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Jump shot performance and strength training in young team handball players

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Abstract

The purpose of this study was to determine the effects of 12-week strength training on the jumping throw performance in young handball players. 18 handball players (age:13.66±0.5 year; height:160.0±6.25 cm; weight: 49.0±8.97 kg) participated to the study. The Training Group Program: A 12 week strength training and handball technical training program were supervised 3 times a week and each session was 60 min. Control Group Program: A 12 week handball technical training program were supervised 3 times a week and each session was 60 min. Push up, vertical jump (VJ), performances and some kinematic parameters (velocity (V_{CG}) and height (h_{CG}) of center of gravity) were evaluated before and after training program. For kinematics parameters, performances were recorded with a camera (50Hz) and evaluated with Videopoint 2.0. program. There were significant differences between before and after training program in push up and the height of center of gravity parameters($p<0.05$). But there is no significant differences found that vertical jump (VJ) and velocity of center of gravity (V_{CG}) ($p>0.05$).

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1. Introduction

Regular development starts with the beginning of the school age. Contrary to the sprint and throwing power, in jumping power there is development which is in line with the maximal power and pushing power. Perhaps due to the first leaping height increase, the change in horizontal jump power is more noticeable in comparison with vertical jump. Extremity and muscle development forms the basis for later performance while increase in step frequency reaches its peak value at the end of primary school period and following this period, it can only develop through purposive training. Girls at the age of 12-13 are as successful as boys in vertical jump and long-jump. Later, boys' jumping power shows a larger development than that of girls (Antonakopoulou *et al*., 2009).

Handball, which has millions of supporters and practitioners all over the world, is a sport which has become widespread and received a lot of interest internationally. In European countries, this interest has made handball an essential element of physical education.

Running speed and explosive power are important factor in competitive handball (Ohnjec *et al*., 2008; Granados *et al*., 2007)According to Harre, in sports types (artistic gymnastics, skating, trampoline or swimming) where technical skills, are dominant, special power exercises should begin as early as the primary school period (Harre,

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1982). However, in areas like sportive games and fight sports, multidimensional general power exercises must be carried out (Muratlı *et al*., 2005).

The special power exercises should be carried out bearing in mind the continuity in power principle. In addition, at these ages they maintain quick power development. To this end, usually general exercises are applied (eg., multidirectional jumps, explosive power and reaction time exercises, throw exercises). Quick power exercises similar to branch-specific techniques are used as special power exercises (Muratlı *et al*., 2005).

The aim of this study is to identify the effect of jump and power trainings on 13-14 aged trained female handball players' jump throwing performance.

2. Material and Methods

2.1. Subjects

The participants were 18 female players from the Mediterranean Youth Sports Club Handball Team and they had done technical training regularly for the past 2 years (age: 13.66±0.5 years; height: 160±6.25cm; weight: 49±8.97 kg). Nine of the players (the experimental group) did technical trainings five days a week as well as strength trainings three days a week for 12 weeks. The strength trainings were structured as 9 stations with 2 sets as continuity in strength exercises as appropriate to the children's age. Before the trainings started, the players' vertical jump performances, performances in throwing medicine ball and repetition numbers in stations were determined. The trainings started with the repetition number of 12 and were raised to 20 repetitions 4 weeks later.

The subjects' height, weight and vertical jump test were measured before examination (Özer, 2001). Each player's three jump throwing performances were measured. In accordance with the rules of the handball game, each player threw at the target which was at a 6m distance from the throwing line by speeding in three steps. The target point was determined on the basis of the players' mean vertical jump distances. Players who use their right or left hand chose the target point appropriate for themselves. A two-minute break was given between each trial of jump throwing.

Jump performances were recorded video camera (50 Hz). Camera was placed in a matter that it could cover an overarm throwing performance. Reflective signs were used to identify the fallowing anatomical landmarks (hip, knee, ankle, shoulder, elbow and wrist). Some kinematic parameters (horizontal and vertical velocity of center of mass (COM) before jump, velocity of COM at the highest point after jump) were calculated in Videopoint 2.0 movement analyzing program.

2.2.Training application

Beginning phase

Warm-up
Warm-up runs
Warm-up with a ball
Warm-up with an educational game

The main phase

Station Training for Strength: Along with the real warm-up and cooling phases, 9 station activities were done for an hour over 2 sets and 12 repetitions. The rests took place during the station changes. The stations were performed respectively in order to work out the upper extremity and lower extremity muscles, with the lower extremity followed by the upper extremity. The repetition numbers were determined on the basis of the trials with players in the stations. After the 4th week, the repetition numbers were raised to 15 (Faigenbaum & Westcott, 2000).

1. Station : Double-feet jump exercise over four 47 cm-long barriers (4 forward, 4 return)
2. Station : Lateral holding with a dumbbell of 1.5 kg (12-20 repeat)
3. Station : Jumping to the right and left over the medicine ball (12-20 repeat)

4. Station : Push-ups 12-20 repeat)
5. Station : Jumping to the back and forth over the medicine ball
6. Station : Half-squat exercises with an empty bar of 5 kg (12-20 repeat)
7. Station : Back extension at waistline, over a box of 25 cm (12-20 repeat)
8. Station : Throw-in training with a 4 kg medicine ball from a 2-meter distance
9. Station : Crunch with the feet over a 25cm box (12-20 repeat)

Final Phase

Cooling down

2.1.2. Statistical Analysis

The statistical analyses and distributions of all study subjects were analyzed. A one-way ANOVA and Kruskal Wallis test were applied by means of SPSS 10.01 (Sümbüloğlu & Sümbüloğlu, 1995).

3. Results

Subject characteristics of the experimental and control group are shown in Table 1.

Table 1. Subjects characteristics

Groups	Age(year)	Height(cm)	Weight(kg)
Control Group	13.27±0.65	165.11±1.62	56.78±9.16
Experimental Group	13.66±0.50	160.11±6.15	49.00±8.97

Before and after training program, push up test variables and vertical jump performances are shown in Table 2. A significant difference was found between the pre-training and post-training push-up values ($p<0.05$). Although there was an increase in the post-training vertical jump values, this difference was not found to be significant ($p>0.05$).

Table 2. Push-up test and vertical jump before and after training

Groups	Pre-Training	Post-Training
Push up	17.6±7.19	24.7±4.66
Vertical jump(cm)	29.10±6.59	32.70±6.73

The height of COM was found to increase from 0.43±0.13 m (prior to training) to 0.63±0.13 m after the training. It was observed that after the training handball players jumped 20 cm higher, starting from the last jump ($p<0.05$).

The velocity of COM was determined as 4.78±0.94 m/sec prior to training and as 5.08±0.52 m/sec after the training. In terms of pre-training and post-training analysis, although there was no significant difference between the horizontal and vertical velocity of COM as a group, an increase of 0.62 m/sec was recorded in post-group horizontal velocity. However, this increase was not found to be significant ($p>0,05$).

Table 3. Kinematic variables before and after training

Groups	Pre-Training	Post-Training
h (m)	0.43±0.23	0.63±0.13
V_{COMx}(m/sec)	3.92±1.01	4.54±0.69
V_{COMy}(m/sec)	2.55±0.71	2.06±1.10
V_{COM1}(m/sec)	4.78±0.94	5.08±0.52
V_{COM2}(m/sec)	5.30±0.84	4.44±0.96

h: height of COM, V_{COMx}: horizontal velocity of COM before jump; V_{COMy}: vertical velocity of COM before jump; V_{COM1}: velocity of COM before jump; V_{COM2} : velocity of COM at the highest point after jump

4. Discussion and Conclusion

In the strength trainings performed 3 days a week in addition to players' handball technical trainings, COM was found to increase from 0.43±0.13 m (prior to training) to 0.63±0.13 m after the training. Regarding the group scores in the pre-training and post-training, it was observed that after the training handball players jumped 20 cm higher, starting from the last jump. This finding was also found to be significant ($p<0.05$).

During the last jumping stride, the COM velocity was determined as 4.78±0.94 m/sec prior to training and as 5.08±0.52 m/sec after the training. In terms of pre-training and post-training analysis, although there was no significant difference between the horizontal and vertical velocity of COM as a group, an increase of 0.62 m/sec was recorded in post-group horizontal velocity. This was effective over the players' post-jumping velocity. The decrease in COM's vertical velocity during the players' last jump stride may have stemmed from the brake during transition to jumping. However, this increase was not found to be significant ($p>0,05$).

The throwing action has been investigated by many researchers and muscle strength was found to be the most significant factor affecting the throw speed. In such a study, it was found out that the body flexors (abdominal muscles: rectus abdominis, external and internal oblique muscles) have a significant role in the determination of muscle strength and throwing speed (Eliasz, 1998); a significant difference was found between maximal ball speed and other throw analyses during cross-step throw in. It was determined that the motor skill factors, the body's total muscle strength, the power of the body flexors and the angular speed of the maximal arm (shoulder joint) were definitely effective over the ball speed in the throw techniques analyzed (Campos *et al*., 1994; Tillaar & Ettema, 2003; Zapartidis *et al*., 2009). Trainers should take into account these characteristics and training program should organize to improve the properties.

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