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ORIGINAL RESEARCH

The effect of athletics and football training characteristics on some respiratory parameters in female athletes

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Abstract

The aim of this research is to examine the effect of training characteristics specific to athletics and football branches on some respiratory parameters in female athletes. 15 female long-distance runners (age: 18.86 ± 1.18 years), 15 female football players (age: 20.40 ± 1.24 years), and 15 female sedentary (age: 20.26 ± 2.05 years) participated voluntarily in the study. The respiratory function values of the participants were determined using a spirometer device. A one-way ANOVA test was applied to compare the mean of respiratory parameters between groups. Tukey post-hoc test was used to determine which group caused the difference in cases where there was a significant difference. In the research findings, the forced vital capacity (FVC), the volume of air exhaled in the first second of forced expiration (FEV_1), the volume of air exited in the first second/forced vital capacity (FEV_1/FVC), peak expiratory flow rate (PEF), forced expiratory flow between 25% and 75% of vital capacity ($FEF_{25-75\%}$), vital capacity (VC) and maximal voluntary ventilation (MVV) values of the long-distance runners were statistically significantly higher than the sedentary ($p<0.05$). It was determined that the FEV_1, PEF, and $FEF_{25-75\%}$ values of the long-distance runners were significantly higher than the football players ($p<0.05$), and there was no significant difference between other parameters ($p>0.05$). It was found that the football players' PEF and MVV values were significantly higher than the sedentary ($p<0.05$). As a result, it was determined that the respiratory functions of female long-distance runners were better compared to football players and sedentary females. Training characteristics of long-distance runners can be applied for better development of respiratory functions.

Keywords: Athletics, football, long-distance runners, respiratory functions, training.

Introduction

Regular physical activity and exercise provide many adaptations in the human organism. One of these adaptations is seen in the respiratory system. The functionality of the respiratory system is determined by testing the lung volume and capacity (Atan et al., 2012). In determining lung volume and capacity, the spirometry test is a physiological test that shows the volume and flow of air that an individual breathes and exhales at a certain time, and is considered the gold standard. The spirometry test is frequently used for the prevention, diagnosis, and evaluation of various respiratory disorders (Durmic et al., 2015). Lung volume and capacities are affected by genetic factors, respiratory system diseases experienced in early childhood and regular sports activities started at an early age. In addition, although lung functions

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are determined by unchanging factors such as race and genetics, it has been reported that physically active individuals have higher respiratory function values compared to passive ones, regardless of gender, age, height, and body weight (Fox et al., 1999; Atan et al., 2012). In addition, the duration, type, and intensity of physical activity or exercise affect lung function. As a result of regular training, a significant change occurs in respiratory volume and frequency (Losnegard & Hallén, 2014).

It has been reported in many studies that the respiratory parameters of athletes are better compared to sedentary ones (Doherty & Dimitriou, 1997; Prakash, 2007; Degens et al., 2013; Mazic et al., 2015; Durmic et al., 2015). In addition, the physical and physiological characteristics of the athletes competing in different branches may be similar or different according to the sport types. Increasing respiratory capacity with training is mostly seen in sports that require long-term endurance performance (Patlar et al., 2000). There are many sports branches with different training characteristics. It is very important to know how these training characteristics affect the respiratory parameters of the athletes. Although the cardiovascular system directly affects the endurance performance of athletes, improved lung volume and capacities lead to more efficient oxygen uptake. Considering the lack of studies on spirometric measurements specific to athletes, this may lead to misclassification or misdiagnosis of some respiratory dysfunctions (Durmic et al., 2015).

Long-distance runners generally participate in low-to-moderate-intensity long-term running training. Football is known for its intense activities such as sprinting, jumping, double combat, dribbling, and limited area games are intense, and these activities are frequently applied in the training of football players. However, there are few studies examining the respiratory parameters of athletes in branches where high-intensity activities such as football are dominant. In addition, the number of studies examining the respiratory functions of female athletes in the literature is quite limited. It is thought that this research will contribute to the literature by determining how much doing sports improve respiratory functions in female compared to sedentary ones and how these functions change according to long-distance running and football branch. In light of this information, the aim of our study is to examine the effects of exercise on respiratory functions, as well as the respiratory functions of female long-distance runners and female football players with different training characteristics.

Methods

Participants

Fifteen long-distance runner females, 15 female football players, and 15 sedentary females (Table 1), who did not have any chronic disease, did not smoke before, and did not experience any health problems in the last 3 weeks, voluntarily participated in the study. Long-distance runners and football players consist of individuals with at least three years of training history, who train at least five days a week and more than 1 hour a day. All participants were informed of the possible risks of participating in the study and signed a written informed consent form. The participant groups were warned that they should avoid physical activity, caffeine, and alcohol consumption that would affect the measurement results 24 hours before the test days. Measurements were performed between 10.00-12.00 in the morning.

Anthropometric Measurements

The height measurements of the participants were measured with a 1 mm stadiometer (Seca California, USA), and their body weights were measured with a digital scale. BMI was calculated by dividing weight in kilograms by the square of height in meters (kg/m^2).

Table 1

Demographic characteristics of the participants (n=15).

Groups	Age (year)	Body Weight (kg)	Height (cm)	BMI (kg/m^2)
Athletics	18.86 ± 1.18	52.60 ± 4.37	164.86 ± 5.15	19.34 ± 1.16
Football	20.40 ± 1.24	55.73 ± 7.17	162.86 ± 4.01	20.96 ± 2.06
Sedentary	20.26 ± 2.05	53.53 ± 8.80	163.06 ± 5.72	20.10 ± 3.06

BMI = Body mass index.

Spirometer Measurements

Before 24 hours of the spirometry test, the participants were instructed not to smoke, exercise, consume alcohol, drink caffeinated beverages, or any medication. The respiratory function values of the individuals participating in the study were measured with the Pony Fx spirometer (Rome, Italy). The tests were carried out while the participants were in a sitting position and the nose of the participants was closed with a latch after they got used to it by breathing several times with the mouthpiece connected to the spirometer. Measurements were repeated 3 times and the best value was recorded. Vital capacity (VC), forced vital capacity (FVC), the volume of air exhaled in the first second of forced expiration (FEV_1), the volume of air exited in the first second/forced vital capacity (FEV_1/FVC), peak expiratory flow rate (PEF), forced expiratory flow between 25% and 75% of vital capacity ($FEF_{25-75\%}$) and maximal voluntary ventilation (MVV) parameters were examined.

Data Analyses

SPSS 22.00 program was used in the analysis of the data. After descriptive statistics were made, it was determined that the data showed normal distribution with the Kolmogorov-Smirnov test. A one-way ANOVA test was applied to compare the mean of respiratory parameters between groups. Tukey from post-hoc tests was used to determine from which group the difference occurred. The significance level was accepted as p<0.05.

Table 2
One-way ANOVA test results of respiratory parameters between groups.

Parameters	Groups	n	Mean ± SD	F	p	Tukey
FVC (lt)	Athletics[A]	15	4.05 ± 0.54	5.9	.006**	A>C
	Football[B]	15	3.70 ± 0.28			
	Sedentary[C]	15	3.42 ± 0.61			
FEV_1 (lt)	Athletics[A]	15	3.56 ± 0.42	14	.000***	A>B,C
	Football[B]	15	3.13 ± 0.24			
	Sedentary[C]	15	2.81 ± 0.46			
FEV_1/FVC (%)	Athletics[A]	15	89.27 ± 4.15	4.29	.020*	A>C
	Football[B]	15	84.70 ± 5.70			
	Sedentary[C]	15	82.76 ± 8.19			
PEF (lt/sn)	Athletics[A]	15	6.42 ± 0.98	24.1	.000***	A>B,C; B>C
	Football[B]	15	5.24 ± 1.20			
	Sedentary[C]	15	3.72 ± 0.99			
$FEF_{25-75\%}$ (lt/sn)	Athletics[A]	15	4.30 ± 0.67	15.3	.000***	A>B,C
	Football[B]	15	3.48 ± 0.71			
	Sedentary[C]	15	2.97 ± 0.60			
VC (lt)	Athletics[A]	15	3.76 ± 0.50	5.55	.007**	A>C
	Football[B]	15	3.42 ± 0.29			
	Sedentary[C]	15	3.22 ± 0.49			
MVV (lt/dk)	Athletics[A]	15	98.12 ± 18.15	9.74	.000***	A>C; B>C
	Football[B]	15	93.68 ± 17.71			
	Sedentary[C]	15	72.30 ± 15.38			

*FVC = forced vital capacity; FEV_1 = Volume of air exhaled in the first second of forced expiration; FEV_1/FVC = airflow in one second / forced vital capacity; PEF = peak expiratory flow rate; $FEF_{25-75\%}$ = forced expiratory flow between 25%-75% of vital capacity; VC = vital capacity; MVV = maximal voluntary ventilation. *p<0.05; **p<0.01; ***p<0.001.*

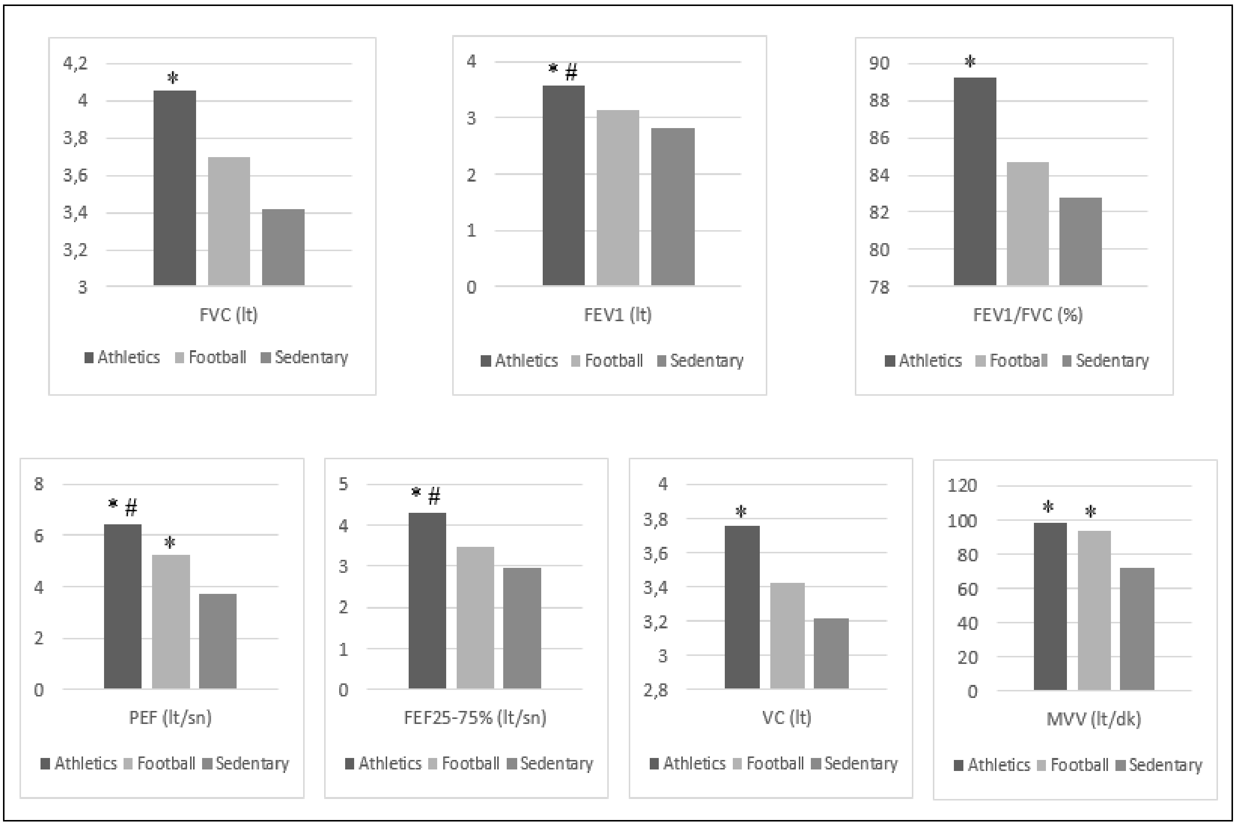

Figure 1. Intergroup respiratory parameters. **p<0.05 vs. sedentary; #p<0.05 vs. football.*

Results

As a result of the one-way ANOVA test performed to compare the respiratory parameters of the participants in Table 2, there was a statistically significant difference in all parameters ($p<0.05$). According to the results of the Tukey test, which was conducted to determine which groups the difference originated from, it was found that the FVC, FEV_1, FEV_1/FVC, PEF, $FEF_{25-75\%}$, VC and MVV values of the long-distance runners were higher than the sedentary individuals. In addition, it was determined that the FEV_1, PEF, and $FEF_{25-75\%}$, values of the long-distance runners were higher than the football players. Higher values were observed in football players in terms of PEF and MVV parameters compared to sedentary (Table 2 and Figure 1).

Discussion

In our study, besides the effect of exercise on respiratory functions, the effects of long-distance training and football training characteristics on some respiratory parameters were investigated. According to our study results, it was determined that the respiratory function values of FVC, FEV_1, FEV_1/FVC, PEF, $FEF_{25-75\%}$, VC, and MVV of female long-distance runners were higher than sedentary ones. In addition, it was observed that the FEV_1, PEF, and $FEF_{25-75\%}$ values of female long-distance runners were higher than football players. On the other hand, PEF and MVV pulmonary function values of female football players were higher than those of sedentary.

When we look at the studies investigating the effect of exercise on the respiratory system, it has been stated that exercise has a positive effect on respiratory function in general (Sable et al., 2012; Ahmadi et al., 2013; Johnson et al., 1996; Gökdemir et al., 2007). In a study examining the effects of physical activity on respiratory functions, it was reported that physical activity improves respiratory parameters such as FVC, FEV_1, PEF, $FEF_{25-75\%}$, VC, and MVV (Bilici & Türker, 2019). In another study, it was determined that low-intensity and long-term exercises applied to adults cause an increase in respiratory parameters such as FEV_1 and $FEF_{50\%}$ (Koubaa et al., 2015). In a study conducted to determine the respiratory function capacity of swimmers and sedentary, it was stated that the lung functions of swimmers were better than sedentary swimmers (Vaithiyanadane et al., 2012). In another study examining the effect of swimming sports on lung functions, it was concluded that the VC, FVC, FEV_1, MVV, and PEF respiratory function values of swimmers were higher than those who did not do swimming sports (Shashi et al., 2013). In a study investigating the effect of exercise on the lungs, it was stated that the FVC, FEV_1 and PEF values of the athletes were higher compared to sedentary individuals (Mehrotra et al., 1998). In a study conducted on university female students, it was determined that the FVC, VC, FEV_1, PEF, and $FEF_{25-75\%}$ respiratory function values of female students who regularly engage in physical activity are higher than those who do not (Bilici & Genç, 2020). The results of our study show similarities with these studies stating that regular exercise improves respiratory functions. Especially high respiratory function values in athletes; It may be that regular forced inspiration and expiration during exercise causes the respiratory muscles to strengthen, which will help the lungs fill and empty with maximum air (Vedala et al., 2013). In addition, there are few studies suggesting that exercise does not have a special effect on respiratory functions (Martin & May, 1987; Lakhera et al., 1994; Çakır Atabek, 2017).

In our study, it was determined that the FEV_1, PEF, and $FEF_{25-75\%}$ respiratory function values of female long-distance runners were higher than female football players. This may be due to the fact that long-distance runner athletes do more aerobic-based training than football players, so the respiratory muscles are exercised more. Each sports branch has a training frequency, scope, and intensity that varies according to the demands and competition time. In addition, the adaptations of the athletes to the branch differ due to the phenomenon known as "sport-specific morphological fitness" (Berglund et al., 2011). In order to provide sufficient energy production in long-distance running, oxygen must reach the tissues aerobically. For this reason, it is expected that the fitness of the heart, circulatory and respiratory systems of long-distance athletes will be at very good levels. Due to this situation, we can say that long-distance runner athletes have better values in some respiratory parameters compared to football players in our study. Although there is no research in the literature comparing only long-distance athletes and football players, there are studies comparing different branches. In a study, branch-specific training was applied to male amateur athletes in basketball, football, volleyball, athletics, and taekwondo branches for 12 weeks and it was reported that the FVC and FEV_1 values of the athletics athletes were better than the football players (Özaltaş et al., 2015). On the other hand, in another study by Holmen et al. (2002) in their study on athletes aged 13-19, they found that athletes engaged in team sports such as football, volleyball, basketball, and handball had higher FEV_1 values when compared to swimmers and long-distance runners. Ghosh et al. (1985), however, no significant difference was found between athletics athletes and football players in terms of VC, MVV, and FEV_1 values. These findings show similarities and differences with the results of our study. The reason for this may be the individual differences of the participants, the level of sports, ethnic origins, and the differences in the training they do. In a study on football players and sedentary, it was observed that football players showed better respiratory functions compared to sedentary (Atan et al., 2012). In addition, in another study examining respiratory functions in different sports branches, it was stated that respiratory parameters changed according to sports branches (Durmic et al., 2015).

In addition to regular physical activity starting at an early age, age, ethnicity, genetics, and physical characteristics are factors that affect respiratory functions (Fox et al., 1999; Quanjer et al., 2012). Although the genetic characteristics of our participants are not known, it is seen that they are very close to each other in terms of age, ethnicity, and physical characteristics. For this reason, we can say that the difference in respiratory functions between groups is due to the characteristics of regular training.

Some limitations should be considered while evaluating the results of our study. Our participants are not elite athletes. Branch-specific differences can be observed more clearly in elite-level athletes. In addition, since the training of the athletes was not done under our control, it was assumed that the training was applied specifically to the branch. Another limitation of our study is that spirometry measurements were taken in one go. Making these measurements on different days can provide clearer results for respiratory values.

Conclusion

As a result, in females; It can be said that airflow increases due to the strengthening of respiratory muscles and the decrease in resistance in the large and small airways in the lungs with the effect of exercise. In addition, factors such as the type of sport, and the type and duration of exercise are thought to have different effects on respiratory functions. In future research, studies examining certain exercise models are needed due to differences in sports branches. Regular exercise can be considered both a preventive and a therapeutic method for some pulmonary diseases in terms of improving respiratory functions. It can be said that especially individuals in childhood can improve their respiratory functions by doing regular exercise together with their physical development.

Authors' Contribution

Study Design: MZK, CS, MFB; Data Collection: SO, CS; Statistical Analysis: MZK, CS; Manuscript Preparation: MZK, SO, CS, ÖMB, MFB.

Ethical Approval

The study was approved by the Muş Alparslan University of Scientific Research and Publication Ethics Committee (2023/1-56) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki.

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Conflict of interest

The authors hereby declare that there was no conflict of interest in conducting this research.

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