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Effects of Plyometric Exercises with Repetition Training Method on Vertical Jump Performance and Soccer-Heading Skills

An Experimental Study Conducted on Junior Players, U-17 Khemis M.C. Soccer Team

تأثير التمرينات البليومترية بالطريقة التكرارية في تطوير الارتقاء العمودي وأداء مهارة ضرب الكرة بالرأس.

بحث تجريبي أجري على لاعبي كرة القدم صنف الاشبال لفريق مولودية الخميس U17

Zemam Abderrahman [1]

[1], University Of Djilali Bounaama, Khemis-Miliana- Algeria , A.Zemam@Univ-Dbkm.Dz

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Abstract : This study aims to find out " Effects of Plyometric Exercises with Repetition Training Method on Vertical Jump Performance and Soccer-Heading Skills". An Experimental Study Conducted on Junior Players, U-17 Khemis M.C. Soccer Team. To achieve this, the sample includes (18) soccer junior players from Khemis M.C. Soccer Team, the players were divided into equated groups ; (09) as a control group and (09) as a experimental group.The experimental group got the suggested plyometric training program whill the control the usual one. pre and post study tests were applied for (09) weeks. all the junior players of the two groups had tests including the vertical jump and Long Distance Ball Heading Test .The (spss) program was used for analyzing data after collecting them.The study indicates that there are statistically significance difference between pre and post measurements for the benefit of the latter related to the experimental group and particularly in all study variables.The researcher has recommendad applying plyometric exercices with repetition training in training process.

keywords: plyometric, repetition training, vertical jump, Soccer-Heading Skills

Corresponding author: Zemam Abderrahman, e-mail: A.Zemam@Univ-Dbkm.Dz

الملخص : هدفت هذه الدراسة الى التعرف على تأثير التمرينات البليومترية بالطريقة التكرارية في تطوير الارتقاء العمودي وأداء مهارة ضرب الكرة بالرأس لدى لاعبي فريق مولودية خميس مليانة صنف الأشبال، ولتحقيق ذلك تكونت العينة من 18 لاعب تم تقسيمهم الى مجموعتين متكافئتين (9) لاعبين كمجموعة ضابطة و (9) لاعبين كمجموعة تجريبية، خضعت المجموعة التجريبية الى البرنامج التدريبي باستخدام تمارين البليومتري بالطريقة التكرارية، بينما المجموعة الضابطة خضعت للبرنامج الاعتيادي، تم تطبيق اختبارات بدنية قبلية ثم تم تطبيق البرنامج التدريبي المقترح المتضمن تمارين بليومترية بطريقة التدريب التكراري لمدة 9 اسابيع وبمعدل حصتين اسبوعيا، ثم قام الباحث بتطبيق القياسات البعدية لقياس تطور الارتقاء العمودي ومهارة ضرب الكرة بالرأس.

وبعد عملية جمع البيانات ومعالجتها احصائيا باستعمال برنامج التحليل الاحصائي SPSS، توصل الباحث إلى أن البرنامج المقترح كان له الأثر المعنوي في تطوير الارتقاء العمودي ومهارة ضرب الكرة بالرأس لدى العينة التجريبية حيث كانت هناك فروق دالة إحصائيا بين الاختبارات القبلية والبعدية ولصالح الإختبار البعدي للعينة التجريبية.

الكلمات الدالة: التمرينات البليومترية- الطريقة التكرارية- الارتقاء العمودي- ضرب الكرة بالرأس.

1. INTRODUCTION TO THE STUDY

1.1. Introduction and problem statement :

The nature of performance in team sports requires physical preparation of players. These trainings provide them with the basic fundamental skills of the game. To optimize the physical preparation of players, the trainers work on different programmes that consist of various components of physical fitness, such as strength, endurance, speed, agility, flexibility and body composition and other components. The specific physical attributes are a prerequisite for each team sport, but vary from game to another, depending on the nature of performance and requirements. The latter is required for adequately trained practitioners so that they can progress in training and reach high levels of all athletic sports (Emad Eddin Abbas Abu Zeid, 2004, p 159). Another important

physical variable affecting other physical qualities and skillful performance is muscle strength, which is considered the most important physical activity related to football since , along with speed and endurance, it is the backbone of this game. McCaughey and Hara have pointed out that muscle strength greatly influences the development of certain physical attributes such as speed, endurance, agility , etc (Mohamed Hassan Allawi and Abu Ela Ahmed Abdel Fattah, 1994 , p 119). Muscle strength involves two factors called strength and speed combined together. It is a kind of force that has begun to take an active role in athletic performance development, in general, and Soccer skillful performance level, in particular. This is clearly has been pointed out by Hassan Allawi and Issam Abdul-Khaliq that the muscle capacity determines the performance level of an athlete in many types of athletics competition in which the level is more related to vertical jump or vertical leap velocity (Mohamed Jaber Abdel Hamid Yunus and Issam Abdel Khaliq, 1992, p 144). A vertical jump or vertical leap (la détente) is a technical movement that reflects the maximal and explosive muscle strength (power) of the lower limbs of soccer players during the various jumping movements. The improvement and development of this type of strength will help to increase the vertical jump height, which in turn will help the athlete to develop remarkable skills and abilities (Atheer Mohammed Sabri, Iraqi Sports Academy blog). On the importance of vertical leap, Cazorla, G, 2014, says that a good expectation, a good position and a good vertical Jump are sometimes enough to get the World Cup. It's very common now specialist advised to perform plyometric exercises, which have spread over the past several years, for the development of the maximal and explosive muscle strength. In this regard, Khairiya Al-Sukkari and Mohammed Jaber Bureika cited that plyometric training has become one of the most important training methods for athletic sports in the

world. Most of the literature to date on plyometrics has been reported that it is an incredibly effective training method in improving performances by inducing the Anatomy and Physiology of the athletes' organ Systems (Khairiya Al-Sukkari and Mohammed Jaber Bureika, 2009, p 13). In addition, it has been noted that the propose of plyometric training is to enhance speed and horizontal and vertical Leap tones as well as capacity to develop generally physical and technical capabilities (Carrio, 2008, p 10). In this study, we noticed, through the observation and due to the experience of the researcher in the field of physical preparation (as a Federal way Fitness Coach), a weakness in the ability of the team sport under study to leap in both; aerial duels and striking stationary balls (coping with air Balls) compared to the global reference level. These remarks are a confirmation of study conducted by Briksi and Hanifi, which indicated that the vertical jump values for Algerian soccer players are weak, compared to other reference values, because of the focus on both technical and tactical factors at the expense of physical training (Hanifi, R. and Brikci, A., 2004, p 59-63). From this point of view, we started designing a plyometric training programme covering the repetition method for developing the ability of improving vertical jump performance and soccer-heading skills. The discussion may therefore consider the following main question: to what extent do plyometric exercises with repetition affect vertical jump performance and soccer-heading skills?

Following this, the sub-questions were:

1. Does the proposed plyometric training programme covering the repetition method affect the ability of improving vertical jump performance in soccer players?
2. Does the programme affect soccer-heading skills?
3.

1.2. Research hypotheses:

1.2.1. Main hypothesis: the proposed plyometric training programme covering the repetition method affects the ability of improving vertical jump performance and soccer-heading skills.

1.2.2. Sub- hypothesis:

1.2.2.1. The proposed plyometric training programme covering the repetition method affects the ability of improving vertical jump performance in soccer players.

1.2.2.2. The programme can positively affect soccer-heading skills.

1.3. Research Importance:

1.3.1. Determining the effect of plyometric exercises covering the repetition method on increasing vertical jump performance in soccer players.

1.3.2. Identifying the impact of the proposed programme on improving soccer-heading skills.

1.4. Research Terms and Definitions:

1.4.1. **Plyometric exercises**: are a form of intense training exercises that contribute to the improvement of physical-fitness qualities; including muscular strength, which is the most important performance characteristic with regard to fitness. Plyometrics is one of the progressive and effective training methods that is used to increase the maximal and explosive muscle strength (power) of the lower limbs (Abul-Ela Ahmed Abdel-Fattah and Ahmed Nasr El-Din, 1993, p 22).

1.4.2. **Repetition Training**: is one of the basic training methods or ways through which an exercise is performed sequentially with a higher load capacity for the purpose of enabling the individual to reach his /or her

maximum potential with a rest interval that allows the muscle to recover (Essam Abdel Khaliq, 1999, p 187).

1.4.3. **Muscular strength**: is the ability of the muscle to exert a maximal force in the shortest time, as represented by the following equation : Muscular strength = power × speed (Mohamed Hassan Allawi, 1990 , p 112, quoted from Larson & Yokom).

1.4.4. **Vertical Jump/or Vertical Leap**: it is the ability of neuromuscular system to overcome resistance with the greatest possible muscle contraction velocity (Badin JC,1991). It is also defined as the athlete's ability to raise his/or her center of mass to the highest possible point in vertical direction by the use of the greatest possible muscle contraction velocity of lower limbs along with the best possible kinetic art.

1.5. Similar and related studies:

1.5.1. Mohamed Abdel-Aal and Sayed Shehata (2000): study entitled "Effect of Weight lifting and Plyometrics and Weight-lifting Plus Plyometric combination Training on the Dynamic Development of Muscular Strength and Digital Record Level in Long Jump Distance". The study aimed at designing three programmes: a Weight lifting (WL), a plyometric (PL), and combined weight lifting+plyometric (WP) training programmes. The sample consisted of 100 students and divided equally into four (04) groups; three experimental groups (PL group, WL group, and WP group) and one control (C) group. The four groups trained 3d-wk, for 12 weeks. The results showed that the first three groups' programmes have a positive impact on muscular strength and digital record level in the athletes' long jump. The combined weight-lifting+plyometric (WP) training programme, however, is superior to both PL and WL programmes.

Besides, the study revealed that the PL training is more effective than the WL training programme.

1.5.2. SPURS R.W. et al. (2003): "The Effect of Plyometric Training on Distance Running Performance". In this study, seventeen male runners were pre- and post-tested. Subjects were randomly split into an experimental (E) group, which completed 6 weeks of plyometric training in conjunction with their normal running training, and a control (C) group, which trained as normal. The results showed that, during the proposed plyometric training, the E group significantly improved 3-km performance compared to the C group.

1.5.3. Mohammad Kazem and Hasna Satar (2004): study entitled "The influence of two different repetition training methods on the development of explosive strength in volleyball players". The study aimed at identifying the influence of two different repetition-training methods on increasing the explosive muscle strength (power) of limbs and arms. The sample included 30 secondary school students (2003-2004 academic year) who were divided into two experimental groups. The results uncover that there are significant differences between pre- and -post test results. Also, there are significant differences between pre- and -post test results in the two experimental groups for the first experimental group (Plyometric Training).

1.5.4. Mahmoud Hamdi and Imad Al-Sarsi (2005): study entitled "Impact of Plyometrics and Weight Lifting and Plyometric and Weight-Lifting Combination Training on The Development of Muscular Strength, Physical abilities and Skilful Performance in Junior Karate Athletes". The study aimed at designing a Weight lifting (WL), a plyometric (PL), and

combined weight lifting+plyometric (WP) training programmes. In the study, an experimental approach was used. A sample was consisted of 30 players. They were deliberately selected from the Menoufia area and divided equally into three (03) groups trained 3d-wk, for 12 weeks. The results revealed that WL, PL, and combined WP training programmes led to the improvement of all the variables under consideration. Addedly, the combined WP training is more effective than both separately used training programmes (PL and WL) which were related to the variables in question.

1.6. Research methodology and procedures:

1.6.1. **Research methodology:** an experimental approach was used to suit the nature of the study by performing the pre-and post-tests.

1.6.2. Study areas:

1.6.2.1. **Sample**: the study sample was selected in a deliberate manner. It was consisted of 25 Junior Players, U-17 from the same Khemis M.C. Soccer Team in Blida regional football league. Both goalkeepers were eliminated and five (05) players were subjected to the survey. The sample final number was 18 players divided into two equal groups; Experimental (E) group and Control (C) group.

1.6.2.2. **Place**: the proposed programme and pre- and post- tests were carried out on the artificial turf at the Mohamed Belkebir stadium, Khemis Miliana municipality.

1.6.2.3. **Time-frame**: the proposed programme and pre- and post- tests were implemented during the period from 06 December 2015 to 01 February 2016.

1.6.3. **Research Society and samples**: The research society consisted of 325 soccer players, U-17 Blida regional football league (2015 – 2016), involving a total of 13 participating clubs (Group-C) representing: Oued Sly-MCO , Oum

Drou-YS, Aïn Merane-YS, El firma-USC, Ouled Ben Abdelkader-YS, El-Khemis-U, Rouina-YS, Bougadir-YS, El Amra-YS, Arib-YS, El Attaf-YS, Ouled Fares-MC, and Khemis- MYSC.

NB: the study was conducted on Junior Players, U-17 Khemis M.C. Soccer Team, who were selected in a deliberate manner as a study sample.

1.6.4. Research Tools and Data Processing:

1.6.4.1. **Technical Processing:** a series of tests were presented to experts in professional training and physical preparation. The tests were as follows:

1.6.4.1.1. Sargent Jump Test :

1.6.4.1.1.1. Description:

1.6.4.1.1.1.1.Tools required: measuring tape or marked wall, a piece of chalk or chalk dust for marking wall, a rag for wiping marks, and a smooth, dark wall (height greater than 3.6 m).

1.6.4.1.1.1.2. Description procedure: the athlete stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. The athlete puts chalk on their fingertips to mark the wall at the height of their jump. The athlete then stands away from the wall, and jumps vertically as high as possible using both arms and legs to assist in projecting the body upwards. Attempt to touch the wall at the highest point of the jump.

1.6.4.1.1.1.3. Scoring: the difference in distance between the standing reach height and the jump height is the score. The best of three attempts is recorded.

Figure 1: Sargent Jump Test.

1.6.4.1.2. **Long Distance Ball Heading Test**: it is designed to measure the distance achieved and the ability to head soccer balls in athletes. (Amr Abul-Magd and Jamal Ismail Al-Nemaki, 1997, p 147).

1.6.4.1.3. Description: The soccer player stands behind the starting point holding the ball with both hands. The soccer player then throws the ball high and jumps to head it forward as far as possible. Attempt to increase the heading distance. The difference in distance between the starting point and the heading point is the score. The best of two attempts is recorded.

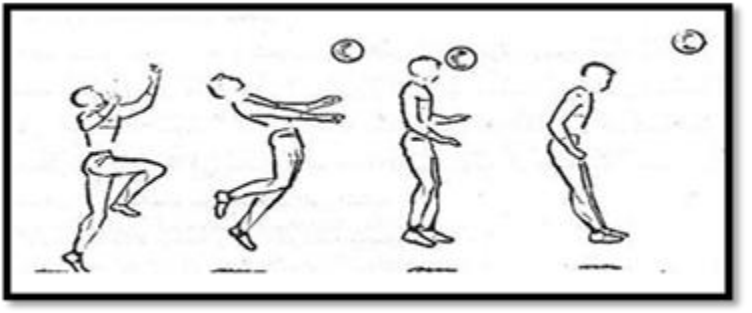

Figure 2: Long Distance Ball Heading Test

1.6.4.2. **Statistical Processing**: the nature of the study determines the statistical means used, which were as follows:

1.6.4.2.1. The Arithmetic Mean (average): the mean was calculated using the following formula (Eq. 1):

$$A = \frac{S}{N} \qquad (1)$$

where, A = average (or arithmetic mean)

N = the number of terms (e.g., the number of items or numbers being averaged)

S = the sum of the numbers in the set of interest (e.g., the sum of the numbers being averaged).

1.6.4.2.2. Standard deviation: it measures the spread of the data about the arithmetic mean (Abdelkader Helmi, 1993: 48). The standard deviation is given by the formula (Eq. 2) below:

$$\sigma = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

σ = **lower case sigma**
$\sum$ = **capital sigma**
$\bar{x}$ = **x bar**

(2)

Where, s means 'standard deviation'.

S means 'the sum of'.

$\bar{x}$ bar means 'the mean'

1.6.4.2.3. Karl Pearson's Correlation Coefficient: is a measure of the strength of a linear association between two variables and is denoted by r (Muhammad Hasan Allawi and Muhammad Nasir al-Din Radwan: 225).

$$r = \frac{N\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{[N\Sigma x^2 - (\Sigma x)^2][N\Sigma y^2 - (\Sigma y)^2]}}$$

(3)

Where, N= number of pairs of scores;

Σxy=Sum of products of paired scores;

Σx=Sum of x scores;

Σy=Sum of y scores;

Σx^2=Sum of squared x scores; and

Σy^2=Sum of squared y scores.

1.6.4.2.4. Student's T-Tests: is used for unequal and equal variances as well as for a difference in mean involve unpaired (independent) samples and paired samples. In this study the following two formulas were given:

$$t = \frac{(\overline{X}1 - \overline{X}2)}{\sqrt{\frac{s_1^2 + s_2^2}{n - 1}}}$$

(4a)

Where, $\overline{X}1 - \overline{X}2$ = differences between sample means based on all possible pairs of random samples.

$s_1^2 + s_2^2$ = Sum of squared standard deviations of both tests.

It is used to determine the difference between pre- and post- test of the two samples, as well as to detect the homogeneity of the control group and the experimental group (Qasim Hassan Hussein and Samir Musallat al-Hashemi, 1988: 75).

$$t = \frac{\bar{d}}{\sqrt{\frac{\Sigma \bar{d}^2}{(n-1)n}}}$$

(4b)

Where, $\bar{d}$ = Mean of differences $\Sigma \bar{d}^2$ = sum of the squared deviations

n – 1 = degrees of freedom (with n being the total number of observations)

It is used to determine the difference between pre- and post- test results of each sample (N 1 = N 2) (Muqaddam Abdul Hafeez: 109).

1.6.4.2.5. **Test Validity**: the validity of a test is the square root of reliability coefficient, which is represented by the following formula:

$$\text{Validity} = \sqrt{\text{Reliability Coefficient}}$$

(5)

In addition to statistical means mentioned above, statistical processing was done using Exel and SPSS 16.0.

1.6.5. Results and Discussions:

1.6.5.1. Sargent Jump Test:

The results for VJ test for each testing condition are presented in Table 1 below.

	Pre-test		Post-test		Calculated T-test	-T tabular	significance at the level of 0.05
	$\overline{X}$	S	$\overline{X}$	S			
C Sample	0.3	0.2	0.32	0.03	**1.73**	**2.30**	Non-significant
E Sample	0.3	0.1	0.41	0.04	**7.26**		Significant

Table 1: VJ test results for each experimental and Control group before (pre) and after (post) training.

The pre- and post- test results are presented in table 1 above. For the experimental (E) group, the results revealed that there are a significant mean and an important standard deviation: ($\overline{X}$ =0.3), and (S=0.1) and ($\overline{X}$ =0.41), and (S=0.04) for pre-and post-tests results, respectively. The calculated T-test reached a value of (T=7.26) at a level of significance (=0.05), a degree of freedom (n – 1 =08) and a T-tabular value (=2.30). The latter, however, has a value less than of the degree of freedom, which indicates that there are statistically significant differences between the pre- and post- test values for the post-test. For the Control (C) group, the findings demonstrated that there are neither a significant mean average and nor an important standard deviation: ($\overline{X}$ =0.3), and (S= 0.02) and ($\overline{X}$ =0.32), and (S= 0.03) for pre-and post-tests values, respectively. The calculated T-test attained a value of (T= 1.73) at a level of significance (=0.05), a degree of freedom (n – 1 =08) and a T-tabular value (=2.30). The latter, however, has a value higher than of the degree of freedom, which indicates that there are no statistically significant differences between the pre- and post- test values.

As can be seen from the results indicated above, we conclude that the experimental sample, on which the proposed plyometric training programme was applied, showed statistically significant differences in the measurements of explosive muscle strength (power) of lower limbs in soccer players during the various jumping movements. The muscles of lower limbs are the most important muscular group the trainers focus on. The essence of these lower limb muscles, particularly, lies in the use of the greatest possible muscle contraction velocity during plyometric exercises. "The explosive muscle strength of lower limbs makes the player do a higher vertical leap before his opponent. The biggest advantage is that the player who jump before his opponent prevents the latter from being able to jump or at least will from jumping correctly" (Hanafi Mahmoud Mukhtar, 1994, p 68).

It is worth note that this essence is due to the effectiveness of the proposed training programme, which included vertical jump exercises, which had an impact on the positive development of the explosive muscle power of lower limbs. This would be in line with the study of Saad Mohsen (1996), which demonstrated that the use of vertical jump exercises and deep jump exercises have a great impact on the development of explosive muscle strength of lower limbs. Shephard et al. (2013) found that the replacement the replacement of part of the regular handball training for youth players with 8-wks Plyometric training programme, can improve performance, vertical leaps, jumping movements and shooting force as a result of increasing the explosive muscle strength of lower limbs. The researchers therefore recommend the inclusion of Plyometric exercises at a rate of 2d-wk to develop the characteristics of the drill; namely, the explosive movements.

1.6.5.2. Long Distance Ball Heading Test:

The results for the soccer ball heading test for each testing condition are presented in Table 2 below.

	Pre-test		Post-test		Calculated T-test	-T tabular	significance at the level of 0.05
	$\overline{X}$	S	$\overline{X}$	S			
C Sample	12.16	1.03	12.45	0.86	**1.68**	**2.30**	Non-significant
E Sample	12.88	1.11	15.77	1.27	**6.57**		Significant

Table 2: Long Distance Ball Heading test results for each experimental and Control group before (pre) and after (post) training.

The pre- and post- test results are demonstrated in table 2 above. For the experimental (E) group, the results revealed that there are a significant mean and an important standard deviation: ($\overline{X}$ = 12.88), and (S= 1.11) and ($\overline{X}$ = 15.77), and (S=1.27) for pre-and post-tests results, respectively. The calculated T-test reached a value of (T=6.57) at a level of significance (=0.05), a degree of freedom (n – 1 =08) and a T-tabular value (=2.30). The latter, however, has a value less than of the degree of freedom, which indicates that there are statistically significant differences between the pre- and post- test values for the post-test.

For the Control (C) group, the findings uncovered that there are neither a significant mean average and nor an important standard deviation: ($\overline{X}$ = 12.16), and (S= 1.03) and ($\overline{X}$ =12.45), and (S= 0.86) for pre-and post-tests values, respectively. The calculated T-test attained a value of (T= 1.68) at a level of significance (=0.05), a degree of freedom (n – 1 =08) and a T-tabular value (=2.30). The latter, however, has a value higher than of the degree of freedom,

which indicates that there are no statistically significant differences between the pre- and post- test values.

As can be revealed from the results indicated in Table 2 above, we conclude that the experimental (E) group has statistically significant differences before and after training in Long Distance Ball Heading test compared with the control (C) group. The researcher attributed the difference to Plyometric Training Programme, which includes Vertical Leap exercises plus ball heading skills. This programme therefore led eventually to increasing the explosive muscle strength power of limbs and arms in soccer players and accordingly an effective impact on increasing the force of Soccer heading.

It is worth to note that this skill has become an important and influential factor in enhancing matches scores. It requires the ability to jump correctly and reach the maximum height point due to the fact that Plyometric drills were adopted quickly and effectively. This, therefore, This would be in line with the study proposed by Hassan Ali Karim (2002), who confirmed that the Plyometric training programme had an influential effect on improving the soccer ball heading skill.

Conclusion :

The findings of our research are quite convincing, and thus the following conclusions can be drawn:

- The proposed plyometric training programme has a positive effect on developing vertical jump capability.
- The plyometric training programme has an influential effect on improving the soccer ball heading skill.

This research was concerned with the effect of plyometric exercises on increasing vertical jump performance and ball heading in soccer players;

however, the results should be applicable also to use plyometric drills in the competition as well as in juniors' trainings. Further study of the issue on other age groups is still required.

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