

## **The effect of a plyometric training strategy on the explosive ability and digital level of junior discus throwers**

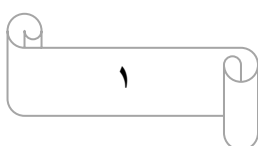
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### **Introduction:**

The discus throwing competition is one of the difficult competitions that depends on the athletes' physical abilities and characteristics and is affected by many mechanical variables such as (speed, strength, etc). This competition is also characterized by rapid performance. The total movements in which it is performed are synchronized and integrated. All these stages require the trainer to be precise in choosing the exercises related to the quality of performance (JPG, Review of Relevant musculars Chapter<sup>٨:٣٤</sup>).

Discus throwers are characterized by neuromuscular control of movement, represented by coordination, speed, strength, the strength of the athlete lower and upper limbs, flexibility, and agility. The discus competition is characterized by what is characteristic of all throwing competitions in athletics. The throwing distance depends on the flexibility and accuracy of the coordination in the performance of the movement between the movements of the legs and the throwing arm, and the distance of the throwing lengthens when the discus comes out at the appropriate speed and angle (Ahmed, ١٩٩٧:٩٥).



Muscular power is a compound characteristic of the elements of strength and speed, and it is characterized by a mutual interrelationship of varying levels of strength and speed characteristics in line with the nature of skillful performance in the exercised activity so that it includes the effectiveness of this sports performance under the conditions of the competition (Abdul Fattah, ١٩٩٤: ١٨).

Consider the term explosive force, ability, and strength characterized by speed and rapid force, all of which means one component and it is the motor component that results from the link between muscle strength and maximum speed to produce a harmonic movement pattern (Allawi and Radwan, ٢٠٠١: ٦٤).

The scientific development of sports training methods aims to achieve and develop the highest possible level in the specialized sports activity. Plyometric training is a method for developing explosive strength, where plyometric exercises consist of an eccentric contraction followed by a shortening contraction, and as a result of the sudden relaxation that occurs results in a significant increase in strength constriction; Also, plyometric exercises help to increase the link between strength and speed training, and it is considered a special method for developing muscular ability, in addition to developing and improving the relationship between maximum strength and muscular ability.

Explained the importance of plyometric training as the best method for developing explosive power because of its impact on excitation of additional motor units, which results in a very strong and rapid muscle contraction, as this method contributes to overcoming the problems that correspond to the development of the explosive capacity to the relationship

between strength and speed (Jalal, ٢٠٠٤: ٥). mentioned that weight training helps stimulate the nervous system and make it work at full capacity, causing stimulation of fast fibres involved in performance when followed by the implementation of plyometric exercises and thus obtaining the greatest possible strength (Giechaskiel ٢٠١٧: ٣٥).

Also, the main objective of the throwing competitions is to achieve maximum throwing distance without violating the rules of the competitions. The kinetic requirements of throwing the discus are summed up in reaching high power levels during the phase of discus disposal due to the speed and force resulting from the throwing. The diversity of physical exercises and their different effects, and the athletes' need for physical preparation are commensurate with their capabilities and abilities according to the type of sport and its requirements.

Since the explosive force is one of the basic manifestations of muscular strength, which plays an effective role in preparing the athlete for the discus throwing competition and other events, the researcher's attention was drawn through his field experiences that there is a problem that manifests in how to choose effective plyometric exercises in achieving the goal of developing explosive power with the least time and effort. So the main aim of the present study is to identify the effect of improving explosive power by a plyometric training program on physical abilities and digital level of junior athletes

Study objective:

This study aims to design a strategy using plyometric training and studying its effect on developing the explosive power and digital level of junior discus throwers

### Study procedures:

- The study conducted during the period from ٠٥ June ٢٠٢١ to ٣٠ July ٢٠٢١.

### Research sample:

- (١٢) Junior discus-throwing (from Qena athletics area) under ٢٠ years, divided into two groups (٦) experimental, and (٦) control. The following tables illustrate sample characteristics.

**Table ١. descriptive statistics of Basic variables for research sample.**

(n=١٢)

No .	Variable s	Averag e	SD	Skewness , coefficient	Kurtosis coefficient s	Kolmogorov– Smirnov test	
						Statistic al power	signa l level
١	Age (years)	١٨.١٣	١.٣ ٠	-٠.٠٥	-٠.٦٠	٠.٢٠	٠.٠٧
٢	Height (cm)	١٧٢.٧٧	٥.٢ ٨	-٠.٢٢	-١.٥٥	٠.١٧	٠.١١
٣	weight (Kg)	٦٨.٨٦	٥.٧ ٩	-٠.٠٢	-١.٣٥	٠.٢٠	٠.١٠

Table (١) results reveal skewness coefficients ranged between (-٠.٠٢, - ٠.٢٢), and thus they lie between +٣ which indicates the moderation of the sample distribution and that it is homogeneous in the basic variables.

**Table ٢. Equivalence between the two research groups.**

The researchers made the appropriate experimental control with the nature of the research by dividing the research sample into the

experimental group (٦) and the control group (٦) and making parity between the two groups in the tribal measurement.

Table ( ٢) The significance of the differences for the pre-measurement in the measurements physical (n = ١٢)

No.	Variables	Unit	Experimental group (n=٦)		Control group (n=٦)		T value
			Mean	SD	Mean	SD	
١	٣٠m sprint from flying start	Sec	٣.٩١	٠.٣١	٣.٨٣	٠.٢٤	٠.٥٠٩
٢	٥٠m sprint from a standing start	Sec	٦.٧١	٠.١٠	٦.٦٧	٠.١٠	٠.٧١٤
٣	Static strength of leg muscles	Kg	٤٤.٠٠	٢.٧٦	٤٤.١٧	٢.٩٣	٠.١٠٢
٤	Maximum Strength	Kg	٨٨.٣٣	٩.٣١	٩٠.٠٠	٧.٠٧	٠.٣٤٩
٥	Vertical jump	Cm	٣٧.٨٠	٢.٥٦	٤١.٣٣	٢.٥٠	٠.٣٤٢
٦	Standing long jump	Cm	٢٠٠.٠٠	٣.٤١	١٩٩.٦٧	٦.١٥	٠.١١٦
٧	٣ kg Medicine Ball forward throw	M	٨.٨٧	٠.٧٣	٨.٨٣	٠.٤٩	٠.١٣٩
٨	Record level	M	٢٩.٧٧	١.٥٣	٣٠.١٧	١.٤٧	٠.٤١٦

"T" significance at ٠.٠٥ level = ٢.٢٨\*\*at ٠.٠١=٣.١٩٦

It is clear from Table (٢) there are no significant differences between the experimental and control group in the variables under study, which indicates the parity between the two research groups of players.

### Training program

The training program for both groups lasted for ٨ weeks during the period from ٥/٦/٢٠٢١ to ٣٠/٧/٢٠٢١ , ٤ units per week and the duration of each unit around ٧٠ min. It includes a set of general and special warm-up exercises for the discus and specific discus technical drills ,for the experimental

group the plyometric training program consists of a set of plyometric exercises for the discus, and cooling-down exercises after the implementation of the training unit. And the training program load was applied using ٢ : ١ method

### Results and discussion

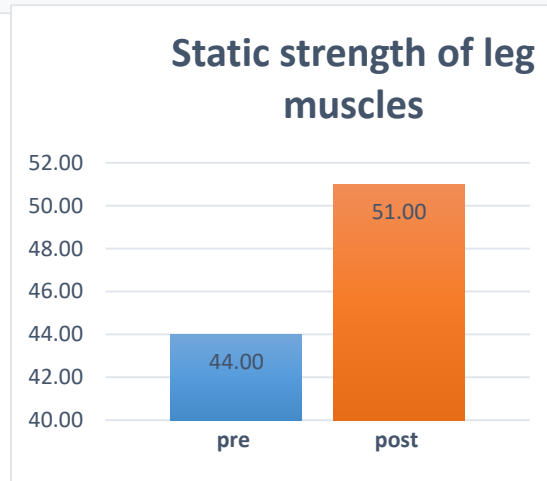
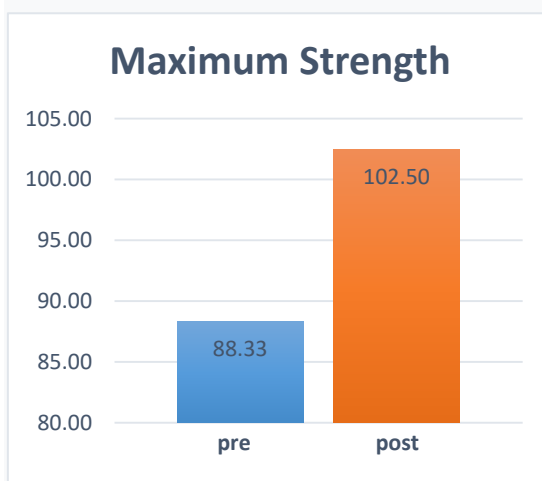
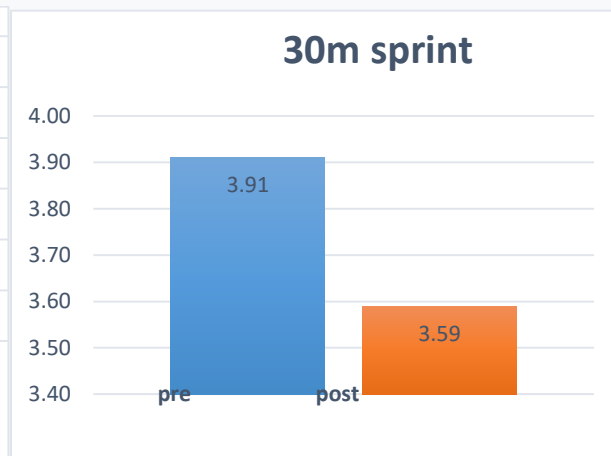
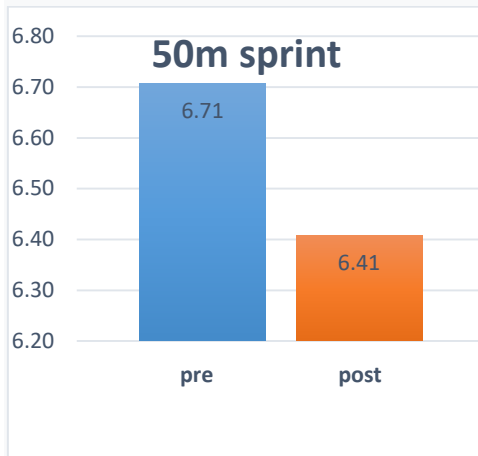
The researchers presented the results that were reached after applying the program to the experimental research sample, and we will discuss the results in the light of scientific references and related studies and the researcher's opinion in order to achieve the objectives and hypotheses of the research, through the following tables as follows

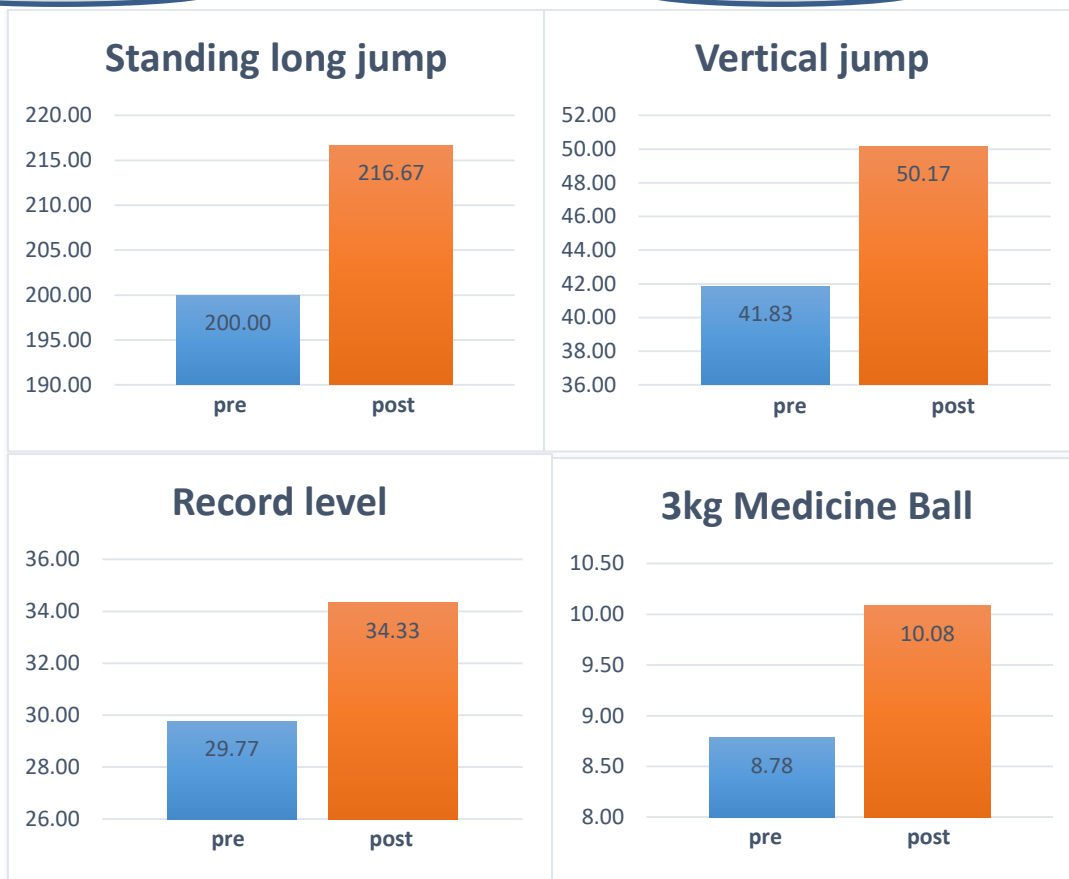
**Table ٣. Table (٣) The significance of the differences between the pre and post measurements for the experimental group in the measurements (n = ٦)**

No	Variables	Unit	Pre measurements (n=٦)		Post measurements (n=٦)		Difference		Improvement %	T value
			Mean	SD	Mean	SD	Mean	SD		
١	٣٠ m sprint from flying start	Sec	٣.٩١	٠.٣١	٣.٥٩	٠.١٩	٠.٣٢	٠.١٨	٨.٢٢	٤.٢٧**
٢	٥٠ m sprint from a standing start	Sec	٦.٧١	٠.١١	٦.٤١	٠.٢١	٠.٣٠	٠.٩٠	٤.٤٥	٨.١٢**
٣	Static strength of leg muscles	Kg	٤٤.٠٠	٢.٧٦	٥١.٠٠	٢.٣٧	٧.٠٠	١.٤١	١٥.٩١	١٢.١٢**
٤	Maximum Strength	Kg	٨٨.٣٣	٩.٣١	١٠٢.٥٠	٦.٨٩	١٤.١٧	٣.٧٦	١٦.٠٤	٩.٢٢**
٥	Vertical jump	Cm	٤١.٨٣	٢.٥٦	٥٠.١٧	٣.١٣	٨.٣٣	١.٨٦	١٩.٩٢	١٠.٩٢**
٦	Standing long jump	Cm	٢٠.٠٠	٣.٤١	٢١٦.٦٧	٣.٧٨	١٦.٦٧	٥.٢٨	٨.٣٣	٧.٧٣**
٧	٣ kg Medicine Ball forward throw	Kg	٨.٧٨	٠.٧٣	١٠.٠٨	٠.٨٩	١.٣٠	٠.٣٤	١٤.٨٠	٩.٤٧**
٨	Record level	M	٢٩.٧٧	١.٥٣	٣٤.٣٣	٢.١٦	٤.٥٧	١.٤١	١٥.٣٤	٧.٩٢**

Tabular "T" significance at the ٠.٠٥ level = ٢.٥٧١, \*\* at the ٠.٠١ level = ٤.٠٣٢

It is clear from the table (٣) and figure (١) that there are significant differences in the calculated "t" value between the pre- and post-measurement of the experimental group in the measurements, where the percentage of improvement ranged between (٤.٤٥% and ١٩.٩٢%) in favor of the dimensional measurement of the research sample





The shape ( ) The arithmetic mean between the pre and post measurement for the experimental group

**Table ٤. The significance of the differences between the pre and post measurements for the control group (n = ٦)**

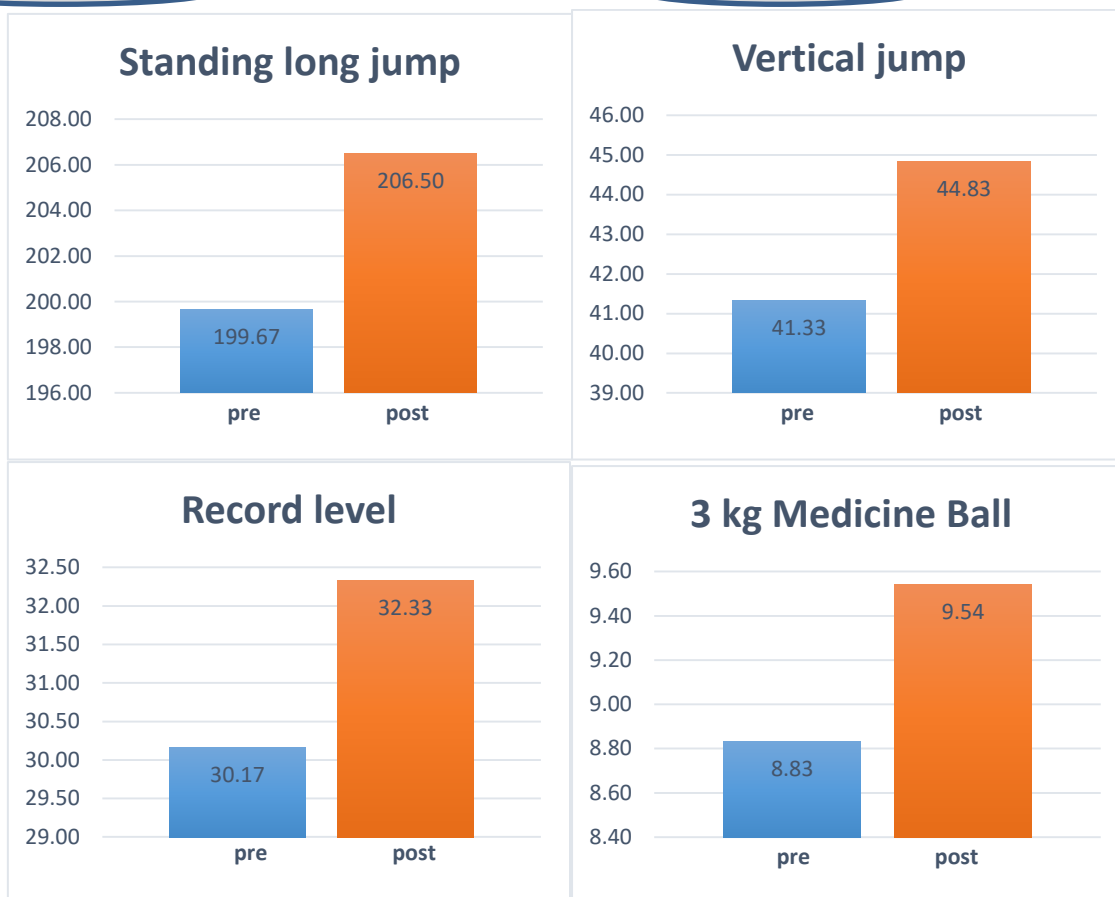
N o	Variables	Unit	Pre measurements (n=٦)		Post measurements (n=٦)		Difference		Improvement %	T value
			Mean	SD	Mean	SD	Mean	SD		
١	٣٠m sprint from flying start	Sec	٣.٨٣	٠.٢٤	٣.٧٥	٠.٢٢	-٠.٠٨	٠.٠٢	٢.٠٥	*٧.٧٣*
٢	٥٠m sprint from a standing start	Sec	٦.٦٧	٠.١٠	٦.٥٩	٠.١٠	-٠.٠٨	٠.٠٣	١.٢٠	*٦.٠٨*
٣	Static strength of leg muscles	Kg	٤٤.١٧	٢.٩٣	٤٦.٦٧	٢.٩٤	٢.٥٠	١.٦٤	٥.٦٦	*٣.٧٣*
٤	Maximum Strength	Kg	٩٠.٠٠	٧.٠٧	١٠٠.٠٠	٧.٠٧	١٠.٠٠	٣.١٦	١١.١١	*٧.٧٥*
٥	Vertical jump	Cm	٤١.٣٣	٢.٠٥	٤٤.٨٣	١.٩٤	٣.٥٠	٢.٠٧	٨.٤٧	*٤.١٣*
٦	Standing long jump	Cm	١٩٩.٧٦	٦.١٥	٢٠٦.٥٠	٤.٧٩	٦.٨٣	٢.١٤	٣.٤٢	*٧.٨٣*
٧	٣ kg Medicine Ball forward throw	Kg	٨.٨٣	٠.٤٩	٩.٥٤	٠.٦٩	٠.٧١	٠.٢٦	٨.٠٢	*٦.٧٣*
٨	Record level	M	٣٠.١٧	١.٤٧	٣٢.٣٣	١.٥١	٢.١٧	١.٤٧	٧.١٨	*٣.٦١*



Tabular "T" significance at the 0.05 level = 2.571, \*\* at the 0.01 level = 4.032

It is evident from the table ( ٤ ) that there are significant differences in the calculated "t" value between the pre- and post-measurement of the control group in physical measurements, where the percentage of improvement ranged between (١.٢٠%, ١١.١١%) in favor of the post-measurement of the research sample.





The shap( ٧) The arithmetic mean between the pre and post measurements of the control group in the measurements

Table (٤) shap ( ٧) results reveal statistically significant differences between pre and post measurement for the experimental group in all physical variables in favor of the post measurement, as the T value and the percentage of improvement The researchers attributed the progress in the level of the physical abilities and the digital level of the competitors to the impact of the proposed training program using plyometric exercises, which depends on the foundations and principles of upgrading the level of physical abilities of the experimental group. Also, these differences indicate that plyometric exercises have an important impact on the development of the physical abilities of the discus throwers, represented in increasing the speed and increasing the jump distance in the horizontal displacement to measure the force characteristic of speed, as well as increasing the ability to force and force characterized by speed (pushing the medical ball), and these results are due to the positive effect of the plyometric training program for the experimental group. Plyometrics are of

great importance in improving physical abilities (Jalal, ٢٠٠٤; Al Hadidi, ٢٠١٣, and Abdel Moneim, ٢٠١١). Moreover, Saad(٢٠١٣) indicated that weight training leads to the development of the elements of physical fitness for the experimental group in the pre and post measurements in all research variables for the junior discus throwing competition.

**Table ( ٥) Significance of differences in the post measurement between the experimental and control group in the research**

measurements (n = ١٢)

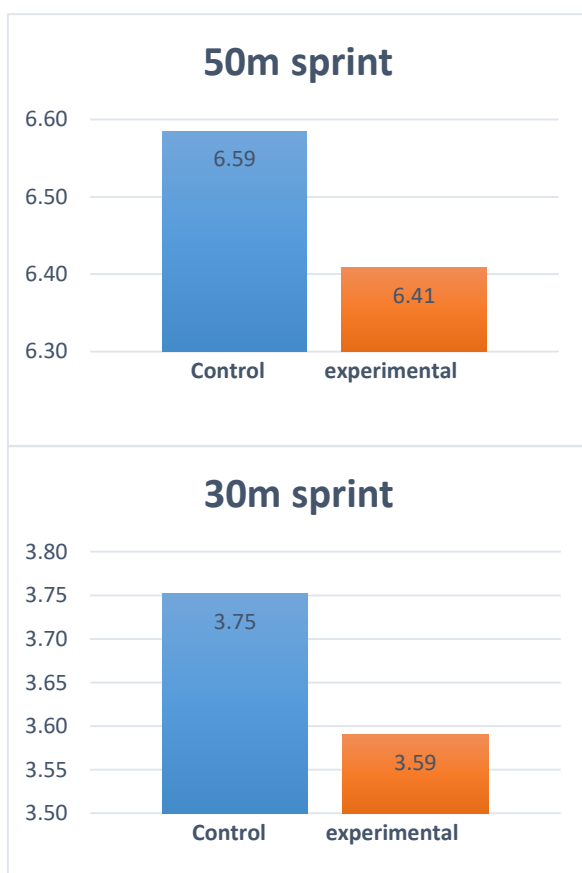
No	Variables	Unit	experimental group (n=٦)		Control group (n=٦)		the difference between n average	Difference %	T value
			Mean	SD	Mean	SD			
١	٣٠m sprint from flying start	Sec	٣.٥٩	٠.١٩	٣.٧٥	٠.٢٢	-٠.١٦	٤.٣١	١.٣٥
٢	٥٠m sprint from a standing start	Sec	٦.٤١	٠.٠٢	٦.٥٩	٠.١٠	-٠.١٨	٢.٦٨	**٤.٢٣
٣	Static strength of leg muscles	Kg	٥١.٠٠	٢.٣٧	٤٦.٦٧	٢.٩٤	٤.٣٣	٩.٢٩	*٢.٨١
٤	Maximum Strength	Kg	١٠٢.٥٠	٦.٨٩	١٠٠.٠٠	٧.٠٧	٢.٥٠	٢.٥٠	٠.٦٢
٥	Vertical jump	Cm	٥٠.١٧	٣.١٣	٤٤.٨٣	١.٩٤	٥.٣٣	١١.٩٠	**٣.٥٥
٦	Standing long jump	Cm	٢١٦.٦٧	٣.٧٨	٢٠٦.٥٠	٤.٨٩	١٠.١٧	٤.٩٢	**٤.٠٣
٧	٣ kg Medicine Ball forward throw	Kg	١٠.٠٨	٠.٨٩	٩.٥٤	٠.٦٩	٠.٥٤	٥.٦٨	١.١٨
٨	Record level	M	٣٤.٣٣	٢.١٦	٣٢.٣٣	١.٥١	٢.٠٠	٦.١٩	١.٨٦

\* Tabular "T" significance at the level of ٠.٠٥ = ٢.٢٢٨, \*\* at the level of ٠.٠١ = ٣.١٦٩

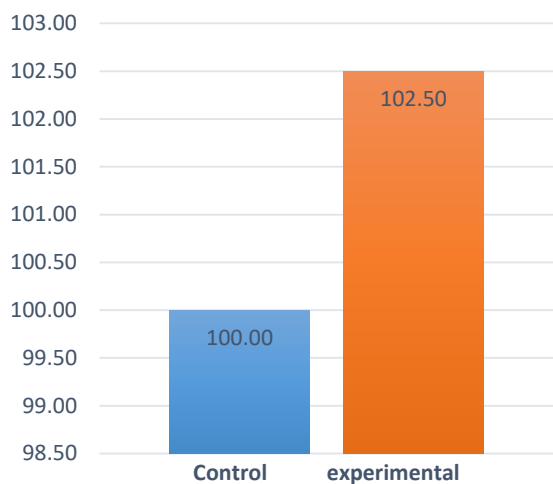
It is clear from Table (٥) and shap (٣) that there are significant differences in the "T" value calculated for the dimensional measurement between the experimental and control group in the measurements, where the percentage difference between (٢.٦٨%, ١١.٩٠%) in favor of the experimental

The researchers return these differences to the combination between the plyometric exercises and the skill exercises of throwing discus which improved performance due to raising the level of the explosive power of the arms and legs .This result agrees with Huwaidi & Muhammad (٢٠١٣) where the strength training programs positively affect the growth rates of

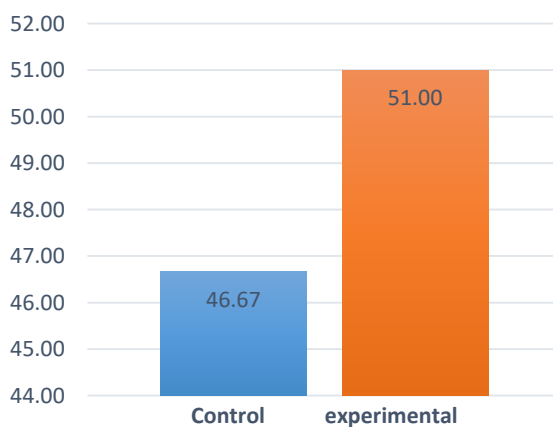
the muscular capacity of the legs and arms of these throwers which confirms that the training program of the present study has a positive effect on the experimental group , The researcher explains the reason for these differences, that plyometric training improved performance due to raising the level of the explosive power of the arms and legs for juniors, which led to increase the physical abilities and the digital level of the competitors. These results are in line with the findings of Gharib (٢٠٠٨), ٨. Abdel Monsef (٢٠١٤), and Awad(٢٠١٢) where the strength training programs positively affect the growth rates of the muscular capacity of the legs and arms of the throwing athletes, which leads to an improvement in the digital level of the research sample..



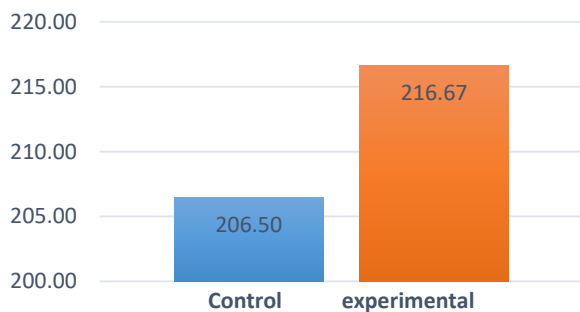
### Maximum Strength



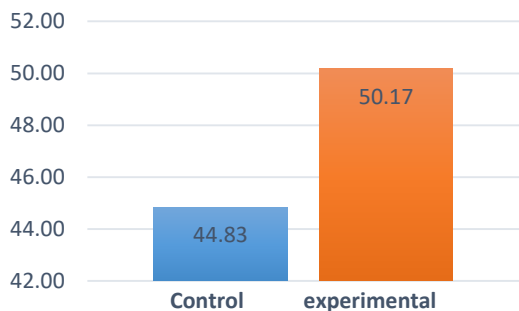
### Static strength of leg muscles



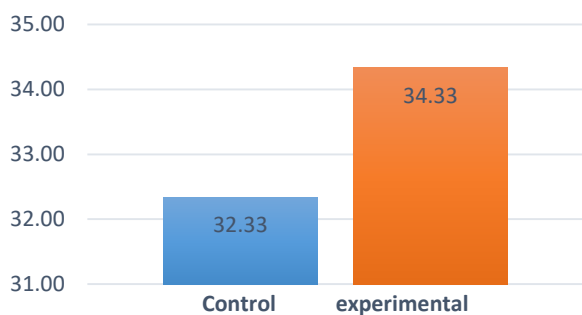
### Standing long jump



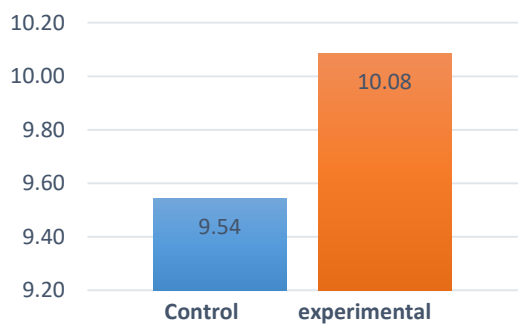
### Vertical jump



### Record level



### 3 kg Medicine Ball



# The shap(٣ ) Arithmetic average of the dimensional measurement between the

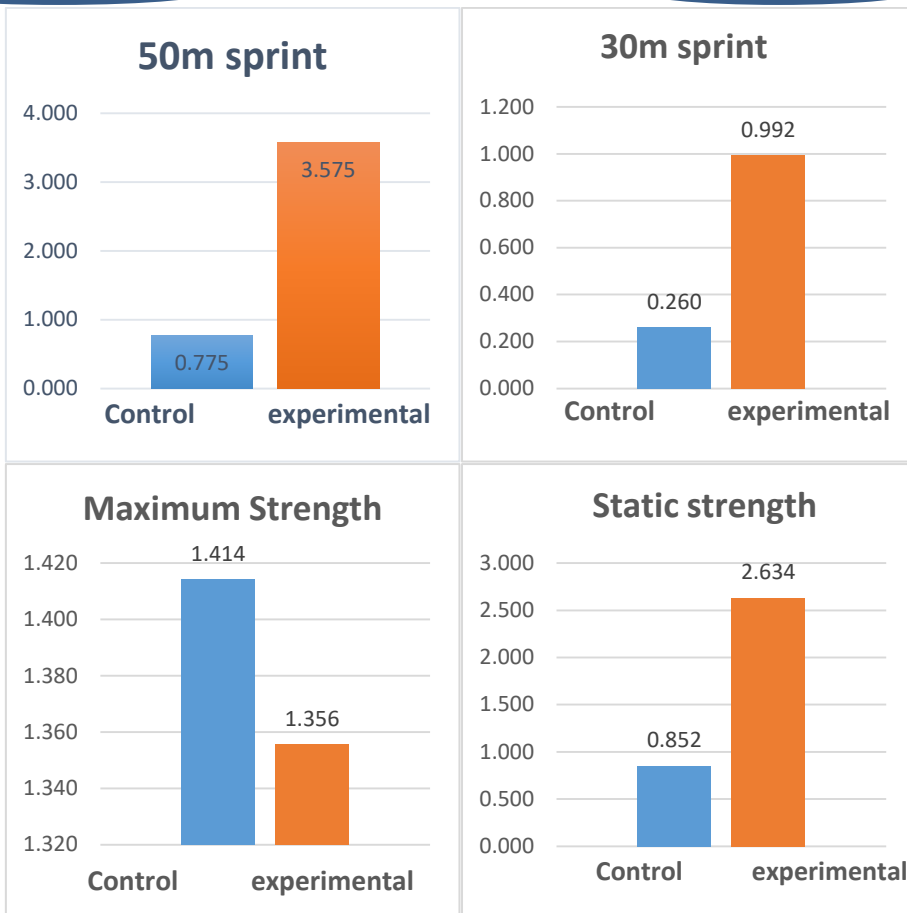
experimental and control group in physical measurements

Table ٥. the significance of the Eta square and the effect size of the  
proposed program in the measurements of the researcher (n = ١٢)

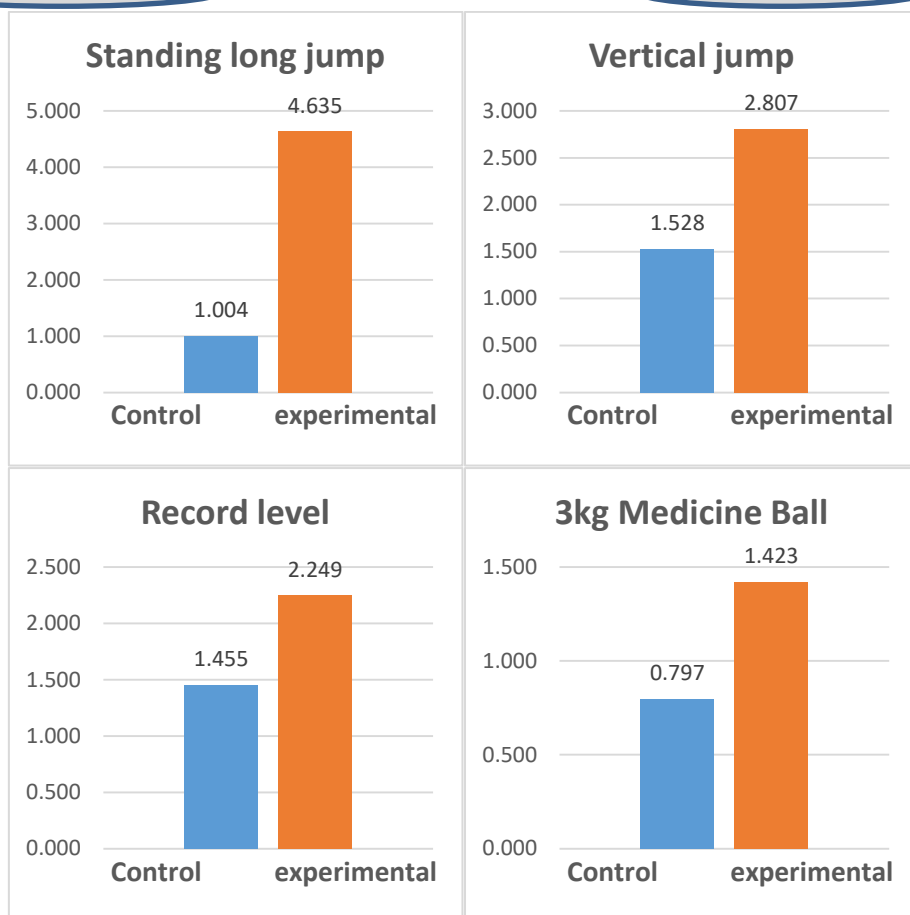
No	Variables	Unit	experimental group (n=٦)			Control group (n=٦)		
			Eta square	Values Effect size	amount Effect size	Eta square	Values Effect size	amount Effect size
١	٣٠m sprint from flying start	Sec	٠.٧٨٥	٠.٩٩٢	high	٠.٩٢٣	٠.٢٦٠	low
٢	٥٠m sprint from a standing start	Sec	٠.٩٣٠	٣.٥٧٥	high	٠.٨٨١	٠.٧٧٥	middle
٣	Static strength of leg muscles	Kg	٠.٦٩٧	٢.٦٣٤	high	٠.٧٣٥	٠.٨٥٢	high
٤	Maximum Strength	Kg	٠.٩٤٤	١.٣٥٦	high	٠.٩٢٣	١.٤١٤	high
٥	Vertical jump	Cm	٠.٩٦٠	٢.٨٠٧	high	٠.٧٧٤	١.٥٢٨	high
٦	Standing long jump	Cm	٠.٩٢٣	٤.٦٣٥	high	٠.٩٢٥	١.٠٠٤	high
٧	٣ kg Medicine Ball forward throw	Kg	٠.٩٤٧	١.٤٢٣	high	٠.٩٠١	٠.٧٩٧	middle
٨	Record level	M	٠.٩٢٦	٢.٢٤٩	high	٠.٧٢٢	١.٤٥٥	high

\* Eta square = less than ٠.٠٩ weak, greater than ٠.١٤ high

\*Effect size = ٠.٢ weak, ٠.٥ medium, ٠.٨ high.







shap (٤) The effect size of the proposed program in the physical and digital measurements

It is clear from the table (٦)shap(٤) that the effect of the program on the measurements of the program for the experimental group was high, as the values of the effect size ranged between (٠.٩٩٢: ٤.٦٣٥), and the values of the ETA squared ranged between (٠.٧٨٥: ٠.٩٩٦٧), which are high values greater than ٠.١٤, while the The control group with an effect amount that ranged between weak, medium and high, and with lower values than the experimental group, which indicates the high and positive impact of the proposed program on physical and skill measurements for the players

The researcher explains the reason for these differences, that plyometric training improved performance due to raising the level of the explosive power of the arms and legs for juniors, which led to increase the physical abilities .digital level of the competitors. These results are in line with the findings of Gharib (٢٠٠٨), ٨. Abdel Monsef (٢٠١٤), and Awad(٢٠١٢) where the strength training programs positively affect the growth rates of the muscular capacity of the legs and arms of the throwing athletes, which leads to an improvement in the digital level of the research sample..

### Conclusions

Considering the objectives of the research and within the limits of the research sample and based on what was stated in the results of the statistical analysis, our results showed the followings:

- Plyometric exercises positively affect explosive power development in the junior discus throwers
- Plyometric exercises positively affect the development of the level of digital achievement among the junior discus throwers

### Recommendations:

- Using the plyometric training strategy in the different age groups in the field of training, considering their abilities and the individual differences between them.
- Using plyometric exercises to improve the digital level of discus throwing and other throwing competitions.
- Considering the selection of the appropriate plyometric training strategy in the specialized performance like the nature of performance in the competition.
- Paying attention to safety factors while performing the exercises and providing the appropriate conditions to achieve this.
- Attention to the development of physical fitness components in general by coaches and focus on developing explosive power, particularly for discus throwers.
- Re-conducting such a study with different samples in terms of age, gender, and type of sports activity practiced and other variables that the researcher did not address to reveal the remaining contribution values.

### References

١. Abdel Moneim, A. (٢٠١١). The effect of plyometric exercises on the sprint's step and the digital level of relay juniors, MSc Thesis, Faculty of Physical Education in Damietta, Mansoura University. (In Arabic)
٢. Abdel Monsef, R.A. (٢٠١٤). The effect of two complex training methods on explosive power and some kinematic variables for the triple jump competition, Faculty of Physical Education for Boys. The Scientific Journal of Sports Science Applications, Alexandria University. (In Arabic).
٣. Abdul Fattah, A. (١٩٩٤). Sports and training physiology, ١<sup>st</sup> edition. Cairo: Arab Thought House. (In Arabic)
٤. Ahmed, B. (١٩٩٧). Track and field races. Cairo: Arab Thought House. (In Arabic).
٥. Al-Hadi, A. (٢٠١٩). The effect of using weights training on the muscular strength of livestock jerry skill in karate. MSc Thesis, Faculty of Physical Education, Benha University. (In Arabic)
٦. Al-Hadidi, R.O. (٢٠١٣). The effect of self-training exercises with weights and body weight on the development of some elements of physical fitness and the skill of throwing discus among students of the Faculty of Physical Education, Zagazig University. Journal of Sports Science and Arts, Volume (٤٢), Faculty of Physical Education for Girls, Helwan University. (In Arabic).

٧. Allawi, M.H., Radwan, M.N. (٢٠٠١): Motor performance tests. Cairo: Arab Thought House. (In Arabic)
٨. Awad, A.A. (٢٠١٢). The effect of ballistic training on the maximal muscular capacity and some mechanical properties of the throwing arm in discus throwing. Journal of Sports Science and Arts, Faculty of Physical Education for Girls, Helwan University.
٩. JPG, Review of Relevant musculars  
Chapter<sup>٨</sup>[www.phys.WashingtonEdu/user/jeff/Courses/Ken\\_yongwebs/٢٠٨A/images/anatomy](http://www.phys.WashingtonEdu/user/jeff/Courses/Ken_yongwebs/٢٠٨A/images/anatomy) (accessed on ٣ Jan ٢٠٢٢)
١٠. Gharib, I.F. (٢٠٠٨). A proposed strategy for mixed training and its impact on the explosive ability and the digital level of the high jump competition by arching method. Ph.D. Thesis, Faculty of Physical Education for Boys, Alexandria University. (In Arabic).
١١. Giechaskiel, B. (٢٠١٧). A Guide to Weight Training: Designing Programs and Setting Goals Based on Scientific Literature.
١٢. Huwaidi, H.H., Muhammad, J.M. (٢٠١٣). The percentage of the contribution of some biomechanical variables to achievement in the effectiveness of discus throwing. Al-Qadisiyah Journal of Physical Education Sciences, Vol. ١٣, no.٣.
١٣. Jalal, M.M. (٢٠٠٤). The effect of plyometric training on developing strength with speed and its relationship to the effectiveness of some of the most common offensive skills among karate players, stage (١١-١٣). MSc. Thesis, Faculty of Physical Education for Boys in Alexandria, Alexandria University. (In Arabic).
١٤. Makmakh, T. (٢٠١٨). The effect of weight training and plyometric training on developing muscular ability and the level of performance of the crushing skill of volleyball juniors in the State of Kuwait. MSc Thesis, Faculty of Physical Education, South Valley University. (In Arabic)
١٥. Mohamed, O. (٢٠٠٢). The effect of weight training using the distributed and intense methods on the development of the explosive power of the lower limb and its relationship to the digital achievement of the triple jump, MSc Thesis, Faculty of Physical Education for Boys, Zagazig University. (In Arabic)
١٦. Saad, M.A. (٢٠١٣). A complex training program (weights - plyometric) for the development of some physical variables and its impact on improving the digital level of the ١٠٠m sprint. MSc. Thesis, Faculty of Physical Education in Qena, South Valley University. (In Arabic).

## Abstract

### **The effect of a plyometric training strategy on the explosive ability and digital level of junior discus throwers**

This study aims to determine the effect of improving explosive power of the sample under study for the discus throwing competition and developing the digital level of the sample under study for the discus throwing competition by devising a framework employing plyometric training. The researchers employed an experimental approach with two sets of ١٠ athletes (٥ experimental and ٥ control) under the age of ٢٠ years old from the Qena athletics area. Our results revealed that plyometric training improved performance of the experimental sample due to raising the level of the explosive power of the arms and legs for juniors, which led to raising the digital level of the competitors.

### **Keywords**

digital level; discus-throwing competition; plyometric training