TURKISH JOURNAL OF SPORT AND EXERCISE 2012; 14(3): 76–81

Comparison of Respiratory Functions of Athletes Engaged in Different Sports Branches

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ABSTRACT

The purpose of this study was to research pulmonary functions of sedentary males and athletes in different team sports branches in the same age group. This study was conducted on male athletes in 15-16 age group who participate in matches with license in Samsun. 50 athletes from each of the team sports of football, volleyball, basketball and handball players and 50 sedentary males participated as well; being in total 250 athletes. Among respiratory functions tests; vital capacity (VC), forced vital capacity (FVC) and maximum voluntary ventilation (MVV) values were measured. As a result of the measurements VC values of sedentary males were lower than football and handball players ($p<0.01$). It was determined that VC values of handball players was higher than football, volleyball, basketball players and sedentary males ($p<0.05$ and $p<0.01$). When FVC values were analyzed, first of all it was determined that handball, football and basketball players have significantly higher values compared to sedentary males ($p<0.01$). In the comparison between branches FVC values of volleyball players were significantly lower than football and handball players ($p<0.01$). FEV1 values were significantly higher among football and handball players compared to volleyball players and sedentary males ($p<0.01$). When MVV values were analyzed, it was observed that football players have higher values compared to volleyball and sedentary males ($p<0.01$). MVV results of handball players were significantly higher than sedentary males ($p<0.05$). When the respiratory rates (RR) were analyzed, it was determined that values were not significantly different between subjects ($p>0.05$). As a conclusion, it was determined that respiratory functions were higher among individuals who do exercise compared to those who do not. That the respiratory parameters of athletes doing exercise are higher than those who do not shows the positive effect of training on respiratory system. In addition to this, the difference of respiratory functions between branches shows that the sport branch influences the respiratory capacity.

Keywords: Athletes, vital capacity, forced vital capacity, maximum voluntary ventilation.

Farklı Branşlarla Uğraşan Sporcuların Solunum Fonksiyonlarının Karşılaştırılması

ÖZET

Bu çalışmanın amacı, farklı branşlarda yer alan sporcular ve aynı yaş grubundaki sedanterlerde spor yapmanın ve spor türünün akciğer fonksiyonları üzerinde etkisi olup olmadığını araştırmaktır. Çalışma Samsun bölgesinde yaşları 15-16 olan lisanslı olarak müsabakalara katılan erkek sporcular üzerinde yapılmıştır. Takım sporlarından futbol, voleybol, basketbol ve hentbol branşlarından 50'şer sporcu ayrıca 50 sedanter olmak üzere toplam 250 kişi çalışmaya katılmıştır. Solunum fonksiyon testlerinden vital kapasite (VC), zorlu vital kapasite (FVC) ve maksimum istemli ventilasyon (MVV) değerleri ölçülmüştür. Ölçümler sonucunda sedanterlerin VC değerleri futbol ve hentbol sporu ile uğraşanlardan daha düşük bulunmuştur ($p<0.01$). Hentbolcuların VC değeri futbolcu, voleybolcu, basketbolcu ve sedanterlerden yüksek olduğu tespit edilmiştir ($p<0.05$ ve $p<0.01$). FVC değerleri incelendiğinde öncelikle hentbolcu, futbolcu ve basketbolcuların sedanterlere göre anlamlı derecede daha yüksek değerlere sahip oldukları tespit edilmiştir ($p<0.01$). Branşlar arasındaki karşılaştırmada voleybolcuların FVC değeri futbol ve hentbolculardan anlamlı derecede düşük bulunmuştur ($p<0.01$). FEV1 değeri futbol ve hentbolcuların voleybolculara ve sedanterlere göre anlamlı derecede yüksek bulunmuştur ($p<0.01$). MVV değerleri incelendiğinde futbolcuların voleybolcu ve sedanterlerden daha yüksek değerlere sahip olduğu görülmüştür ($p<0.01$). Hentbolcuların MVV sonuçları sedanterlerden anlamlı derecede yüksek bulunmuştur ($p<0.05$). Dakikadaki solunum sayılarına (RR) bakıldığında denekler arasında anlamlı bir fark bulunamamıştır ($p>0.05$). Sonuç olarak solunum fonksiyonlarının spor yapan bireylerde spor yapmayanlardan daha yüksek olduğu tespit edilmiştir. Farklı branşlarla uğraşan sporcuların solunum parametrelerinin spor yapmayan gruptan yüksek çıkması antrenmanın solunum sistemi üzerindeki olumlu etkisini göstermektedir. Ayrıca branşlar arasında solunum fonksiyonlarının farklılık göstermesi yapılan spor branşının solunum kapasitesini etkilediğini göstermektedir.

Anahtar Kelimeler: Sporcu, vital kapasite, zorlu vital kapasite, maksimum istemli ventilasyon.

INTRODUCTION

Functional state of the respiratory system classically can be determined by measuring the lung volumes and capacities (10). A significant change in the breathing volume and frequency occurs by trainings. In addition, by trainings, O_2 consumption rate which in the maximal aerobic metabolism (max VO2) increases. By 7-13 weekly training, Max VO_2 increases by more than 10%. A person always supplies oxygen to the more than the body reveals. Therefore it is important to ensure increasing oxygen availability in another word increase in Max VO2 by trainings (21). Trainings programs that are implemented regularly have positive effect on the respiratory and circulatory system as well as body fit rate (9). It is also be noted that genetic factors, diseases that affected the respiratory system by early childhood and regular athletic activities that started in the early childhood all have relation to the lung capacity. Even though the lung functions are determined by unchangeable factors such as genetic and race, studies have shown that active individuals have higher value of breathing in comparison to the individuals that are not physically active groups in the some gender, age, height and weight regardless of their progressions. In addition, the width of the rib cage and respiratory muscles are important factors for individuals' efficient breathing capacity use (6).

The degree of vital capacity increases is limited by the development of respiratory muscles, the capability of expansion of lungs and thorax' well and the elasticity of bronchi and bronchioles (3). Vital capacity increases by training depends upon the work style and the severity of the exercise. In practice this sort of increase can be seen mainly types of sports that require long-term durability performance durability performance (19).

The studies with regard to the effects of exercise on respiratory parameters for children and adolescents bring different opinions. Some researchers claimed that intense physical training made on impact for increasing the respiratory parameters (1,7). Some researchers draw attention to the claim that this increase a normal increase that is in parallel with the growth of the age group (5,11). Some other researchers indicated that exercises did not increase the respiratory parameters but make it more efficient and economic.

The purpose of this study was to investigate whether there are differences in lung functions for the team sports athletes and the sedentary males who are in the same age group with the athletes.

METHODS

Athletes and non-athletes in 15-16 age group who participate in matches with license, participated to this study. This study was carried out, with 250 people: 50 athletes participated from each team sports (football, volleyball, basketball, and handball) and also 50 sedentary. All of the subjects had a breakfast 9:00 in the morning. Measurements were carried out one hour after breakfast between 10:00 to 12:00. None of the subjects were smokers. This study was done in accordance with Ondokuz Mayıs University Faculty of Medicine's Ethics Committee's rules and regulations. This study was carried out in accordance with the principles of the Helsinki Declaration of 2008 and from the people who participated in this study " informed consent" were taken. Furthermore this study was supported by Ondokuz Mayıs University's Scientific Research and Development Support Program Project.

Height and Weight: The subject's weights were measured with a weighty instrument (SECA electronics scale) which weigh with 0.01 kg agree of precision. During measurements athletes were on bare feet and with underwear and measurements recorded as 'kg'. Heights were measured when the subjects were upright position to "metal bar" that is fixed in the sensitive bascule. Full attentions given make sure that athletes' body was fully upright and their mandible was parallel to the ground. Taken values recorded as 'cm'.

Body Mass Index (BMI): BMI was calculated by the formula of; Body Mass Index = Weight/Height ^{2}.

Measurements of Respiratory Parameters: Measurements made with CSMI Spirometrics tool. The subjects sat on a chair. Mouthpiece of spirometer placed their mouth thoroughly and noses were blocked by fitted pegs in order air not to escape. Measurements were repeated three times with interval 5 minutes and the best rating recorded.

Vital Capacity, Forced Vital Capacity and Maximum Voluntary Ventilation measurements were made. During the measurements the fallowing different respiratory measurements were also recorded.

Vital Capacity (VC): VC is air volume that discharged by deep exhaust after deep inspiration (22).

Vital capacity as a percentage was recorded

Tidal Volume (TV) is air volume that occurs when normally exhaled and inhaled.

Forced Vital Capacity: It is maximum air volume that discarded by tough, fast and deep expiration after deep inspiration (22).

1. sec tough expiration volume (FEV1): It is volume that discarded at the 1.sec of tough expiration. Furthermore, predicted (expected) 1.sec tough expiration volume percentage (FEV1 %) was recorded.

Forced inspiratory vital capacity (FIVC): It is maximum air volume that with tough inspiration after deep expiration.

Maximum Voluntary Ventilation (MVV): It is maximum breathable volume that occurs with voluntary effect in one minute (22). This measurement was carried out by the subjects while they perform

MVV for 12 seconds. In addition, predicted (expected) value of the MVV% was recorded.

Test results compared with calculated expected values (predicted values) of the same age, height and gender group that have healthy individuals. The expected value is > %80 is considered normal. The spirometer device used in this measurement gives the percentage of expected values.

Respiratory Rate (RR): The number of respirators during MVV per minute.

Statistical Analysis: SPSS 19 software packet was used for the statistical analysis of the data. Kolmogorov-Smirnov test was used to see whether the data show normal distribution and as a result it was found out that there was a normal distribution, one-way ANOVA test was applied. Tukey test was used to look at the difference between branches. Values were presented as Mean ± Standard Deviation.

RESULTS

Table 1. Physical features of the subjects.

	Football(1)	Volleyball(2)	Handball(3)	Basketball(4)	Sedentary(5)	F	p
Age (years)	15,60±0,49	15,54±0.48	15,40±0,51	15,88±0,33	15,72±0,39	0,484	0,747
Height(cm)	174,60±4,90	170,63±7,83	177,60±6.20	181.00±6.34	171.07±7,69	5,74	0,000 4>2,5**
Weight(kg)	64,86±6,38	57,00±10,67	64,20±11,83	68,88±8,79	61,84±10,22	2,78	0,031 4>2*
BMI(kg/m^2)	21,25±1,64	19,48±2,68	20,23±2,78	21,01±2,34	21,06±2,70	1,562	0,191

Table 2. Comparison of subjects' vital capacity values.

Variables	Branches	Mean	SD	F	p
VC (lt)	Football (1)	5,76	1.55	9,301**	4>1,2** 4>3* 5<1,4**
	Volleyball (2)	5.18	1,22		
	Basketball (3)	5,67	1,66		
	Handball (4)	7,25	,649		
	Sedentary (5)	4,56	1,05		
	Total	5,53	1,53		
VC%	Football (1)	126,08	34,98	6,925**	5<1,4** 5<2*
	Volleyball (2)	130,55	18,11		
	Basketball (3)	121,54	23,64		
	Handball (4)	141,68	12,87		
	Sedentary (5)	100,38	21,43		
	Total	121,16	31,11		
TV(lt)	Football (1)	1,043	,40	0,770	
	Volleyball (2)	1,164	,34		
	Basketball (3)	1,039	,32		
	Handball (4)	1,041	,43		
	Sedentary (5)	,950	,35		
	Total	1,03	,38		

* p<0.05; ** p<0.01

Table 3. Comparison of subjects' forced vital capacity values.

Features	Branches	Mean	Standard Deviation	F	p
FVC (lt)	Football (1)	5,34	1,34	11,173**	5<1,3,4** 2<1,4**
	Volleyball (2)	4,34	,971		
	Basketball (3)	5,21	1,19		
	Handball (4)	6,37	1,40		
	Sedentary (5)	3,70	,955		
	Total	5,03	1,38		
FEV1 (lt)	Football (1)	5,13	1,41	12,254**	2<1,4** 5<1,4** 5<3*
	Volleyball (2)	4,00	1,00		
	Basketball (3)	4,78	1,21		
	Handball (4)	6,14	1,20		
	Sedentary (5)	3,36	,936		
	Total	4,75	1,43		
FIVC (lt)	Football (1)	4,62	1,33	8,504**	1>5** 4>1,2,3,5**
	Volleyball (2)	4,41	1,33		
	Basketball (3)	4,52	1,31		
	Handball (4)	6,37	1,12		
	Sedentary (5)	3,35	,745		
	Total	4,58	1,40		

*p<0.05 **p<0.01

Table 4. Comparison of subjects' MVV values.

Features	Branches	Mean	Standard Deviation	F	p
MVV (lt/min)	Football (1)	205,15	77,46	8,310**	1>2** 5<4* 5<1**
	Volleyball (2)	142,72	47,53		
	Basketball (3)	181,24	54,77		
	Handball (4)	202,43	43,69		
	Sedentary (5)	127,71	45,34		
	Total	181,65	71,08		
Prescribed MVV%	Football (1)	155,80	51,61	7,001**	1>2,5**
	Volleyball (2)	114,00	37,10		
	Basketball (3)	140,76	38,37		
	Handball (4)	143,91	37,68		
	Sedentary (5)	109,54	28,86		
	Total	139,92	48,29		
RR (repetition/min)	Football (1)	77,53	22,51	0,122	
	Volleyball (2)	69,80	15,75		
	Basketball (3)	72,81	13,22		
	Handball (4)	79,90	12,03		
	Sedentary (5)	70,34	15,64		
	Total	73,19	20,39		

*p<0.05 **p<0.01

DISCUSSION

This study has examined whether doing sports and the type of sports had an impact on lung functions in both athletes and sedentary who are in the same age group. According to this study it was found out that VC values of sedentary were lower than football and handball players (p<0.01). VC value of handball players found to be higher than football, volleyball and basketball players and sedentary (p<0.05 and p<0.01). The vital capacity of 10-13 years old handball players found to be higher than children who had not involved in any sport activity by Kurkcu and Gokhan (2011) (15). Nikolic and Ilic (1992) compared the athlete and non-athlete students with a mean age of 15 and found out the non-athletes' and athletes vital capacity 4.9 and 4.57 respectively, but they could not find any meaningful differences (17). Alpay and et al. (2008) indicated that the children in the school sports team (with a mean age of 12.63±1.13 years) have lower resting heart rate and blood pressure values than those of students who identified is sedentary. They have found that sedentary students have lower VC and FVC values of respiratory (2).

From our study, when we look at the %VC values, the best value 141.68±12,87 belongs to handball players'. VC% values of handball, football and volleyball athletes were significantly higher than sedentary ($p<0.01$ and $p<0.05$). Some difference emerge over time for the people who do exercise and do not exercise in their physical capacity and proper functioning of organs and systems, and these differences are always evolving in fewer of those who exercise and sports (3).

When the FVC values of athletes who participated to this study were examined handball, football and volleyball players' values found to be significantly higher than those of sedentary ($p<0.01$). Comparing between branches, volleyball players' FVC values were significantly lower than football and handball players' values ($p<0.01$). Holmen et al. (2002) performed a study on non-smokers in athletes who were 13-19 years old, and they determined that athletes engaged with team sports like football, volleyball, basketball and handball had higher FEV1 values in compare to swimmers, long-distance runners and skiers (13). Alpay et al. (2008) FEV1values of the children who were 11-13 age range and engaged in sports found to be 2.78±0.60 L while FEV1 values of the children who were also 11-13 age range but not engaged in sports found to be 2.57±0.64 L. In terms of FEV1 and FEV1% they found out that there were no significant difference between the groups. However, in their study that they found FVC values as 3.13±0.68 L for the children who engaged in sports and as 2.71±0.64 L for the children who not engaged in sports, and between the forced vital capacity of these groups they found a meaningful ($p<0.01$) difference (2). Mehrotra at al. (1998) compared the four different groups that engaged in basketball, volleyball and other individual sports among themselves and with sedentary group and they concluded that FVC and FEV1 values of all groups were higher than sedentary (16). The forced vital capacity values found in our study were higher than the above-mentioned studies values. These differences may be the result of age differences of the subject groups and the differences in the levels of training.

Tasgın and Dönmez compared the effects 3 month training program of on respiratory parameters like FVC, FEV1, PEF, PIF Vmax 25-50-75 and FEF 25-75 on the sedentary children who were 10-16 years old. Exposed to a 3 month training program they indicated that exercise had no effect on FVC, FEV1 and PIF values ($p>0.05$) (23). In our study FEV1 values of football and handball players were significantly different from volleyball players and sedentary ($p<0.01$). Furthermore a significant difference was found between basketball players and sedentary ($p<0.05$). Among the reasons for lower values of FVC and FEV1 for volleyball players, we can consider that during the game, volleyball players do not repeat running movements as well as football and handball players, mostly they repeat jumping movements and there might be differences in physical characteristics of the subjects in the subject group. In addition weakness of the diaphragm muscle cause lower FVC value scores (12). All of the subjects in our study had higher FVC values than sedentary. This may imply that respiratory muscles strengthened by training and with increase in VC the forced vital capacity may be higher for the children who engaged in sports. As a matter of fact, Cakmakcı et al. (2009) established that 4-week technical and tactical training increased the FVC values of taekwondo athletes (4). In our study, handball players' FIVC value (6.37±1.12) found to be significantly higher than football, volleyball and basketball players and sedentary at the level of $p<0.01$. In addition, FIVC values of football players were significantly higher than those of sedentary ($p<0.01$).

Koc established that a 6-week (3 days in a week) aerobic training program had descending effect on circulation parameters while had increasing effect on respiratory parameters (14). Ozcelik and Colak (2001) indicated that even though the respiratory increase that suppressed acutely during the exercise impacted the maximal exercise capacity downward, but it did not show any effect on aerobic capacity which is an important health criterion (18). Studies that were done on children showed that training had no impact on MVV values (8). Alpay et al. (2008) found that maximum voluntary ventilation (MVV) measurement values of the children who engaged in sports were 99.04±25.84 lt/min while the MVV values of the children who did not engage in sports were 97.04±24.4 lt/min (2). Between groups it was indicated that statistically there was no significant difference in terms of MVV measurement values. In our study, MVV values of volleyball players (142.72±47.53) was the lowest value after sedentary. Football and handball players' MVV values found to be significantly higher than sedentary ($p<0.01$ and $p<0.05$). In one study, it was established that MVV values were increased because of a 4 week and mostly technical and tactical training (4). In our study when we looked at the number of breathing per minute (RR) no significant difference was found ($p>0.05$).

In conclusion, respiratory functions in individuals who do exercise have been found to be higher than who do not. Respiratory parameters of the sportsmen engaged in different branch of sports in 15-16 years age group found to be higher than sedentary and this indicated that training has a positive impact on the respiratory system. Furthermore, the differences that were found in the respiratory functions between different sport branches have shown that sports branch has an impact on respiratory capacity.

ACKNOWLEDGMENT

This study was supported by Ondokuz Mayıs University's Scientific Research and Development Support Program Project. Thanks for the support.

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