European Journal of Physical Education and Sport Science
ISSN: 2501 - 1235
ISSN-L: 2501 - 1235
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.3779299 Volume 6 | Issue 3 | 2020

THE EFFECT OF STRENGTH EXERCISES ON VERTICAL JUMP IN HANDBALL PLAYERS WITH AGES BETWEEN 15 AND 17

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Abstract:
In our study, we tried to investigate the effect of strength exercises with handball players on vertical jump. 24 athletes (n = 12 Experiment A group, n = 12 Experiment B group), who struggled with the handball league infrastructure with the ages between 15 and 17, participated in our research. In addition to the technical and tactical exercises 3 days a week for 8 weeks, the experimental group A carried out the Olympic lifts 2 days a week. In addition to the technical tactical exercises 3 days a week, the experimental group B carried out 2 days of force exercises without Olympic lifts. As a result of the pre-test and post test data of the Experiment A and Experiment B groups, the statistical analysis of the values obtained was made according to the paired group t-test and independent group t-test, and the correlations of the measurements were interpreted. There was no significant difference in the weight and measurements of the Experiment Group A before and after the training ($p < 0.05$). A significant difference in vertical jump, fat percentage and height measurements were found ($p < 0.05$). In the Experiment Group B, no significant difference was found in weight, fat percentage measurements ($p < 0.05$). However, there was a significant difference in height, vertical jump measurements ($p < 0.05$). When the independent group t-test results between the two groups were examined, no significant difference was found in height, weight, fat percentage measurements ($p < 0.05$). However, the significant difference between the experimental A group vertical jump 1st and 2nd measurement averages was found to be significantly larger than the Experiment Group B vertical jump 1st and 2nd measurement averages ($p < 0.05$). As a result, it was observed that the strength exercises performed with the Olympic lifts in the handball players of the 15 - 17 age group increased the vertical jump force more than the other strength exercises without the Olympic lifts. In addition, there

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was a significant difference in height measurements in both groups. We think that the reason for this may be due to the fact that the subjects were still in the development age. A significant difference was found in Experiment A group fat percentage measurements and body fat percentage was lower than before. We think this is due to muscle hypertrophy.

Keywords: strength, vertical jumping, Olympic style weightlifting

1. Introduction

The maximum power produced by a muscle or muscle group in the shortest time is called an explosive force. Since vertical jump is a force that affects the formation of movement in the vertical direction, there is a high relationship between explosive force and vertical jump (Akgün, 1994: 28). One of the most popular activities for power development is plyometric exercises. This method uses body weight to increase the effect on training (Chu, 1998). Today, exercises to increase the jump force are plyometric exercises with low weights and body weight. These exercises have been proven to improve the jump force (Brown, 1986). In addition, suggested that athletes who want to improve their jumping ability should also include jump force exercises with Olympic lifts (Garmammer, J., R. Groger, Res.6(3), 1992).

The importance of Olympic style trials in the development of low body strength and vertical jump ability has also been proven by Stoussel. On the vertical jump performance of Stoussel, 14 national female weightlifters and 13 unemployed university students have worked on it and as a result proved a 50% increase in their performance (Stoessel, 1991).

In handball force exercises, firstly, the throwing force and the jumping force should be developed. This is an important condition for the acquisition of movement and playing skills. In particular, there is a need to improve the jump force in jumping shots, goal shots, long distance passes, multi-speed shots, defence and offensive positions. In handball strength exercises, techniques for the operation of the single joint and associated muscle groups are used (for example, arm bending involves only working the elbow joint and the muscles attached to it). On the other hand, the most used method for increasing the jump force is plyometric exercises and jump exercises with low weights. However, lifting a weight from the ground provides strengthening, supporting each other and great body coordination of many joints and muscles attached to it. In this regard, we believe that the exercises done by the Olympic lifts in order to increase the jump force of handball players, accordingly, exercises involving many joints are needed. In our study, we tried to statistically find out that force exercises involving Olympic lifts improved the jump force more.

Handball played in the halls demands that many game-specific skills and bodily features exist. Better development of technique and tactic was one of the most considered topics in the past years. Even the maximization of the individual technical skills of the

players was greatly accomplished. However, besides these, condition related features should be improved.

A big start and sprint are required for fast attacks that are very common in handball. A fast run is required in jumps and goal shots. In jumping, falling, rotating and twisted shots, other factors such as body deceptions, shooting force, continuity in force and mobility are prominent.

Reaction speed in holding and throwing balls, anaerobic and aerobic endurance are the features that an athlete should improve for a 2x30 minutes game. However, speed and various elements of speed; start speed, passing speed or reaction speed and successfully defending opponent's shoots are other motoric features.

In handball, strength is a feature that is needed at every stage of the game and the force of shooting during shooting becomes important as the force of jumping during jumping.

In particular, the mobility or flexibility of the shoulders, trunk and hips are necessary for taking the ball, fighting with the opponent player and a successful goal throw. The handball player has to be quick first of all. All game actions in defence and offense require a maximum speed. In trot shooting movements, besides rapid force, general force has an important effect. Endurance should be considered the basis for the development of speed in all sports games.

2. Method

24 athletes (n = 12 Experiment A group, n = 12 Experiment B group), who struggled with the handball league infrastructure with the ages between 15 and 17, participated in our research. In addition to the technical and tactical exercises 3 days a week for 8 weeks, the Experiment Group A carried out the Olympic lifts 2 days a week. In addition to the technical tactical exercises 3 days a week, the Experiment Group B carried out 2 days of force exercises without Olympic lifts.

2.1 Materials Used

A. Olympic Bar

218.4 cm. length Olympic bar was used in Experiment A group weight exercises.

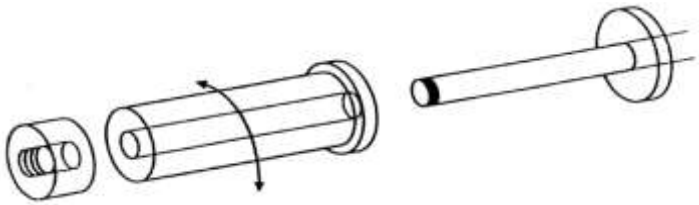

Figure 1: Olympic bar

B. Health Ball

In Experiment Group B strength exercises, 3 kg weight, swelling, standard health ball was used.

Figure 1: Health Ball

C. Plyometric Case

In the Experiment Group B strength exercises, a standard wooden case measuring 60x45 cm and a height of 60cm was used.

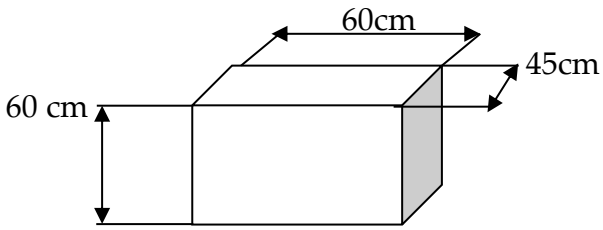

Figure 2: Plyometric Case

D. Training Cone

In the Experiment Group B strength exercises, a standard plastic cone with a height of 60 cm. was used.

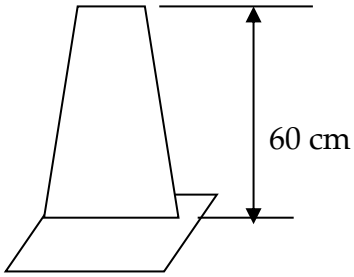

Figure 3: Training Cone

E. Dumbbell

In Experiment B Group strength exercises, 2 kg of dumbbell filled with sand was used.

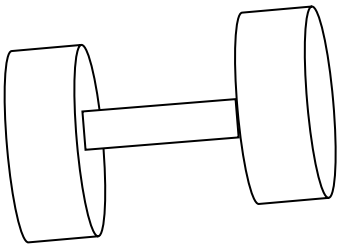

Figure 4: Dumbbell

2.2 Measurement Methods

A. Height-Weight Measurement

Height measurements of Experiment A and Experiment B group athletes were done in the morning with a stadiometer. The subject stood barefoot on the flat ground towards the stadiometer and was asked to distribute his/her weight equally to both feet. The moving part of the stadiometer was brought to the top of the head and the hair was tightened sufficiently and the measurement was measured in cm (Özer, 1993: 41). Body weight measurement was carried out with shorts using scales and it was recorded in terms of in kilograms.

B. Body Fat Measurement

Body fat percentage measurements were measured with the Harpenden skinfold caliper, which applies pressure of 10g / mm^2 between the tips, with a precision of 0.1mm in accordance with international standards.

Since an equation for handball players was not developed in determining the body fat ratio, Lange's formula for% fat was used (Özer, 1993: 60).

% fat = (biceps + triceps + supscapula + suprailiak + chest + thigh) x 0.097 + 3.64

C. Vertical Jump Measurement

The test was told to the subjects. The subjects stretched their hands upwards on the wall and the wall was marked with a middle finger tip, the subject walked away from the wall 20-30cm and marked the wall by jumping with two feet (Sevim, 1997: 216). The distance between the point where the fingers first touched, and the highest point touched after the jump was recorded in cm among 3 attempts.

Table 1: Training Program Applied to Experiment A Group

Experiment A Group Exercise Program							
Exercise	**Exercise Style**	**Intensity**	**No. of Repeats**	**No. of Sets**	**Rhythm**	**Rest Between Sets**	**Activity During Rests**
Power lift	Station Work	65% of Maximal	8	3	Fast	3-5 minutes	Relaxation and Breathing Exercises
Power Jerk							
Power snatch							
Power clean							
Abdominal Exercises	20-30						

Table 2: Training Program Applied to Experiment B Group

Experiment B Group Exercise Program							
	Exercise No.	**No. of Repeats**	**No. of Sets**	**Rest Between Sets**	**Exercise Style**	**Rhythm**	**Activity During Rests**
1	1,3,5,7,11	65% of Maximal	3	3-5 minutes	Station Work	Fast	Relaxation and Breathing Exercises
2	2,4,6,8,10						
3	1,4,9,11,12						
4	1,2,4,6,9						
5	3,6,7,10,12						
6	1,3,5,8,10						
7	4,6,7,11,12						
8	5,6,8,9,12						

In addition to the technical-tactical work 3 days a week, Experiment A group was subjected to rapid strength training with the Olympic lifts aimed at increasing the jump force for 2 days. The training intensity was taken as 65% of the maximum weight that the Experiment A group could bear since the training period was the transition period. Since the maximum strength of the subjects would change at the end of the 4 weeks exercise, the maximum weight of the subjects could be determined again, and the intensity of the training was regulated accordingly.

2.3 Experiment A Group Training Program

1) power lifts (lift lifts),
2) power jerk lifts (pushing with toes and arms),
3) power snatch (snatch),
4) power clean (jerk),
5) abdominal exercises.

The following abdominal exercises were performed in each set.

- abdominal crunch,
- knees twisted straight crunch,
- pulling the trunk with the knees,
- reaching to feet,
- side crunch,
- reaching elbow to the cross knee,

2.4 Experiment B Group Training Program

For the Experiment B Group to improve the jump force, attack and defence drills, shooting and passing exercises, tactical set practices 3 days a week, as well as rapid strength training, and exercises in the form of station work with their own body weights and small weights for 2 days were carried out.

1) continuous jump over the case,
2) knee bend with a health ball,
3) cross jumping with dumbbells,
4) rising at fingertips with dumbbells,
5) side jump over the towers,
6) jumping by pulling the knees up,
7) double feet long jump,
8) jump with health ball between legs,
9) cross jump with body weight,
10) crouching and jumping with a health ball,
11) jumping over the cases,
12) vertical jump by pulling the heels over the hip.

3. Findings

3.1 Experiment A and Experiment B Group Findings

In this study, paired group t-test and independent group t-test were applied in SPSS packet program to detect differences between Experiment A group and Experiment B groups before and after the 8-week training program. The arithmetic means, correlation, standard deviations, significance levels of the data we obtained as a result of this test were found and the results were tabulated by revealing whether they were significant according to the significance level of $p < 0.05$.

Within the scope of our study for 12 Experiment A and 12 Experiment B groups, the distribution of the values we obtained as a result of fat, height, weight and vertical jump pre-test post-test measurements are given here.

Table 3: Physical characteristics of the participants M (SD)

Group	Age (year)	Height (cm)	Body weight (kg)
Experiment A (n=12)	16.17 (.83)	178.75 (4.22)	68.42 (6.37)
Experiment B (n=12)	16.00 (.85)	179.00 (5.17)	69.00 (6.06)
Total (N=24)	16.08 (.83)	178.88 (4.62)	68.71 (6.09)

Table 4: Changes in dependent variables after an eight-week training programme in Groups M (SD)

Groups	Dependent variables	M (SD)	t	df	p
Experiment A (n=12)	pre-test BW	68.42 (6.37)	.290	11	.777
	post-test BW	68.33 (5.79)			
Experiment B (n=12)	pre-test BW	69.00 (6.06)	-1.301	11	.220
	post-test BW	69.33 (5.94)			
Experiment A (n=12)	pre-test BF	10.09 (1.43)	5.492	11	.000
	post-test BF	9.59 (1.40)			
Experiment B (n=12)	pre-test BF	10.89 (1.64)	-.831	11	.423
	post-test BF	10.94 (1.64)			
Experiment A (n=12)	pre-test VJ	61.25 (3.52)	-9.950	11	.000
	post-test VJ	64.25 (3.05)			
Experiment B (n=12)	pre-test VJ	58.17 (7.03)	-5.000	11	.000
	post-test VJ	59.00 (7.10)			

There was no statistically significant difference between the pre-test and post-test BW (kg) scores of the Experimental A and Experimental B groups, respectively t (11) = 0.290, p> 0.05; t (11) = - 1.000, p> 0.05).

While the BF (%) scores of the Experiment Group A changed significantly from the pre-test to the post-test scores of Experiment Group A [t (11) = 4.864, p <0.01], there was no change in the Experiment Group B [t (11) = - 0.831, p> 0.05].

There is a statistically significant difference between the pre-test and post-test VJ (cm) scores of Experiment A and Experiment B groups, respectively t (11) = - 9.950, p <0.01; t (11) = - 5,000, p <0.01). The development in the Experiment A group is higher than in the Experiment B group, t (22) = 6.289, p <0.01).

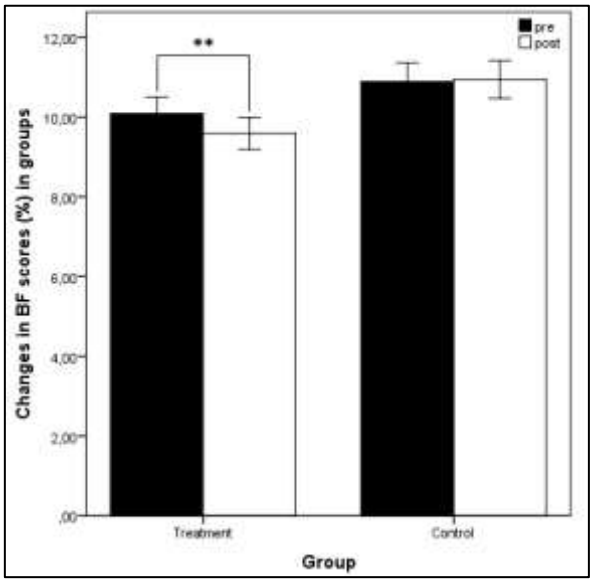

Figure 5: BF (%) scores of the treatment group decreased significantly from pre-test to post-test (**=p<0.01). (+/-1 SE)

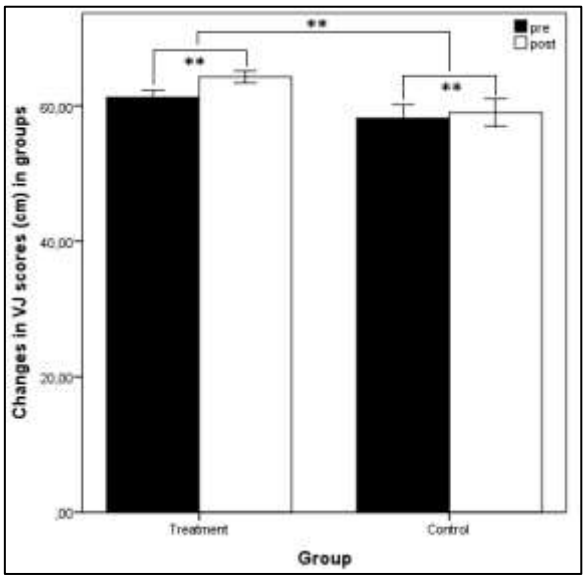

Figure 6: VJ (cm) scores of both groups increased significantly from pre-test to post-test, (**=p<0.01). (+/-1 SE)

4. Discussion

Validity of jump exercises with low weights has been proved by plyometric exercises in increasing vertical jump force with the studies in the literature. In addition, the importance of Olympic-style trials in the development of low body strength and vertical jumping ability has been demonstrated by Stoussel. Stoussel worked on 14 national female weightlifters and 13 unemployed university students on vertical jump performance. As a result, an increase of up to 50% was observed in the performance of

the subjects compared to before (Stoessel, 1991: 87-95). Both weight training and plyometric exercises have been found to be individually effective in improving vertical jumping performance. But if these two working methods are combined, better results can be obtained. In the study titled "The study of the effect of plyometric exercises related to the Rock Technique on some motoric parameters in wrestlers", 37 randomly selected athletes who consistently trained for two hours a week for 5 hours a day, 20 athletes as a control group, 37 wrestlers participated voluntarily as a result of 8-week training, hand grip strength, back force and V02 max values increased significantly.

In the study by (Kaya I. vol. 9, issue 1, 2015) ''The effect of plyometric exercises related to Rock Technique on some motoric parameters in wrestlers'', Technique, 17 randomly selected athletes who regularly train two hours a week for 5 hours a day, 20 athletes as a control group, 37 wrestlers participated voluntarily as a result of 8-week training in vertical jumps. , hand grip strength, back force and $V0^2$ max values increased significantly.

In the study by (Adams K. et al, 1992 : 36-41)while vertical jumping performance improved (3.30 and 3.81 cm) with the application of weight training or plyometric exercises alone, the best results for non-athlete subjects were obtained with the combination of weight and plyometric exercises. These subjects performed the weight and plyometric exercises for 6 weeks and 2 times a week. According to the tests carried out at the end of 6 weeks, the vertical jump of these subjects reached an average of 10.67 cm. Similar solutions have been seen in the works of (Duke, S. and D. Ben Eliyahu. 6-1: 10-15: 1992) They divided 10 high school athletes into two groups as weight training and weight + plyometric training. Athletes worked 3 times a week for 6 weeks. According to the tests performed after 6 weeks, only the weight- training group showed a 3% improvement (1.52cm.) The weight + plyometric training group showed a vertical jump performance of 11% (6.35cm.), (Clutch D. et al, volume 54 issue 1, 1983) also provided a basis to further strengthen all these claims. 32 subjects were randomly selected. While 16 of these were volleyball players studying in college, the other 16 were children from the weight training class. The first group performed both weight and plyometric exercises, and the second group applied only weight exercises. The plyometric study consisted of in-depth jumps, while weight training consisted of deadlift, bench-press and parallel law. Subjects trained twice a week on a 16-week program. Finally, it was seen that only those who participated in weight training without participating in plyometric training or volleyball exercises could not achieve a significant success in the vertical jump ability. In contrast, a significant increase was observed in the vertical jump ability of the subjects who added plyometric training or volleyball training to the weight training.

In a study carried out in the USA, it was seen that as the weight lifted in the force exercises with the Olympic lifts increased, the jump height increased in direct proportion. (Hedrick, 1996: 7-12). In our study, in parallel with this study, they lifted an average of 37783.6kg and accordingly, there was an increase in the jump height. In our study, a result equivalent to the studies in the literature has emerged. While there was an increase of 0.83 cm in Experiment B group, which performed only plyometric study, an increase of 3

cm was observed in our Experiment A group, which made handball-specific jumps along with the Olympic-style lift.

What is seen from all the studies is that both training with Olympic lifts and plyometric exercises shave positive effects on vertical jump (Stoessel, 1991), (Hedrick, 1996: 7-12). However, as can be seen in both our study and recommends in the literature, if these two exercises are carried out together, the vertical jump height will increase more.

5. Conclusion

In the 15 - 17 age group handball players, the strength exercises performed with the Olympic lifts and plyometric jumps specific to handball are more effective than the other strength exercises. However, we think that the increase in the height in both groups may be due to the fact that the subjects are at the stage of development age. We are of the opinion that the lower fat percentage in the post-test of the Experiment A Group was caused by muscle hypertrophy as the Experimental A group did weight training. There is no change in other parameters. Our study is in parallel with the studies in the literature.

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