

The Effectiveness of Using the Ballistic Training for Developing the Muscular Ability On the Strength and Accuracy of High-jump Shooting upon Handball Players

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Abstract: The main purpose of this study is to examine the effectiveness of using ballistic training to enhance the muscular ability of the arms and legs on the strength and accuracy of high-jump shooting upon handball players whom less than eighteen years old. The research was conducted on fifteen handball juniors (less than eighteen yearsold) from Port Said Sports Club (age 16.80 ± 0.74 years, height 178.00 ± 5.12 cm., weight 69.90 ± 4.38 kg and training age 4.60 ± 0.91 years).The measures were the test of pushing a three-kg medical ball, vertical jump, shooting strength test from the high jump and the proposed ballistic training program. Standard statistical methods were used for the calculation of means and SDs for age, height, weight, training age and the other variables of the present study. Ballistic training program was applied on the individuals of the basic research sample for eight continuous weeks, of three training units per week, the time of each unit was 85 minutes of which 20 minutes is extracted for skilful exercises of shooting with high-jump at the end of basic part of training unit. The most important results of this study proved that the proposed ballistic training program has a positive effect on the muscular ability of the arms and legs upon handball juniors less than 18 years. Moreover, using ballistic training leads to improve the strength and accuracy of high-jump shooting upon the handball juniors less than eighteen years.

Key words: Ballistic training • Handball • Muscular ability

INTRODUCTION

Muscular ability is one of the most special abilities in Handball and it is a composite of strength and speed; it is defined that the ability of muscles to overcome the resistance at high speed and to produce the strength in a maximum speed [1, 2]. For doing exercise on the muscular ability, it is necessary to maintain, as much as possible, the internal motor power through which the transition to shorten-muscle contraction is made as fast as possible. This transition is called the maximum muscular ability. The methods of enhancing the fast strength are the one which affects in this rate. One of these methods is ballistic training and plyometric training [3]. Muscular ability is one of the most important dynamic factors of motor performance, greatly affects on the velocity of motor performance and the proficiency of the required ability and considers one of the essential reasons in achieving progress of motor performance. It is "the motor performance with maximum launched exertion in the possible least time and with the highest efficiency" [4].

For Ballistic training, muscular fibers may adapt to work very quickly for a short time before the cessation of

repositioning which is required to perform high-jump shot in Handball [5]. Ballistic training is one of the most important methods to develop the muscular ability in the sports activities that rely on throwing such as Handball. They required the greatest possible velocity and strength in performing high-jump shot through weight training and different equipments (such as medical balls - weight Jacket - jeter weights) where freedom from the weight is done for one-time or freedom from the weight and return to it according to the motor path For each skill [6].

Ballistic training is "to achieve maximum muscular ability by acceleration the contraction muscular fibers to the maximum velocity in conjunction with the velocity of actual throwing to objects in the space. This type of training relies on breaking free of weight according to the nature of each skill" [7]. Olsen and Hopkins [5] have conducted a study to recognize the effect of ballistic training on the strength and motor velocity of encountering players. The study examined 22 players and the duration of the program was 10 weeks; the most important result was that ballistic training program had a positive impact on the strength and motor velocity of the encountering players.

Tomomi [8] has conducted a study to recognize the effect of ballistic resistance on flexibility. It was applied to 9 university scholars. The duration of the program was 8 weeks. The most important result was that ballistic training had a positive impact on flexibility (motor range) of athletes. McEvoy and Newton [9] have conducted a study to recognize the effect of ballistic training program on throwing skill and running velocity in the baseball. It was applied to 18 baseball players of national teams; the duration of the program was 8 weeks. The most important result was that ballistic training has a positive impact on running velocity and throwing skill of baseball players. Ramzi [10] has conducted a study to recognize the effect of ballistic training on maximum muscular ability and some mechanical characteristics of the throwing arm in the javelin. It was applied to 10 volunteering fourth year students at Faculty of Physical Education for Men, Zagazeg University. The duration of the program was 12 weeks. The most important result was that ballistic training has a positive impact on the maximum muscular ability and the numerical level in the javelin competition. El-Ebeedi *et al.* [11].

Conducted a study to recognize the effect of ballistic training on some physical and skilful variables upon handball players. It was applied to 16 baseball players in El-Karkh Club, Iraq. The duration of the program was 12 weeks. The most important result was that the proposed ballistic training led to improve physical variables such as (muscular ability- flexibility- fitness-velocity) and the skilful ones (the velocity of dribbling, velocity of passing, pivot shot) of handball players.

Practically, the researcher noted through his contact with the coaches of Port Said handball teams, that some coaches use traditional weighting exercises or free weight lifting equipments in the juniors sector as a core support to develop physical fitness of handball players. He also noted that they did not recruit the ballistic training which negatively affects the muscular ability of arms and legs, in addition to declining in the strength and accuracy level in the level of high-jump performance skill. The researcher has been assured of that through his work as a handball referee and his follow up to the junior handball team matches less than 18 years in Port Said area.

By reviewing the literature in this topic, it was found that there was no single scientific study (according to the researcher's knowledge) has addressed the ballistic training and its effect on the muscular ability of the arms and legs, the strength and accuracy of high-jump shooting upon the handball players. Therefore, the aim of

the present study is to examine the effectiveness of using the ballistic training to enhance muscular ability upon the strength and accuracy of high-jump shooting upon handball players less than 18 years.

MATERIALS AND METHODS

The researcher specifies 8 weeks of the period of application of proposed program for ballistic training with 3 times per week to be applied to the research group (n=15). He also specifies 85 minutes for daily training unit divided to 15 minutes for physical preparing, 45 minutes for basic part, 20 minutes for ability exercises and 5 minutes final step. The proposed ballistic training program contained some selected exercises suitable for handball junior team under less than 18 years. It complied with principle of progression from easy to difficult in the performance of ballistic exercises within the training units and throughout the training program [12, 13, 14]. The strength of load of exercises used during the stages of program ranged from 50% to 90%. Each daily training unit included of a set of exercises using some instruments and equipments (medical balls of different weights, sandbags, Damblz, barriers and suede seat).

The volume of training load must range from 8 to 15 repetitions in one group while groups should range from 3 to 5 groups [14]. For the loading volume of ballistic training with weightings, it is ranging from 10 to 12 repetitions while groups should range from 3 to 5 groups [6, 8]. Most of the scientific studies in the ballistic training agreed that a rest period should extend until the recovery, so the period of rest is specified between groups (2 s - 3 s) [5,10, 11].

Participants Subjects were intentionally chosen of 25 juniors of handball players less than 18 years, from Port Said Sports Club. Ten juniors are excluded to perform the survey; therefore, the basic research sample became 15 juniors (age 16.80 ± 0.74 , height 178.00 ± 5.12 , weight 69.90 ± 4.38 and training age 4.60 ± 0.91). The normality of the growth rates distribution and the physical and skilful variables computed in the present study were muscular ability of arms 4.10 ± 0.52 , muscular ability of legs 32.95 ± 4.98 , strength of shooting with high-jump 22.50 ± 4.26 and accuracy of shooting with high-jump 2.62 ± 0.99 .

The tests used to measure the variables of the present study are based on a questionnaire form filled out through interviews with professors of Physical Education in Port Said Faculty of Physical Education with more than ten years experience in training or teaching handball. The researcher satisfies with 85% of experts'

Table 1: The significance of differences in both distinct and indistinct groups in physical and skilful tests of the study

Tests	Measurement Unit	Distinct Group		Indistinct Group		t Value	Significance
		S1	P1	S2	P2		
Muscular ability of arms	Meter	4.00	0.29	3.15	0.21	7.08	Significant
Muscular ability of legs	Centimeter	32.50	3.02	28.25	2.60	3.19	Significant
Strength of shooting with high-jump	Meter	22.30	2.17	19.50	1.74	3.01	Significant
Accuracy of shooting with high-jump	degree	2.48	0.53	1.92	0.39	2.55	Significant

The value of tabular t at 0.05= 2.101

Table 2: consistency coefficient of physical and skilful tests under discussion.n = 10

Tests	Measurement Unit	First Application		Second Application		r	Significance
		S1	P1	S2	P2		
Muscular ability of arms	Meter	4.00	0.29	4.05	0.27	0.927	Significant
Muscular ability of legs	Centimeter	32.50	3.02	33.00	3.14	0.731	Significant
Strength of shooting with high-jump	Meter	22.30	2.17	22.30	2.85	0.799	Significant
Accuracy of shooting with high-jump	Degree	2.48	0.53	2.50	0.45	0.935	Significant

Value of tabular r at 0.05 = 0.632

opinions to specify the tests for measuring the muscular ability of arms and legs, in addition to the skilled tests which measure the strength and accuracy of high-jump shooting as follows, test of pushing medical ball weight 3 kilograms, test of vertical jump, test of the Strength of shooting with High-jump and test the accuracy of shooting with high-jump. The tools used were restameter equipment to measure the total body length, medical standard scale for measuring the weight, medical and Sand Balls weighted (1.50 - 2.00 - 2. 50 - 3 kg), tape of centimeter measurement, handball legal balls, high-jump device and cloth curtain [15, 16].

A survey study was conducted on the survey research sample of 10 junior players less than 18 years from the same research population and from outside the sample; to recognize the scientific coefficients (reliability and consistency) for tests used in the present research.

For computing the reliability coefficient, variance reliability between two groups was used. One of them is distinct (10 junior players) and the other is indistinct (10 juniors less than 16 years). The significant differences were computed between the two groups in physical and skilful tests of the present study. There were statistically significant differences at level 0.05 between the two distinct and indistinct groups in physical and skilful tests in favor of the distinct group indicating the sincerity of the selected tests (Table 1).

To ensure the consistency of the physical and skilful tests, the researcher used the method of testing and re-testing to the survey sample of 10 junior handball players less than 18 years. The researcher considers measurements of reliability as a first application of the consistency; the application was repeated with interval

of one day between the two applications. All calculated coefficients of correlation are bigger than tabular coefficients of correlation at the level 0.05 which indicate to the stability of discussed tests (Table 2).

The pre-measurements was conducted on the research sample in all variables of the present study, which were the test of pushing medical ball, weighed 3 Kg, the test of vertical jump, the test of strength of shooting with high-jump and he test of accuracy of shooting with high-jump.

Ballistic training program was applied on the individuals of the basic research sample for eight continuous weeks; on three training units per week, the time of each unit was 85 minutes of which 20 minutes is extracted for skilful exercises of shooting with high-jump at the end of basic part of training unit.

Post-measurements were applied at the same conditions and arrangement of the pre-measurements.

All data were analyzed statistically using the Statistical Package for Social Sciences (version 10.0; SPSS Inc, Chicago, IL) for Microsoft Windows. The data were handled in terms of mean, standard deviation, median, coefficient of Skew, t test, coefficient of simple correlation and the percentage of variance rate (percentages of progress).

RESULTS AND DISCUSSION

Table 3 showed that there were statistical significant differences at 0.05 between both pre and post measures for members of the research sample in the muscular ability of the arms and legs in favor of post-measurements.

Table 3: Significance of differences in both pre and post measures for members of the research sample in the muscular ability of the arms and legs. n = 15

Variables	Measurement Unit	Pre-measurement		Post-measurement		t Value	Significance
		S1	P1	S2	P2		
Muscular ability of arms	Meter	4.10	0.52	5.00	0.37	5.92	Significant
Muscular ability of legs	Centimeter	32.95	4.98	41.32	4.25	7.38	Significant

Value of tabular t at 0.05 = 2.145

Table 4: Rate of change of post-measurement rather than pre-measurement for research sample members in the muscular ability of the arms and legs

Single Group n = 15				
Variables	Measurement Unit	Before	After	Rate of Change %
Muscular ability of arms	Meter	4.10	5.00	21.95%
Muscular ability of legs	Centimeter	32.95	41.32	25.40%

Table 5: Significance of differences in both pre and post- measurements for members of the research sample in strength and accuracy of shooting with high-jump n = 15

Variables	Measurement Unit	Pre-measurement		Post-measurement		t Value	Significance
		S1	P1	S2	P2		
Strength of shooting with high-jump	Meter	22.50	4.26	25.91	3.02	4.13	Significant
Accuracy of shooting with high-jump	Degree	2.62	0.99	4.88	1.63	8.29	Significant

Value of tabular t at the level 0.05 = 2.145

Table 6: Rate of change of post-measurement rather than pre-measurement for research sample members in strength and accuracy of shooting with high-jump

Single Group n = 15				
Variables	Measurement Unit	Before	After	Rate of change %
Strength of shooting with high-jump	Meter	22.50	25.91	15.16%
Accuracy of shooting with high-jump	Degree	2.62	4.88	86.25%

Table 4 showed that there was a rate of change of post-measurement rather than pre-measurement for research sample members in the muscular ability of the arms and legs ranging from 21.95% to 25.40%.

Table 5 showed that there were statistically significant differences at 0.05 between both pre and post-measurements for members of the research sample in strength and accuracy of shooting with high-jump in favor of post-measurement.

Table 6 showed that there was a rate of change of post-measurement rather than pre-measurement for members of basic research sample in the strength and accuracy of shooting with high-jump ranging between 15.16%- 86.25%.

The first hypothesis of the study was that there would be statistical significant differences in both pre and post-measurements of the members of the research sample in the muscular ability of the arms and legs in

favor of the post-measurement. The researcher attributed the improvement in the muscular ability of the arms and legs for members of the research sample (Table 3) to the effectiveness of ballistic training, which included a group of weighting exercises for arms and legs to establish the muscular strength (first stage of proposed training program). In the second stage, ballistic training was carried out taking into account the rationing of training loads in order to suit the nature of the research sample (junior handball less 18 years) and to proceed exercises from easy to difficult, which had a positive effect on muscular ability of the arms and legs. This finding corresponds with previous studies on the effectiveness of ballistic training in the development of muscular ability of the arms and legs of the players of team and individual sports [5, 8-11]. In this regard, Fleck and Kraemer [17] referred that it could be benefited from ballistic training because one of its principles was to be free from loads.

This forced the muscular fibers to speed of contraction to produce the maximum strength in minimum possible time and this greatly affects on maximum muscular ability of the arms and legs of athletes.

Furthermore, there was improvement in the muscular ability of the arms and legs ranging from 21.95% to 25.40% (Table 4). This result corresponds with what indicated by Dintiman *et al.* [3] that ballistic training was one of the best types of exercises to develop muscular ability of the athletes. Most of the exercises were explosively performed where it was converted from shorten contraction to lengthen contraction in the least possible time. Thus, the first hypothesis was supported.

The second hypothesis was that there would be statistically significant differences in both pre and post-measurements of the members of the research sample in the strength and accuracy of high-jump shooting in favor of the post-measurement. The improvement in strength and accuracy of shooting with high-jump for post-measurement (Table 5) and the high difference of rate in both variables (Table 6) was attributed to the effectiveness of proposed ballistic training which was used with the members of basic research sample. This positively affected the muscular ability of arms and legs positively reflected on the strength and accuracy of shooting with high-jump upon handball junior players less than 18 year. This result corresponds with what indicated by Stone [6] that ballistic training had an influential effect on developing the muscular ability of arms, which in turn affected the improvement of throwing ability (strength of shooting) and the ability of jumping in the two vertical and horizontal axes that also affected the accuracy of the direction of the movement. This result also corresponds with the results of previous studies [9-11] on the effectiveness of Ballistic training in improving the ability performance of team and individual sports.

It is necessary to concern about developing and advancing the sets of working muscles in performing various motor skills in order to perform the skill effectively and with latest effort through the preparation period for athletes [18-20]. The perfect method to enhance the muscular ability was to have similarity in the motor and temporal path during training with the motor and temporal path during the performance of the same skill [1]. Thus, the second hypothesis was supported.

CONCLUSION

The proposed ballistic training program has a positive effect on the muscular ability of arms and legs upon juniors of handball players less than 18 years.

Moreover, using ballistic training leads to improving the strength and accuracy of shooting with high-jump upon juniors of handball players less than 18 years.

Recommendations:

- Using the ballistic training program to develop the muscular ability of arms and legs due to its influential effect on the accuracy and strength of shooting with high-jump upon junior handball players less than 18 years.
- Development of muscular ability during the period of physical preparation by using ballistic training should be considered due to its influential effect on the accuracy and strength of shooting with high-jump upon junior handball players.
- Sports equipment and facilities used in ballistic training should be provided in the sports foundations and authorities to serve the training process of handball players.

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