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Full Length Research Paper

Evaluation of respiratory and echocardiography parameters in young female handball players

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Long-term handball training has a significant impact in increasing cardiovascular resistance and the performance of ventilation on the respiratory system. In the present study, we investigated the effects of the long-term handball training of young female athletes on respiratory function and echocardiography (ECG) values. Thirty (30) girls (12.58±0.51 years) participated in the study. Some physical measurements, respiratory function test and ECG values of female athletes were measured in pre and post-training. There were significant differences on physical values (p<0.001). In comparison of pre-training and post-training results for lung function values, significant differences were found in forced vital capacity (FVC) Pred and forced expiration volume (FEV1) Pred values (p<0.05 level). Also, significant differences were found in FVC-MEAS, FEV1-MEAS and FEV1-FVC Pred values (p<0.001). Significant differences were not found in the other respiratory function parameters. When we investigated the effect of pre and post-training values of subjects in ECG parameters, significant differences were not found in PR and QRS values (p>0.05). In heart rate (HR) values, we found a significant difference (p<0.05). Also, there was a significant difference between QT interval and corrected QT (QTc) interval (p<0.001). As a result, it was seen that systematic handball trainings affect the level of physical development, pulmonary functions and ECG values of young girls significantly. Female players achieved major degree at the end of Turkish young women's championships.

Key words: Handball, training, respiration, echocardiography.

INTRODUCTION

Long-term training is associated with physical and physiological changes. Handball also requires players to have well developed physical and physiological capacities. Motor ability, sprinting, jumping, flexibility and throwing velocity represent physical activities that are considered as important aspects of the game and contribute to the high performance of the team (Mitchell et al., 2005; Zapartidis et al., 2009). Therefore, handball requires a combination of resistance and endurance training. In this game, many movements are characterized as intermittent and change continuously in response to different offensive and defensive situations (Deng et al., 1990).

Females are usually less physically active than boys. However, handball is a sport widely practiced by girls around the world. Therefore, handball is a suitable way to easily improve physical fitness (Lindquist et al., 1999; Vicente-Rodrigueza et al., 2004). In fact, everything is actualized due to large number of factors that influence the final results, and it is mostly seen in little girls (Srhoj, 2002). Children are in a continuous development and growth period. Children in particular under the age of 11 to 12 years have a quite high sympathetic system activity. The development of these systems is seen after puberty (Williams and Reilly, 2000).

Long-term exercise for females are accepted as

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systematic exercise. Oxygen demand increases in exercise hence, the respiratory system is also physiologically adapted to changing conditions. Repeated exercise 2 to 3 times per week is accepted as regular exercise for health and body composition changes significantly. This change can be observed in all age groups (Akgün, 1986; Heyward, 1998; Lohman, 1995).

Regular endurance training gives rise to many adaptive changes in the cardiovascular system which include expansion of plasma volume, resting bradycardia, increased vagal tone, reduced sympathetic outflow, inhibited sympathetic baroreflexes, increased stroke volume and enhanced coronary circulation (Gallagher et al., 1999).

Many of the beneficial, adaptive responses in the hearts of athletes, giving rise to increased contractility and cardiac power output, take place at the level of the cardiac myocyte, although changes in the nervous supply and in the peripheral circulation make important contributions (Hart, 2003).

Athletic training in female commonly results in prolongation of the echocardiography (ECG) intervals. It has been demonstrated that long-term physical activities increase physiological capacities, particularly in cardiovascular and respiratory system in young population. It becomes interesting to determine duration and what kind of activities are the most beneficial for physical development during growth. In the present study, we aimed to evaluate the effects of long-term handball training of young female athletes on respiratory function and ECG values.

METHODOLOGY

Participants

Thirty (30) girls (12.58±0.51 years) were selected from different schools and sports clubs of Elazığ City for this study. Height and body weight parameters of subjects were measured. Both parents and girls were informed about the aims and procedures of the investigation and girls and parents gave their written informed consent before the start of the investigation. We left out of the study the athletes who have past injuries, medication and known diseases. This study was performed at Fırat University Medical Center. The study protocol was approved by University Ethical Committee.

Training program

Girls performed intensive handball training along 1 year and 3 to 4 times per week in a regular basis for about 65 to 75 min, including about 10 to 15 min of low-intensity jogging and stretching exercises, 30 to 35 min of basic handball exercises (individual-team sets, dribbling, shooting, defending, passing and positions) and 20 to 25 min of handball match practice. The exercise program comprised a combination of aerobic exercises, strength conditioning, handball game activities and other recreational activities involving continuous work bouts maintained on average at 65 to 85% of maximum heart rate (HR). We split up our program into 2 distinct phases consisting of pre-season handball training and in season handball training program. The basic principles of program are available that develop primarily either the aerobic and anaerobic or all three energy systems (Fox et al., 1993). The official match program applied weekends and sometimes gave a break the chance to recover.

Spirometric measurements

Spirobank, Medical International Research, Italy was used to conduct respiratory tests of participants. Measurements were taken after participants, who were seated and their noses blocked with a band grip, got used to breathing connected to a spirometre with the help of a mouthpiece, after taking a few breaths within the set breath volume. Every measurement was taken three times, and the best measurement was recorded.

Forced expiration volume (FEV1)

This identifies the amount of air exhaled in the first second of the FEV_1 test. Normally, FEV_1 = 80 to 83% of the forced vital capacity (FVC) (Fox and Mathevs, 1976).

Forced vital capacity (FVC)

The is amount of air exhaled, after being forced to rapidly exhale a maximum amount of air, without taking a full breath. In general, the important point is the percentage amount of air, expired by the forced vital capacity, within 1 s (Sönmez, 2002).

Peak expiratory flow, forced expiratory flow, forced expiratory flow 25 to 75 and forced expiratory time measurements were also expressed as percentage predicted.

Maximum voluntarily ventilation (MVV)

This is the amount of air inhaled within a minute while taking a fast, deep and full breath was recorded.

Vital capacity (VC)

The amount of air (that is, VC) left in the lungs, after taking a full breath (with no force), was measured (Günay et al., 2005).

ECG parameters

The QT interval is an important ECG parameter and the identification of ECGs with long QT syndrome is of clinical importance. Considering the required standards for precision, the measurement of QT interval is subjective (Panicker et al., 2009). The QT interval is a measure of the time between the start of the Q wave and the end of the T wave in the heart's electrical cycle. In general, the QT interval represents electrical depolarization and repolarization of the left and right ventricles. QT interval and according to HR corrected QT interval (QTc) on HR and all derivations were calculated simultaneously by taking the average of the three consecutive RR range in DII derivation. Bazzet's formula ($QTc=QT/\sqrt{RR}$) was used for calculating the values of the QTc (Garson, 1993). QT interval was considered as the distance from beginning of the QRS complex to the end of the T wave. Three QT distances and averages were measured for each derivation.

Statistical analysis

The Statistical Package for the Social Sciences was used for

Table 1. The comparison of respiratory function parameters of the subjects.

Parameter	Pre- test	Post - test	p
	Average ± SD	Average ± SD	
FVC MEAS (litres)	2.70 ± 0.37	3.36 ± 0.27	0.00**
FVC Pred (litres)	2.93 ± 0.14	3.52 ± 0.24	0.01*
FVC % Pred (litres)	93.67 ±10.86	95.67 ± 7.95	0.72
FEV1 MEAS (litres)	2.60 ± 0.33	3.09 ± 0.18	0.00**
FEV1 Pred (litres)	2.64 ± 0.14	3.00 ± 0.20	0.01*
FEV1 % Pred (litres)	98.78 ± 9.40	103.33 ± 4.79	0.44
FEV1 FVC MEAS (litres)	94.17 ± 3.94	92.39 ± 5.81	0.31
FEV1 FVC Pred (litres)	86.89 ± 1.16	84.00 ± 0.00	0.00**
FEV1 FVC % Pred (litres)	106.44 ± 7.89	109.92 ± 7.10	0.36
FEF 25-75% (litres)	3.35 ± 0.85	3.98 ± 0.70	0.16
PEF MEAS (litres/s)	5.21 ± 1.18	5.30 ± 0.99	0.89
PEF Pred (litres/s)	5.49 ± 0.30	5.41 ± 0.52	0.89
PEF % Pred (litres/s)	93.33 ± 18.31	96.83 ± 18.52	0.91
FEF 25% (litres)	5.38 ± 0.83	5.25 ± 1.06	0.87
FEF 50% MEAS (litres)	3.71 ± 1.15	4.33 ± 0.69	0.37
FEF 50% Pred (litres)	3.78 ± 0.61	4.20 ± 0.27	0.12
FEF 50% Pred (litres)	100.44± 27.20	103.17 ± 16.33	1.00
FEF 75% (litres)	1.94 ±0.78	2.42 ± 0.53	0.21

*Significance was found at *p<0.05 **p<0.001levels and results was expressed as mean ± SD. N=30.

Table 2. Comparison of ECG parameters of subjects.

Parameter	Pre- test	Post- test	p
	Average ± SD	Average ± SD	
HR	84.33 ± 9.50	71.83 ± 10.29	0.01*
PR	136.50 ± 17.33	138.50 ± 21.53	0.84
QRS	83.83 ± 6.58	107.58 ± 69.75	0.62
QT interval	364.17 ± 21.02	404.18 ± 33.44	0.00**
QTc	404.08 ± 13.68	443.75 ± 38.60	0.00**

*Significance was found at *p<0.05 **p<0.01levels and results was expressed as mean ±SD. N=30.

statistical analysis. It was used for evaluation of the subject's data who received their modifications in the pre-test and post-test comparison of paired student's t-test. Data are summarized by calculating the average standard deviation, t and p values.

RESULTS

Average age of female participants was 12.58 ± 0.51. In comparison of pre-training and post-training results for lung function values, significant differences were found in FVC Pred and FEV 1 Pred values at $p<0.05$ level and in FVC-MEAS. FEV1-MEAS and FEV1-FVC Pred values at the level $p<0.001$. No Significant differences were found in the other variables (Table 1).

In the effect of pre-training and post-training values of subjects in ECG parameters, no significant differences were found in PR and QRS values at $p>0.05$ level (Table 2). In HR values, we found a significant difference at $p<0.05$ level. Also, there was a significant difference between QT interval and corrected QT interval values at $p<0.001$ level.

DISCUSSION

It was seen that long-term handball trainings affect the level physical development, pulmonary functions and ECG values of young girls significantly.

Long-term regular training also has the beneficial effects on all the organ systems such as exercise hypertrophy which is more specific in girls than men due to exercise intensity. Even though handball is a common known sport, it has high dynamic played by girls in the world; the girls are less physically active than men

(Vicente-Rodrigueza et al., 2004; Dzudie et al., 2007). Especially, body weight and height gain in puberty may be strongly influenced by developmental change (Vicente-Rodrigueza et al., 2004). They are related with exercise mode to sport-specific and developmental period of girl's the skeleton and muscle systems. Height and weight are important for performance in handball. But it is not safe to overestimate the anthropometric characteristics of junior players as predictors of their future anthropometric profile (Williams and Reilly, 2000).

Long-term training is quite effective on circulation and respiratory functions. In fact, the organism needs more oxygen during training. The circulation and respiratory systems show physiologic compatibility in line with this increase in order to meet the need. While a resting person takes 12 to 16 breaths per minute, breathing frequency may increase upto 40 to 50 during training (Ghosh et al., 1985). In our study, significant differences were found in FVC Pred and FEV 1 Pred values and in FVC-MEAS, FEV1-MEAS and FEV1-FVC Pred values at the end of long-term handball training. Also, Doherty and Dimitriou (1997) found the significant differences in VC, FVC and FEV1 parameters of athletes than control group.

In the last years, important physiological and functional differences have been noted between the male and female response to dynamic exercise where sex differences have been reported for most of the major determinants of exercise capacity. Sex differences have been shown in resting pulmonary function, which may impact on the respiratory response to exercise. Women typically have smaller lung volumes and maximal expiratory flow rates even when corrected for height relative to men. Expiratory flow limitation and a high work of breathing are seen in women. Pulmonary system limitations, in particular exercise-induced arterial hypoxia, have been reported in both men and women; however, the prevalence in women is not yet clear (Sheel et al., 2004).

A study observed that the mean FVC and FEV1 values were lower than the predicted mean values of normal Nigerians when matched for age, sex, height and weight. However, the mean observed FVC value of athletes was higher than the observed FVC value of non-athletes. It was also noted that the mean FVC value of the sportsmen correlates with their sporting events, which are determined by the extent of regular and strenuous physical training (Onadeko et al., 1976).

Participation in long-term training is associated with ECG changes in the athlete's heart that provide structural and functional changes for prolonged periods. When we investigated the effect of ECG parameters, significant differences were not found in PR and QRS values. However, we found significant differences in HR, QT interval and QTc interval values.

It has been reported that first degree heart block occurs in up to 33% and Mobitz type I second degree heart block in upto 10% of athletes. Sino-atrial exit block and higher degrees of atrio-ventricular block are less common but have been reported (Holly et al., 1998). All of these conduction abnormalities disappear on exercise or following detraining, if they are attributable to physical conditioning. Prolongation of the QT and the rate QTc intervals in trained athletes has been described in several studies (Jordaens et al., 1994; Sharma et al., 1999; Stolt et al., 1997). In a comparison of 100 athletes with 50 non-athletic controls, Langdeau et al. (2001) found prolonged RR and QT intervals in the athletes, but QTc was not different from the control group. Zoghi et al. (2002) documented increased QT but unchanged QTc intervals, and unchanged QT dispersion, in athletes (Zoghi et al., 2002). In female endurance athletes, QRS duration was prolonged compared with non-athletic controls (Stolt et al., 1997).

A study showed that 10% of the athletes had voltage criteria for left ventricular hypertrophy, and 7% had intermittent right bundle branch block (Langdeau et al., 2001). Sharma et al. (1999) found that almost half of elite junior athletes had voltage criteria for left ventricular hypertrophy (Sharma et al., 1999). ST segment elevation soon after the QRS complex, known as 'early repolarization', appears to be a normal feature of the ECG in athletes (Bianco et al., 2001).

In a study of repolarization in over 1200 athletic students, Bjornstad et al. (1994) found that the mean QRS–T angle was significantly greater in athletes, and U waves were more prominent. Differences in echocardiographic indices handball players have been reported suggesting sport-specific adaptation (Gates et al., 2004). Furthermore, it has been proposed that the structural cardiac adaptation to endurance exercise training depends on the group of muscles, that is, those of lower or upper extremities, primarily involved (Csanady and Gruber, 1984; Gates et al., 2003).

Subsequent studies, however, were frequently in discord with that dichotomy of the cardiac structural patterns in athletes. For instance, even very intense strength training aimed at increasing skeletal muscle power/strength/mass would not necessarily result in cardiac wall thickening (Bertovic et al., 1999; Haykowsky et al., 2002; Pelliccia et al., 1993; Wernstedt et al., 2002; Whyte et al., 2004) or the resultant myocardial structure in strength/power athletes would not differ from that of endurance athletes (Legaz Arrese et al., 2005; Pelliccia et al., 1999; Urhausen and Kindermann, 1999).

In order to prove if athlete's heart generally has no risk in terms of cardiac arrhythmia, there are requirement to new studies which comprise participates in different sport branches.

Conclusion

It was observed that the changes depend on the long-term training in female athletes. Long-term training is associated with a wide range of significant changes in physiological parameters. In the end of the long-term training for 1 year, female handballers had better circulation and respiration values and played final at their age category in young women's championships of Turkey.

REFERENCES

Akgün N (1986). Exercise Physiology. Ege University Press, Second print, Bornova, pp. 134-135.

Bertovic DA, Waddell TK, Gatzka CD, Cameron JD, Dart AM, Kingwell BA (1999). Muscular strength training is associated with low arterial compliance and high pulse pressure. Hypertension, 33:1385-1391.

Bianco M, Bria S, Gianfelici A, Sanna N, Palmieri V, Zeppilli P (2001). Does early repolarization in the athlete have analogies with the Brugada syndrome? Eur. Heart J., 22:504-510.

Bjornstad H, Storstein L, Meen HD, Hals O (1994). Electrocardiographic findings of repolarization in athletic students and control subjects. Cardiology, 84:51-60.

Csanady M, Gruber N (1984). Comparative echocardiographic study in leading canoe-kayak and handball sportsmen. Cor. Vasa., 226:32-37.

Deng PL, ZHR Lin, HQ Xia, YH Cheng (1990). A study of somatotypes of Chinese elite handball players. J. China Sports Sci. Soc., 10:48-53.

Doherty M, Dimitriou L (1997). Comparison of lung volume in Greek swimmers, land based athletes, and sedentary controls using allometric scaling. Br. J. Sports Med., 31:337-341.

Dzudie A, Menanga A, Hamadou B, Kengne AP, Atchou G, Kingue S (2007). Ultrasonographic study of left ventricular function at rest in a group of highly trained black African handball players. Eur. J. Echocardiog., 8:122-127.

Fox EL, Mathevs DK (1976). The Physiological Basis of Physical Education and Athletics. Saunders New York, pp. 218-219.

Fox EL, Bowers RW, Foss ML (1993). The Physiological Basis for Exercise and sport. Fifth Edition. Wm C Brown Communications, Inc, pp. 287.

Gallagher KM, Raven PB, Mitchell JH (1999). Classification of sports and the athlete's heart. In the Athlete and Heart Disease, ed. Williams RA, pp. 9-21.

Garson A (1993). How to measure the QT interval-What is normal? Am. J. Cardiol., 72:14-6B.

Gates PE, Campbell IG, George KP (2004). Concentric left ventricular morphology in aerobically trained kayak canoeists. J. Sports Sci., 22:859-865.

Gates PE, George KP, Campbell IG (2003). Concentric adaptation of the left ventricle in response to upper body exercise training. J. Appl. Physiol., 94:549-554.

Ghosh AK, Ahuja A, Khanna GL (1985). Pulmonary capacities of different groups of sportmen in India. Br. J. Sports Med., 19:232-234.

Günay M, Tamer K, Cicioğlu İ (2005). Sports Physiology and Performance Measurement. Gazi Publication, Ankara, pp. 186-189.

Hart G (2003). The Athlete's Heart Exercise-induced cardiac hypertrophy: a substrate for sudden death in athletes? Experim. Physiol., 88.5, 639-644.

Haykowsky MJ, Dressendorfer R, Taylor D, Mandic S, Humen D (2002). Resistance training and cardiac hypertrophy: unravelling the training effect. Sports Med., 32: 837-849.

Heyward VH (1998). Advanced Fitness Assessment and Exercise Prescription. Sixth Edition, Human Kinetics, University of New Mexico, USA, pp. 4.

Holly RG, Shaffrath JD, Amsterdam EA (1998). Electrocardiographic alterations associated with the hearts of athletes. Sports Med., 25:139-148.

Http://www.sciencedirect.com/science?_ob=RedirectURL&_method=outwardLink&_partnerName=655&_origin=article&_zone=art_page&_targetURL=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Feid%3D2-s2.0-0032887920%26partnerID%3D10%26rel%3DR3.0.0%26md5%3De61e88a8a0e247f173d971648dad53d0&_acct=C000040879&_version=1&_userid=736663&md5=658e485aaa36add1af021970efacdb63

Jordaens L, Missault L, Pelleman G, Duprez D, De Backer G, Clement DL (1994). Comparison of athletes with life-threatening ventricular arrhythmias with two groups of healthy athletes and a group of normal control subjects. Am. J. Cardiol., 74:1124-1128.

Langdeau JB, Blier L, Turcotte H, O'Hara G, Boulet LP (2001). Electrocardiographic findings in athletes: the prevalence of left ventricular hypertrophy and conduction defects. Can. J. Cardiol., 17: 655-659.

Legaz Arrese A, Serrano Ostariz E, Gonzalez Carretero M, Lacambra BI (2005). Echocardiography to measure fitness of elite runners. J. Am. Soc. Echocardiog., 18:419-426.

Lindquist CH, Reynolds KD, Goran MI (1999). Sociocultural determinants of physical activity among children. Prev. Med., 29:305-12.

Lohman TG (1995). Anthropometric Standardization Reference Manual, Human Kinetics USA, pp. 55-70.

Mitchell JH, Haskell W, Snell P, Van Camp SP (2005). Task Force 8: Classification of sports. J. Am. Coll. Cardiol., 45:1364-7.

Onadeko BO, Falase AO, Ayeni O (1976). Pulmonary function studies in Nigerian sportsmen. Afr. J. Med. Sci., Dec; 5(4):291-5.

Panicker GK, Karnad DR, Joshi R, Shetty S, Vyas N, Kothari S, Narula D (2009). "Z-score for benchmarking reader competence in a central ECG laboratory". Ann. Noninvasive Electrocardiol., 14(1):19-25.

Pelliccia A, Maron BJ, De Luca R, Di Paolo FM, Spataro A, Culasso F (1999). Physiological left ventricular cavity dilatation in elite athletes. Ann. Internal Med.. 130:23-31.

Pelliccia A, Spataro A, Caselli G, Maron BJ (1993). Absence of left ventricular wall thickening in athletes engaged in intense power training. Am. J. Cardiol., 72:1048-1054.

Sharma S, Whyte G, Elliott P, Padula M, Kaushal R, Mathon N, McKenna WJ (1999). Electrocardiographic changes in 1000 highly trained junior elite athletes. Br. J. Sports Med., 33:319-324.

Sheel AW, Richards JC, Foster GE, Guenette JA (2004). Sex differences in respiratory exercise physiology. Sports Med., 34(9): 567-79.

Sönmez GT (2002). Exercise and Sports Physiology. ISBN: 975-92842. Bolu, pp. 162-164, 176-177.

Srhoj V (2002). Situational Efficacy of Anthropomotor Types of Young Female Handball Players. Coll. Antropol., (26)1: 211-218.

Stolt A, Kujala UM, Karjalainen J, Viitasalo M (1997). Electrocardiographic findings in female endurance athletes. Clin. J. Sport Med., 7:85-89.

Urhausen A, Kindermann W (1999). Sports-specific adaptations and differentiation of the athlete's heart. Sports Med., 28:237-244.

Vicente-Rodrigueza, Doradoa GC, Perez-Gomeza J, Gonzalez-Henriquezb JJ, Calbeta JAL (2004). Enhanced bone mass and physical fitness in young female handball players. Bone, 35: 1208-1215

Wernstedt P, Sjostedt C, Ekman I, Du H, Thuomas KA, Areskog NH, Nylander E (2002). Adaptation of cardiac morphology and function to endurance and strength training. A comparative study using MR imaging and echocardiography in males and females. Scandinavian J. Med. Sci. Sports, 12:17-25.

Whyte GP, George K, Sharma S, Firoozi S, Stephens N, Senior R, McKenna WJ (2004). The upper limit of physiological cardiac hypertrophy in elite male and female athletes: the British experience. Eur. J. Appl. Physiol., 92:592-597.

Williams AM, Reilly T (2000). Talent identification and development in soccer. J. Sports Sci., 18: 657-67.

Zapartidis I, Vareltzis I, Gouvali M, Kororos M (2009). Physical Fitness and Anthropometric Characteristics in different Levels of Young Team Handball Players. Open Sports Sci. J., 2:22-28.

Zoghi M, Gürgün C, Yavuzgil O, Akilli A, Türkoglu C, Kültürsay H, Akin M (2002). QT dispersion in patients with different etiologies of left ventricular hypertrophy: the significance of QT dispersion in endurance athletes. Intl. J. Cardiol., 84:153-159.