($p < 0.001$).

Regarding body weight, no statistically significant difference was found ($p > 0.05$).

Table 3 shows the fatigue heart rate, resting heart rate, warm-up heart rate, anaerobic endurance and Borg scale values of the students who participated and did not participate in sports and recreational activities. According to the analysis results, there was a statistically significant difference in all of them (fatigue-rest-warm-up heart rate, anaerobic endurance, Borg scale) ($p < 0.05$; $p < 0.001$). According to these results;

The average of students participating in sports and recreational activities ($\bar{X}$ = 172.30) in fatigue heart rate was found to be significantly lower than the average of students who did not participate in activities ($\bar{X}$ = 183.06). It was observed that non-participating students had more fatigue and that participating students completed the same job in fewer seconds and with less pulse load, and with less exertion. There was a significant difference in favor of the participants ($p < 0.001$).

Regarding the resting heart rate averages, it was found that the average of those who did not participate in sportive recreational activities ($\bar{X}$ = 84.46) was higher than the average of the participating students ($\bar{X}$ = 78.11). In athletes, the lower the heart rate during rest, the better.

Table 1. Age, height and body weight values of students.

Parameter	X̄	SS	Min.	Max.
Age (years)	22.36	2.99	18.00	39.00
Body height (cm)	175	0.08	1.55	1.98
Body weight (kg)	69.82	7.52	53.90	86.30

N = 104.

Table 2. The comparison of age, height and body weights according to the participation of the students in sports and recreational activities.

Parameter	Group	N	X̄	SS	t	*p*
Age (years)	Participants in events	54	22.98	3.71	2.26*	**.026**
	Those not attending the events	50	21.68	1.75		
Body height (cm)	Participants in events	54	1.78	0.08	4.15**	**.000**
	Those not attending the events	50	1.72	0.06		
Body weight (kg)	Participants in events	54	70.11	6.77	0.41	.685
	Those not attending the events	50	69.50	8.30		

N = 104.

Table 3. The comparison of students' rest-warm-up-fatigue heart rate, anaerobic endurance and Borg scale values.

Parameter	Grup	N	X̄	SS	t	*p*
Fatigue heart beat	Participants in events	54	172.30	18.31	-3.798**	**.000**
	Those not attending the events	50	183.06	8.44		
Anaerobic endurance	Participants in events	54	31.15	2.53	-8.942**	**.000**
	Those not attending the events	50	35.72	2.68		
Resting heart beat	Participants in events	54	78.11	13.09	-2.479*	**.015**
	Those not attending the events	50	84.46	13.01		
Warming heart beat	Participants in events	54	119.06	22.71	-2.640*	**.010**
	Those not attending the events	50	131.96	27.07		
Borg scale	Participants in events	54	7.52	1.06	-4.899**	**.000**
	Those not attending the events	50	8.42	0.78		

N=104.

It was also observed that the difference is in favor of the participating students ($p < 0.5$).

In warm-up heart rate values, the average of those who did not participate in the activities ($\bar{X} = 131.96$) was significantly higher than the average of the participants ($\bar{X} = 119.06$). The fact that this difference was higher in students with the same warm-up protocol is because they had physiologically more fatigue. This difference is in favor of those who participate in sports and recreational activities ($p < 0.05$).

In Borg scale values, the average of those participating in sports and recreational activities was $\bar{X} = 7.52$ and the average of those who did not participate in the activities was $\bar{X} = 8.42$, and those who did not participate found the fatigue protocol more difficult. The difference was found to be in favor of the participants ($p < 0.001$).

DISCUSSION AND CONCLUSION

Literature review reveals that recreational activities positively affect many parameters in terms of physical,

mental, psychological, spiritual and social aspects. Bayazit (2006) found that they develop psychomotor skills while Dogan (2009) determined that they reduce physical and mental tensions. Studies that examine the effects of recreational activities on individuals are generally studies that examine the effects of psychological and social changes. Studies examining the physiological and motoric characteristics of individuals in recreational activities almost do not exist.

Sports and recreation affect each other mutually. While the sport provides an important field of action to meet the recreational needs of people, recreation also plays an important role in the social proliferation and achievement of sports. The sport usually fulfills this role by performing activity roles such as sports for everyone or sports for health (Sahin, 1997). As one of the differences between recreation and non-recreational sports, there is a very different understanding of distinguishing elite sports, amateur club sports, and one's own sports (Roberts, 1992). The sport is a recreational activity as a leisure activity, that is, it is done non-professionally. Research shows that the number of people who prefer sports activities for recreation is higher than the number of people who participate in other activities. Considering all these, this study has examined the endurance, fatigue and heart rate of students who prefer recreation-based sports activities. The basis of recreational sports is physical exercise. Sogat (2007) determined that sports activities play an active role in the physical development of children aged 11 to 12. Accordingly, it was determined that sports activities significantly affect the height and weight development of children. Take Loko et al. (2000) stated that 10 to 17 years old children doing regular sports activities have stronger extensor muscles than children of their own age and sex. In our study, it was found that those who participated in sports activities were in better condition than those who did not participate in terms of endurance and fatigue levels.

Taskiran and Kaya (2015) found that recreational activities reduce the number of resting heart rate of elderly people. The data obtained as a result of the study are similar to the findings of this study in terms of heart rate. In this study, the resting heart rates of students participating in sports activities were found to be lower and better than those who did not. Zorba and Bakir (2004) determined that although there were positive developments in systolic, diastolic pressure and heart rate measurements, they could not find a significant difference between pre-test and post-test values. In addition, Saygın et al. (2010) found significant differences between the flexibility levels of the women participating in the experimental group according to the results of the repeated measurement values after 8 weeks. It was also stated in a study conducted on 30000 people in Denmark that those who are engaged in an active living have a lower risk of death (Sirinkan et al., 2007). All this shows that participating in active living, sports and recreational activities is crucial not only during pupillage but throughout life.

The basis of sports and recreation is physical exercise (Zorba and Bakir, 2004). Physical fitness is defined as the ability to build enough work in the muscle. The health benefits of physical activity are well known. Regular physical activity prevents the development of cardiovascular diseases, heart conditions, some types of cancer and all causes of mortality (Haskell et al., 2007). In addition, regular physical activity has positive effects on blood pressure, lipid and lipid-protein profile, weight control, mental health and psychological well-being (Haskell et al. 2007). In our study, it was seen that the blood pressures of those participating in sports and recreational activities are in better condition. USDHHS (1996) defines moderate physical activity as an energetic activity using large muscle groups. Walking, swimming, cycling, dancing, gardening are examples of this level of physical activity. Physical fitness can be considered as the sum of the features that increase the performance of the physical activity. Fitness elements for performance are quickness, balance, coordination, strength, and speed. The fitness elements for health are body composition, heart and respiratory function, flexibility, endurance, and strength (USDHHS, 1996). Therefore, as a result of the study, it was observed that those who participated in activities with such mobility were better than those who did not participate in terms of endurance, fatigue, and heart rate shifts.

Therefore, in Turkey to carry out works that may encourage such activities in a large part of the university students, mainly comprised of young population and to help them gain a sports and recreational activity habits are important as they may create a healthy model and lead the way for future generations. Although there are limited researches on the study, the results of the studies have shown that various sports and recreational activities have positive effects on the students' endurance, fatigue, and heart rate shifts.

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Citation: Serin, E., and Donmez, M. U. (2020). Comparison of endurance, fatigue, and heart rate shifts of students of physical education department who participate and do not participate in sports and recreational activities. African Educational Research Journal, 8(2): 280-285.