Effect of long-term training on physical and hematological values in young female handball players

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The aim of the study was to evaluate the effect of long-term handball training on physical and hematological variables in young female handball players. Thirty girls (12.58±0.51 year) from different schools and clubs, voluntarily participated in this study for handball training. We found significant differences at height, weight, standing long jump, seated medicine ball throw and 30 m sprint test parameters (P<0.001). We examined the effects between pre-training and post-training values in some hematological parameters and found no significant differences between white blood cell count (WBC), erythrocyte (RBC), hematocrit (HCT), and urea values (P>0.05). However, significant differences was found at aspartate aminotransferase (AST–SGOT), alanine aminotransferase (ALT–SGPT), power of hydrogen (Ph), urine density, mean corpuscular volume (MCV), mean red blood cell distribution width (RDW) and platelet (PLT) values (P<0.05). We found significant differences in hemoglobin (Hgb), creatine, fasting blood glucose, mean corpuscular volume (MCH), mean hemoglobin concentration (MCHC) and mean platelet volume (MPV) values (P<0.001). Research findings were obtained by using paired t test. In conclusion, significant effects were observed in some physical and physiological developments of girls. Especially, the girls who were selected for handball achieved major degree at the end of young women’s Championships.

Key words: Handball, training, female, blood.

INTRODUCTION

Handball is a quite fast sport and includes body contact in game. It is one of the Olympic Games team sports and has recently been classified as a moderate static and high dynamic sport (Dzudie et al., 2007). The game 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).

Investigating the profile of young handball players, we can define the characteristics that contribute to a player’s selection for the team. In addition, results from motor performance tests will allow trainers to identify players’ weaknesses and design training models for improving specific athletes’ deficiencies, but also follow up the athlete’s improvement during a competitive season (Zapartidis et al., 2009).

Physical and physiological profiles may contribute to understanding the suitability of players for the sport of handball, particularly at a high standard of play. Therefore, handball requires a combination of resistance and endurance training. In this game, movement patterns are characterized as intermittent and change continuously in response to different offensive and defensive situations (Deng et al., 1990).

Of course, the differences between females and males are very important in sports. Girls are usually less physically active than boys. Long-term intensive training has quite different effects on the physical and physiological parameters of girl athletes. This may be because exercise intensity could be lower in girls than in
boys, or because the hypertrophy response to exercise is more accentuated in boys than in girls (Lindquist et al., 1999; Vicente-Rodriguez et al., 2004). However, handball is a sport widely practiced by girls around the world. This implies that handball is a suitable way to easily improve physical fitness (Vicente-Rodriguez et al., 2004). In sports activities, everything is actualized due to large number of factors that influence the final results, and it is mostly seen in little girls (Srhoj, 2002). Eventually, becoming well a girl handball player is a very difficult and long process in which, in consistence with the time needed in transformations in later phases.

Long-term exercise for females are accepted as systematic exercise. Oxygen demand increases in exercise, hence the respiratory system is also physiologically adapted to changing conditions. Repeated exercise 2-3 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). This study aimed at investigating the effects of long-term handball training in females, both physically and physiologically.

MATERIALS AND METHODS

Participants

Thirty healthy girls were selected from different schools and sports clubs of Elazığ City for handball training. Height, weight, standing long jump, seated throwing the health ball, 30 meter sprint and some blood parameters of volunteers 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.

Training program

Girls performed intensive handball training along 1 year and 3-4 times per week. Training program was implemented in a regular basis and lasted for about 65-75 min, including about 10-15 min of low-intensity jogging and stretching exercises, 30-35 min of basic handball exercises (individual-team sets, dribbling, shooting, defending, passing and positions) and 20-25 min of handball match practice. The exercise program comprises of 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). The basic principles of program are available that develop primarily either the aerobic and anaerobic or all three energy systems (Fox et al., 1993).

We split up our program into 2 distinct phases consisting of pre-season handball training and in season handball training program. Pre-season training has predominantly continuous type training. We tried to match the movement patterns such as short and intense intervals, turns and running backwards during active recovery periods etc. In-season training, the aim is to maintain the fitness we developed during pre season. Regular, competitive matches maintained basic levels of endurance. The official match program applied weekends. Sometimes gave a break the chance to recover.

Procedures and tests

Field and physiological tests are used to determine during training capabilities athletes. All tests and measurements were done according to the principles of the Helsinki declaration.

Standing long jump test

Standardized instructions were given to subjects that permitted them to begin the jump with bent knees and swing their arms to assist in the jump. The length of the jump was determined using a tape measure. Each subject was given 3 trials, and the degree of the best jump was measured, from the line to the point where the heel closest to the starting line landed. The longest jump degree was used as the test score (Almuzaini and Flect, 2008).

Seated throwing the health ball test

Each subject held the ball in front of him or her with both hands, resting it against his or her lap. Each subject performed two practice throws, and then the distance of the next three throws was recorded, with a 1 to 2 min rest between each throw. The measurement was taken to the nearest eighth of an inch and converted to a metric unit (Davis et al., 2008).

30 meter running speed test

Girls ran for a distance of 30 m as fast as they could. The electronic photocell was automatically activated when the subject crosses. The girls were motivated to run as optimum as they could, and the best performance achieved in three trials separated by at least 1 min rest period was taken as the representative value of this test.

Analyses of blood parameters

A 10 ml blood sample was collected and analyzed with an auto analyzer before and at the end of regular training. Venous blood samples were taken from the antecubital vein with suitable vacutainers with EDTA as anticoagulant. Centrifuged at 4,000 rpm for 5 min, the samples after extraction by taking micro-centrifuge tubes were kept at -80°C, until analysis. In this study, the basal venous blood samples were obtained from all the participants in the morning after 12 h of overnight fasting.

Statistical analysis

The Statistical Package for the Social Sciences was used for statistical analysis. It was used for the 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. Table 1 shows the significant differences at height, body weight, standing long jump, seated medicine ball throw and 30 m sprint test parameters between the pre and post-training values (P<0.001).
Table 1. The comparison of some physical and motor characteristics of the subjects.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Before training</th>
<th>After training</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>12.58 ± 0.51</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>158 ± 0.05</td>
<td>162 ± 0.04</td>
<td>0.00**</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>44.58 ± 5.32</td>
<td>48.75 ± 4.61</td>
<td>0.00**</td>
</tr>
<tr>
<td>Standing Long Jump (cm)</td>
<td>159 ± 0.14</td>
<td>186 ± 0.14</td>
<td>0.00**</td>
</tr>
<tr>
<td>Seated Throwing the Health Ball (m)</td>
<td>6.17 ± 0.54</td>
<td>7.20 ± 0.75</td>
<td>0.00**</td>
</tr>
<tr>
<td>30 meter Sprint (s)</td>
<td>6.35 ± 0.43</td>
<td>5.54 ± 0.32</td>
<td>0.00**</td>
</tr>
</tbody>
</table>

*P<0.05, **P<0.01.

Table 2. The comparison of blood parameters of the subjects.

<table>
<thead>
<tr>
<th>VARIABLES (measure)</th>
<th>Before training</th>
<th>After training</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC (10/µl)</td>
<td>7.33 ± 1.82</td>
<td>7.13 ± 1.73</td>
<td>0.15</td>
</tr>
<tr>
<td>RBC (10/µl)</td>
<td>4.83 ± 0.31</td>
<td>4.79 ± 0.29</td>
<td>0.41</td>
</tr>
<tr>
<td>Hgb (g/dl)</td>
<td>13.46 ± 0.73</td>
<td>12.79 ± 0.60</td>
<td>0.00**</td>
</tr>
<tr>
<td>HCT (%)</td>
<td>40.14 ± 2.32</td>
<td>40.33 ± 1.87</td>
<td>0.75</td>
</tr>
<tr>
<td>AST-SGOT (U/L)</td>
<td>24.67 ± 4.75</td>
<td>20.69 ± 3.35</td>
<td>0.01*</td>
</tr>
<tr>
<td>ALT-SGPT (U/L)</td>
<td>17.50 ± 7.37</td>
<td>14.55 ± 3.60</td>
<td>0.02*</td>
</tr>
<tr>
<td>Urea</td>
<td>21.75 ± 6.33</td>
<td>24.43 ± 6.55</td>
<td>0.13</td>
</tr>
<tr>
<td>Creatine (mg/dl)</td>
<td>0.81 ± 0.09</td>
<td>0.64 ± 0.05</td>
<td>0.00**</td>
</tr>
<tr>
<td>Blood Glucose (mg/dl)</td>
<td>99.42 ± 5.12</td>
<td>92.83 ± 3.98</td>
<td>0.00**</td>
</tr>
<tr>
<td>pH</td>
<td>99.42 ± 5.12</td>
<td>92.83 ± 3.98</td>
<td>0.02*</td>
</tr>
<tr>
<td>Density Urine</td>
<td>5.38 ± 0.48</td>
<td>5.00 ± 0.00</td>
<td>0.03*</td>
</tr>
<tr>
<td>MCV (average erythrocyte volume)</td>
<td>83.19 ± 3.98</td>
<td>84.44 ± 4.24</td>
<td>0.02*</td>
</tr>
<tr>
<td>MCH (average amount of hemoglobin)</td>
<td>27.90 ± 1.31</td>
<td>26.58 ± 1.59</td>
<td>0.00**</td>
</tr>
<tr>
<td>MCHC (average hemoglobin concent</td>
<td>33.44 ± 0.82</td>
<td>31.58 ± 0.71</td>
<td>0.00**</td>
</tr>
<tr>
<td>RDW (average erythrocyte distrib</td>
<td>13.57 ± 0.90</td>
<td>13.18 ± 1.18</td>
<td>0.03*</td>
</tr>
<tr>
<td>PLT (platelet, blood stamps)</td>
<td>297.08 ± 96.00</td>
<td>247.67 ± 60.13</td>
<td>0.02*</td>
</tr>
<tr>
<td>MPV (Average platelet volume)</td>
<td>8.68 ± 1.42</td>
<td>10.28 ± 0.90</td>
<td>0.00**</td>
</tr>
</tbody>
</table>

*P<0.05, **P<0.01.

We examined the effect between pre-training and post-training values of some hematological parameters. Table 2 shows no significant difference between WBC, RBC, HCT and urea values (P>0.05). However, significant differences was found at AST, ALT, pH, urine density, MCV, RDW and PLT values (P<0.05). We found significant differences at the Hgb, creatine, fasting blood glucose, MCH, MCHC and MPV values (P<0.001).

DISCUSSION

Children are in a continuous development and growth period. Children in particular under the age of 11-12 have a quite high sympathetic system activity. The development of these systems is seen after puberty. Body weight and height gain in this age period may be strongly influenced by developmental change. Some anthropometric characteristics such as 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). Significant differences in standing long jump, seated medicine ball throw and 30 m sprint parameters of girls are likely in part related to sport-specificity of the exercise mode used in tests. Handball involves several sprints, a great number of rapid directional changes, starts, stops, jumps, and landings during the game. Additionally, the upper and lower extremities have a relevant role in this sport, as they are involved in different actions like throwing, fall landings, and ball blocks during defensive actions (Vicente-Rodriguez et al., 2004). Skilled female handball players threw faster and more accurately and responded more rapidly than novice players in throwing tasks (Lidor et al., 1998). Analysis of variance yielded greatest differences relative to handball performance in the factor of specific agility and throwing.
strength, and the factor of basic motoricity that integrates the ability of coordination (agility) with upper extremity throwing explosiveness and lower extremity sprint (30 m sprint) and jumping (Cavala et al., 2008). Studies showed insignificant increases in anthropometric characteristics, physical fitness, and throwing velocity. The correlations observed suggest the importance of including explosive strength exercises of the knee and elbow extensions (Granados et al., 2008).

A battery which included physical measurements (height and weight), explosive power tests (medicine ball throw and standing long jump), and speed tests emphasized the testing for selection is one of the most important fundamentals in any multistep sport program for 12-13 years of age at the beginning of period. In most ball games, selection processes are complex, and are often unstructured, and lack clear-cut theory-based knowledge. For example, little is known about the relevance of the testing process to the final selection of the young prospects (Lidor et al., 2005).

Alterations of the hematological variables can influence physical performance. Mackinnon et al. (1997) examined the responses of selected hematological variables in 16 female athletes during intensified training. There were no significant differences including: blood leukocyte, erythrocyte, hematocrit, and mean red cell volume. But change in mean red cell volume was significant in our study. These results are inconsistent with those of the Mackinnon et al. (1997). Yeh et al. (2006) also did not find any significant difference on WBC and RBC values of female athletes post-chronic exercise (P<0.001). There are researches that show no increase in HCT measurements at the end of camping programs and high-intensity interval training (Mashiko et al., 2004; Gren et al., 1991). There are also some studies showing a decrease in hematocrit values of female athletes (P<0.05) at the end of the 5 week training program (Bezci et al., 2010).

Intensive training can cause significant differences in hemoglobin values (Niemann and Pedersen, 1999). Oxygen from red blood cells in tissues is connected to hemoglobin which gives the oxygen to active tissues. Organism's oxygen demand increases during training. In parallel to this increase, the circulatory and respiratory systems should show a physiological adaptation. Then the oxygen need of tissues and the amount of oxygen of the circulatory system increases (Ghosht et al., 1985). Especially, evaluation of blood volume in young is complex. There are conflicting results in literature regarding changes in blood volume per unit body mass increases with age. Girls have lower hemoglobin concentration values and it would result in reduced oxygen carrying capacity (Armstrong and Weilman, 2001). Our study showed significant declines (P<0.01) in hemoglobin and mean hemoglobin concentration after the long-term training.

As creatine is synthesized in muscles, release and transmission of high amount of creatine from muscles into blood during competition, like acute exercises turns up the serum creatine level in blood (Smith et al., 2007) which supports our findings. It is considered that the reason why the change in urea levels was insignificant is that urea is discharged from the body through perspiration during exercise and through urine after exercise.

Creatine and urea values in the study show that the increase in the creatine level was significant whereas the increase in the urea level was insignificant to training. While a study stated that the creatine level increased after exercise (Genç et al., 1999), other expressed that the difference in pre and post exercise creatine and urea levels were not significant (Koç et al., 2007). Also Çevik et al. (1996) found in the outcome of an exercise program they implemented that, there was no significant difference in creatine and urea levels before and after exercise. Kargotich et al. (2007), stated that endurance exercises increased the urea levels, which was, however, statistically insignificant. Priest et al. (1982) studied the influence of acute exercise on serum, biochemical and hematological parameters and stated that the change in urea and creatine levels was statistically significant.

After strenuous physical exercise stress, an increase (90%) in the number of peripheral blood leucocytes is observed. The degree of leucocytosis shows a close correlation with the values of some serum parameters, such as concentrations of aspartate aminotransferase (AST; r = 0.747) and alanine aminotransferase (ALT; r = 0.542) (Kayashima et al., 1995). The aspartate aminotransferase, alanine aminotransferase, pH urine density, glucose, mean red blood cell distribution width, platelet, mean erythrocyte volume, and mean platelet volume values were significantly different before and after training.

Remarkable changes after long-lasting exercise must be expected in the blood values. A glucose value was significant in our study. However, Chevian et al. (2003) found that, in acute exercise glucose levels increased dramatically. These increases presumably reflect persistent damage to the muscles, resulting in a loss of cell membrane integrity, and consequent leakage of proteins into the blood. Biochemical parameters and exercise have become an area of ongoing studies which indicating positive improvement in blood biochemistry due to chronic exercise (Çakmakçı and Pulur, 2008).

Arslan et al. (1997), found 29 female students actively engaged in sports reported a significant increase in levels of PLT after the chronic exercise (P<0.01), compared to controls that have been identified as having high levels of PLT level. An increase was found in platelet counts and some immunological and hematological parameters after
post-acute maximal exercise (Guyton, 1988). A study related to 26 healthy female subjects shows similar results to our investigation on MCV, MCH, and MCHC levels (P<0.05) before and after the 12 week exercise period (Bezci and Kaya, 2010).

In conclusion, several changes in metabolism occur after long-term exercise. Many other factors play a major role, such as adaptation to exercise, adaptation of cardiovascular, physical and physiological balance in hematological levels. We know that handball is a quite complex game, which requires players to have well developed aerobic and anaerobic capacity for successful performance. It has been shown that 4 times per week of handball training is associated with better physical capacity and best hematologic values. Stature, endurance, anaerobic capacity, maximal oxygen uptake and strength seem to be the most important components for selecting a talented handball player, especially for the girls. During and after intense exercise in hematologic values variations may be due to differences of a person's training status, gender, age, environmental conditions and nutrition. It is observed that the changes depend on the long-term exercise in athletes. But most importantly, regular exercises are needed to record significant improvements for athletes. Long-term training is associated with a wide range of significant changes in hematological parameters. In the end of the long-term training for one year, handballers had better physical capacity and some blood values and achieved major success at their age category in young women's Championships of Turkey.

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REFERENCES


