

The Effects of Plyometric Exercises Program to Develop Muscular Strength and Reduce Sports Injuries among Young Football Players

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Abstract

The aim of this study was identify the effect of using the proposed plyometric exercises on reducing the incidence of injuries among football players, as well as to identify the effect of the proposed program on the vertical jump and increase the explosive power of the muscles legs of young football players. The study sample consisted of (33) from young football teams of Al–Nasiriya Sports Club (age $18.5 \pm (0.9)$ yrs.; height $180.7 \pm (5.3)$ cm, weight $72.7 \pm (8.1)$ kg). The researcher used the experimental method by following the tribal and dimensional measurements for two groups, experimental (16) and control (17) players. The players' performance physical tests including: (JUMP TEST (SARGEN JUMP TEST; SQUAT JUMP TEST; STANDING LONG JUMP TEST. The program was applied for (12) weeks (5) times per week for a period of (30) minutes each time, tests were conducted and data were collected before starting the program and this was repeated two and a half months after the start the program. The statistical analysis prefer by means of repeated measures analysis. The most important results of the research indicated that the training program affected all study variables at the significance level ($P < 0.05$). The rates of incidence per 1000 hours (practice and match) are (1.12) in experimental

group and (2.74) in control group, which equates (54.90%) fewer injuries experimental group. The incidence rats of injuries (mild and moderate) in experimental group was (5), while (13) in control group. In addition, the improvement in muscular strength of the leg (PW) reached (15.83%) in experimental group, while in control group (1.08%) with a significance level of (0.005) for strength muscles. The vertical jump reached (5.3 %), and (1.03%) respectively, with a significance level of (0.009) for the height jump, and for explosive leg power reached (6.9%) (2.14) respectively, with a significance level of (0.003), also for squat vertical jump reached (8.2%), and (1.0%) respectively, with a significance level of (0.006). The most important recommendations is that plyometric exercises have positive results in terms of affecting muscle groups as a means of developing muscular ability and gaining strength at the speed required by the vertical leap of skill in football.

Keywords: Plyometric Exercises, Injures, Football, Muscular Strength, Players.

ملخص البحث

الهدف من هذه الدراسة هو التعرف على تأثير استخدام التمارين البليومترية المقترحة على تقليل معدلات حدوث الاصابات بين لاعبي كرة القدم، وكذلك التعرف على تأثير البرنامج المقترح على الوتب العامودي وزيادة القوة الانفجارية لعضلات الساقين لدى لاعبي كرة القدم الشباب، وتكونت عينة الدراسة من (33) لاعب من فريق كرة القدم الشباب لنادي الناصرية الرياضي العمر (0.9) \pm 18.5 سنة ؛ الطول (5.3) \pm 180.7 سم؛ الوزن (8.1) \pm 72.7 كجم. ولقد استخدم الباحث الطريقة التجريبية باتباع القياسات القبلية والبعدية لمجموعتين، تجريبية (16) لاعب وضابطة (17) لاعب. كما استخدم الباحث الاختبارات البدنية، اختبار القفز العامودي (SARGEN JUMP)؛ اختبار القفز بطريقة القرفصاء (SQUAT JUMP)؛ اختبار القفز العريض (STANDING LONG JUMP)؛ تم تطبيق البرنامج لمدة (12) أسبوع، وبمعدل (5) وحدات أسبوعياً لمدة (30) دقيقة في كل وحدة وتم

إجراء الاختبارات وجمع البيانات قبل بدء البرنامج وتكرر ذلك بعد شهرين ونصف من بدء تطبيق البرنامج. واستخدمت الوسائل الاحصائية عن طريق تحليل المقاييس المتكررة للتباين (MEASURES ANOVA REPEATED). ولقد أشارت أهم نتائج البحث إلى أن البرنامج التدريبي أثر على جميع متغيرات الدراسة ذات دلالة احصائية عند مستوى الدلالة ($P < 0.05$)، حيث أن معدلات حدوث الإصابة لكل 1000 ساعة (تدريب ولعب) هي (1.12%) في المجموعة التجريبية و (2.74%) في المجموعة الضابطة والتي تعادل حوالي (54.90%) من الإصابات أقل في المجموعة التجريبية. وقد بلغت نسبة حدوث الإصابات (الخفيفة والمتوسطة) في المجموعة التجريبية (5) بينما كانت (13) في المجموعة الضابطة. وأن التحسن في القوة العضلية المطلقة للساق قد بلغت القوة العضلية للرجلين (15.83%) في المجموعة التجريبية، بينما في المجموعة الضابطة (1.08%) وبدلالة معنوية (0.005) لقوة العضلات. كما بلغت قيمة القفز العالي (5.3%) و (1.03%) على التوالي بين المجموعتين، بمستوى دلالة معنوية (0.009). وإن قيمة القوة الانفجارية للرجل بلغت (6.9%) (2.14%) على التوالي بين المجموعتين، بمستوى دلالة (0.003)، وكذلك للقفز العالي من القرفصاء بلغت (8.2%)، و (1.0%) على التوالي بين المجموعتين بمستوى دلالة معنوية (0.006). ومن أهم التوصيات نرى ان هناك تأثيرات إيجابية للتمارين البايومترية على المجموعات العضلية وتعتبر وسيلة لتنمية القدرة العضلية واكتساب القوة المميزة بالسرعة والتي تتطلبها مهارة القفز العالي في كرة القدم.

الكلمات المفتاحية: التمارين البايومترية، الإصابات، الشباب، كرة القدم، القوة العضلية، اللاعبين.

1. Introduction

The practice of sports activity is a feature of the modern era, and due to the benefits it brings to the body, its described as a medicine for many diseases, football is one of the most popular sports in the world the number of practitioners of this game is estimated at about (200) million people, between professionals and amateurs, and we can call it the game the beautiful scenes where viewers enjoy the movements performed by the players as well as their skills (Longo et al., 2012), (Marques et

al,2013). Football is no longer restricted to males, but rather is practiced by females, as the number of practices of the game in Increasing, and women's football appeared globally in the year (1991) in the World Cup which was held in China. (Henke et al, 2014).

In order for the player to be able to compete, compete in matches and achieve the championship, the player must be well prepared in all respects it is physical, psychological, skill and planning. Physical preparation plays an important and vital role in the process of developing the player's level and continuing to play for as long as possible, in addition to his ability to perform the assigned tasks To it with minimal effort while retaining a measure of energy, as well as the speed of recovery, in addition to the ability of the nervous system to Issuance of nerve signals that are appropriate to the type of muscle contraction of a strong and rapid nature and that lead to performance motor skills correctly and accurately, As the failure of the nervous system and its inability to alert the muscles to do The process of contraction and diastole leads to injuries such as muscle tear or muscle contraction. (Abu Abdo, 2011).

The practice of football requires that the player fulfill its own physiological and skill requirements. From a skill point of view: kicking, heading the ball, throwing the ball over the head, goalkeeper skills, passing, shooting, controlling, Scientific references and research confirm the necessity of good physical preparation for the player, Zaher (2004) and Tawfiq (2004) indicates, the lack of physical preparation constitutes (70%) of the causes of injury, followed by physical exhaustion and Psychological injury by

(17%), while non-compliance with training principles constituted (13%) of the causes of injury. Running with the ball, dribbling (dribbling), and physiologically: endurance, speed, strength, agility.

The use of weight training, especially circular training, is to strengthen the muscles and ligaments working on the joint, Where the muscles work to protect the bone from receiving blows and to overcome external resistances, just as the players Those with weak physical abilities are the least able to perform the skills and the most vulnerable to injury, so it must be included muscular strength training in order to prevent the player from injury, as well as in order to develop his physical abilities and skill (Bird, et al., 1997). Core exercises are designed to gain strength, increase neuromuscular control, and develop strength both explosiveness and force characterized by speed and finally increasing the muscular endurance of the pelvic-hip-lumbar region.

Generally, the greater the individual's ability to control the neuromuscular as well as the strength of fixation, the greater the mechanical effectiveness through the chain-Kinetic transmission, this efficiency is reflected in reducing gravity, reducing the reaction force generated by the ground, increasing the momentum in the desired (correct) joint in the right place and time. The benefits of plyometric training are reflected in the athlete's physique by producing maximum strength during movements' high-speed, peak performance that requires explosive power and technical skills (Meylan and Malatesta, 2009).

Success depends in sports, the speed at which the muscle is contracted and energy is generated, increase the effectiveness of performance, and reduce the risk of injury it

also works to make the muscle reach the peak of its strength in the least possible time, in addition to being a safe and effective way to prepare. The benefits of plyometric training are reflected in the athlete's physique by producing maximum strength during movements High-speed, peak performance that requires explosive power and technical skills. Success depends. In sports, the speed at which the muscle is contracted and energy is generated, increase the effectiveness of performance; reduce the risk of injury (Williams and Poijula, 2016). Also works to make the muscle reach the peak of its strength in the least possible time, in addition to being a safe and effective way to prepare Athletes during short-term preparation periods (Ozbar et al, 2014); (Sohnlein et al, 2014).

Most studies and research agree that the best way to prevent injuries is by identifying the causes leading to their occurrence, the use of prevention tools, and the preparation of training programs based on sound scientific foundations that take into account the sequence The correct performance of the exercise and its intensity, and the need to respect the periods of rest and recovery, in addition to focusing on developing a program Preventive to raise the player's physical efficiency in order to prevent injuries. (Paszkewicz, et al, 2012; Van Beijsterveldt, et al, 2012; Schneider et al, 2013; Wingfield, 2015; Owen et al , 2013; Henke et al, 2014).

The problem among young players may participate in a different type of training program that may ineffective training method or suitable for professional players. With the increase in the number of young players, they were recruited into a football team as well as those enrolled in a football academy at a very young age. The most

important to provide them with a safe and effective training program without overtraining young players. These exercises are suitable and exclusive for young football players and the program design as "warm-up training exercises. The program including physical exercises, such as core stabilization, eccentric training of the main muscles, and self-stimulation training, dynamic stabilization and plyometric exercises. The aims of this study were identify the effects of plyometric exercises program to develop muscular strength and reduce sports injuries among young football players.

2. Materials and methods

2.1 Participants

Thirty-three young male soccer players from Al-Nasiriya Sports Club in Thi-Qar-Iraq. This study assigned randomly to either the (Experimental) and (Control) group, players were randomized (Experimental, (16) and (Control, (17) group. The demographic characteristics of players was (Age $18.5 \pm (0.9)$ yrs.; Height $180.7 \pm (5.3)$ cm, Weight $72.7 \pm (8.1)$ kg) Table 1.

Table 1. Values are mean (\pm SD) for the Experimental and Control group.

Characteristics	Experimental (n = 16)	Control (n = 17)	<i>P value</i>
Age (yrs)	$19.3 \pm (2.5)$	$18.9 \pm (1.7)$	P < 0.05
Height (cm)	$181.5 \pm (1.3)$	$182.3 \pm (2.5)$	
Weight (kg)	$71.6 \pm (5.2)$ kg	$70.7 \pm (3.2)$ kg	

2.2 Muscular power and physical performance tests

2.2.1 The Sears Equation, (1999):

To calculate the absolute muscular power: Muscular power (W) = (6107) X Vertical jump distance (cm) + (8503) X Body mass (kg) – (2155).

2.2.2 Sargent's Jump Test (SJT):

The ability to jump vertically is likely to be required when trying to catch a high ball especially when the opponent is very close to the player, and in which short-term muscle strength is necessary (Farhan, et al., 2013). The maximum height of the vertical jump was measured using a SJT Figure 1.

2.2.3 Standing Long Jump Test (SLJT):

The ability to produce explosive leg force plays a major role in producing the maximum effort for running and jumping while playing football (Farhan, et al., 2013). In this study, the SLJT was used to measure explosive leg force Figure 1.

2.2.4 Squat Jump Test (SJ):

Vertical jump test of stability from a position with the knees bent at an angle is a simple, practical, valid, and very reliable measure of lower-body power (Farhan, et al., 2013). As a consequence, it is no surprise that this has become a cornerstone test for many strength and conditioning coaches and sports scientists Figure 1.

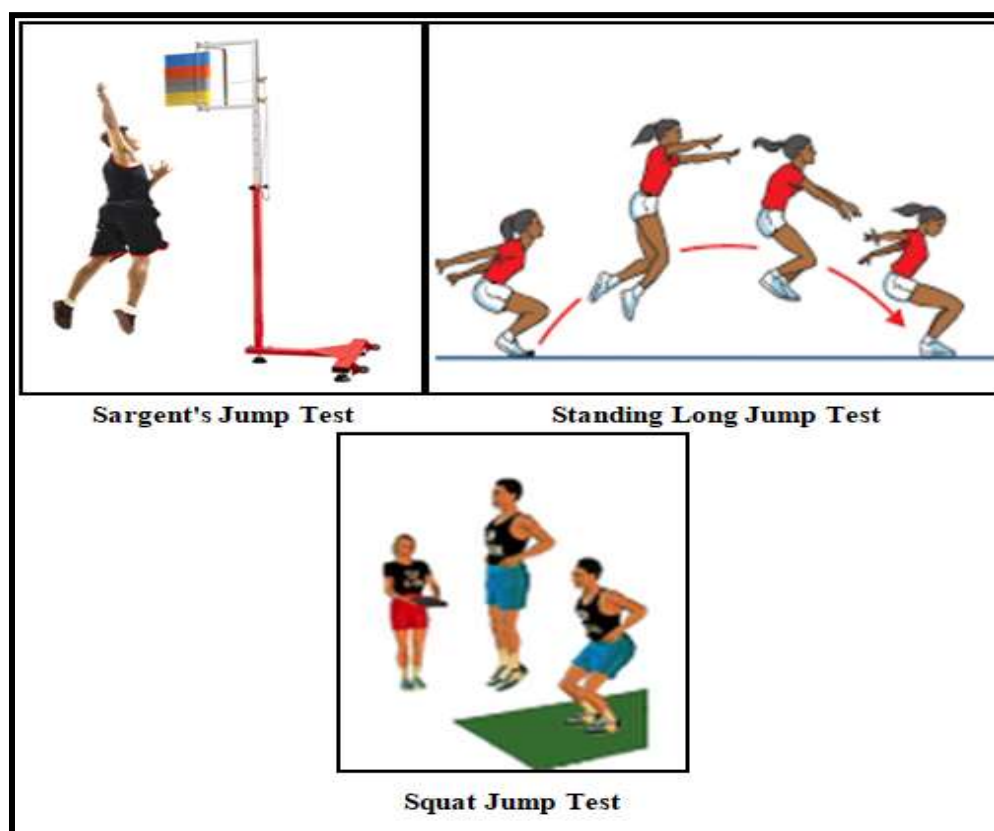


Figure 1. Physical performance tests

Table 2 . The Prevention Plyometric Exercises Program

No .	Exercises	Set s	Repetitions	Rest period between sets	Time for exercises
1.	Lying on the stomach (bowing the torso back while keeping the legs on the ground).	4	5	2 min	5 min
2.	Jump with feet together to a degree and return to the ground quickly and directly.	5	6	2 min	3 min
3.	Partridge on one foot for great	3	5	1.5 min	5 min

	distances on each part.				
4.	Jump up Knees to chest Looking forward.	5	6	2 min	2 min
5.	Standing on a box or step at a height of about (30–50 cm) and jumping to the ground and straight to the highest possible point (deep jump).	4	5	2 min	5 min
6.	(Standing) Bend the knees in half and then jump to the highest height and so on (squat-jump) Angle the knee 90 degrees, keeping the knees not progressing more than the level of the toes, with the chest raised and looking forward	3	6	2 min	5 min
7.	(Standing) bend the knees in half (squat) the knee angle is 90 degrees, keeping the knees not progressing more than the level of the toes, with the chest raised and looking forward.	5	6	1.5 min	5 min

Equipment for plyometric training:

- Hurdles are a great piece of equipment for plyometric training.
- Staircase (stairway hops).

- Boxs jump.
- Different sizes of cones

3. Results and Discussion

The results of the study indicate that the value of tests calculated between the pre and post measurements muscular and physical capabilities was significantly increased in experimental group compared to the control group for all study variables. The rates of incidence per 1000 hours (practice and match) are (1.12%) in experimental group and (2.74%) in control group, which equates (54.90%) fewer injuries experimental group. The incidence rates of injuries (mild and moderate) in experimental group was (5), while (13) in control group Figure 2. In addition, the improvement in muscular strength of the leg (PW) reached (15.83 %) in experimental group, while in control group (1.08%) with a significance level of (0.005) for strength muscles.

With regard to relative muscular ability the percentage change in the post-test for the experimental group (%15.83) when compared with the post-test for the control group (%1.08), where a statistically significant change occurred. Also, at the end of the intervention the experimental group showed superior changes compared to the control group on post-test: (% 4978.57 vs 4117.58). Which indicates that the exercises adopted by the researcher to develop the explosive ability, have contributed to developing and raising the anaerobic capabilities of the experimental group, which has a key role in the performance of the most important movements of the vertical jump.

Table. 3 Values are mean (\pm SD). Pre-and Post-intervention data of “Muscular power and physical capabilities”, and percent changes, for all measures in both the experimental and control group.

Variables	EXP (n = 16)			CON (n = 17)			P value
	Pre	Post	$\Delta\%$	Pre	Post	$\Delta\%$	
MP legs (PW)	4102.54 \pm (3.5)	4978.57 \pm (2.8)	15.83 (5.8)	4099.21 \pm (4.3)	4117.58 \pm (6.9)	1.08 (.34)	.005
SJT (cm)	2.25 \pm (4.6)	2.92 \pm (7.1)	5.3 (3.3)	2.26 \pm (3.7)	2.29 \pm (6.8)	1.03 (0.8)	.009
SLJT (cm)	53.7 \pm (2.5)	98.3 \pm (4.8)	6.9 (7.7)	55.8 \pm (5.2)	59.9 \pm (4.5)	2.14 (4.5)	.003
Squat JT (cm)	28.52 \pm (8.5)	87.13 \pm (9.2)	8.2 (5.2)	25.62 \pm (9.4)	27.58 \pm (9.6)	1.0 (7.8)	.006
Δ = change. P value reflects differences between the change scores for each group							

The vertical jump reached (5.3 %), and (1.03%) respectively, with a significance level of (0.009) for the height jump, and for explosive leg power reached (6.9%) (2.14) respectively, with a significance level of (0.003), also for squat vertical jump reached (8.2%), and (1.0%) respectively, with a significance level of (0.006) Table. 3. In additions, at the end of the intervention the experimental group showed superior changes compared to the control group on post-test: for vertical leg power (%2.92 vs %2.29), explosive leg power (%98.3 vs %59.9), Squat (vertical leg power) (%87.13 vs 27.58).

The physiology of the occurrence of development differs between males and females, as this development is due to the physical performance of the players males lead to morphological changes in their bodies that target the muscles through an increase in the size of the clip intramuscular (Steinberg et al., 2002). Increased capillary count, increased muscle fiber size, increased number of mitochondria, increased elimination speed one of the products of metabolic processes is an improvement in the speed of response, and the last of them is an improvement in the response of the nervous system.

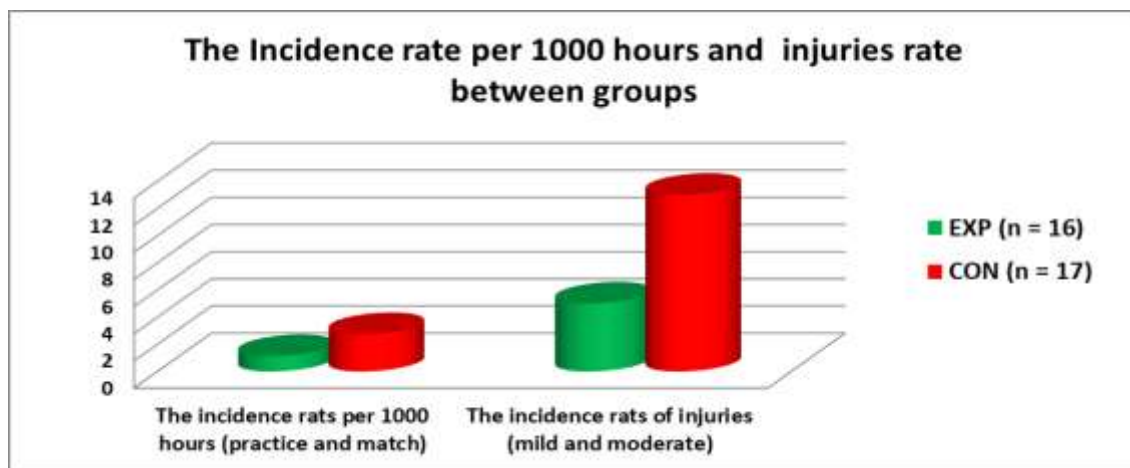


Figure 1. The rates of incidence per 1000 hours (practice and match) and the incidence rats of injuries (mild and moderate) in experimental and control groups

The researcher attributes these results to the effectiveness of the special exercises carried out by the experimental group, as these results confirm the importance of the explosive power of the legs and trunk, which is one of the physical abilities that depend on it in the performance of most sports activities, especially among young

football players. By presenting and discussing the results in general, it was found that the proposed program improved the variables under study. The researcher believes that the reason for this is due to several factors, including the increase in neuromuscular adaptation represented by an increase in the recruitment and effectiveness of motor units, an increase in the neural response and the speed of the nerve impulse, and an increase in the efficiency of fast muscle fibers (Tillin and Bishop, 2009).

Al-Noman, (2005), which compared weight training and plyometric, exercises in terms of improving muscular strength and Football skills, which indicated that both methods led to the development of muscular ability. While plyometric training leads to the development of muscle strength and improves performance of explosive skills such as the vertical jump, the long jump, speed, agility, and the reason for this development is that plyometric training works to put the muscle during motor performance is in a state of rapid lengthening before motor performance, as these lengthening causes the muscle to contract muscular due to the elongation reaction, and the amount of force produced depends on the output of the largest force as quickly as possible. In addition, it works plyometric training to convert chemical energy into mechanical work (Al Qatami, 2004).

These results for plyometric training are in agreement with the study by Ozbar et al (2014) on females and indicated that plyometric exercises were useful in improving maximum foot strength and jumping, but not in improving speed. While the researcher attributes the occurrence of this development, it may be due to the introduction of core

exercises, which led to an increase in movement control. Increasing the effectiveness of getting up and walking on the feet, transferring energy as the effective movements are generated from the center of the body towards Limbs and not only the limbs, transferring body weight in order to increase the effectiveness of the rotation process, distributing weights

The external parts of the body should not be placed on the back, which is consistent with the study of Marques et al (2013), that the improvement in kicking strength is due to the improvement in the strength of the legs, as well as the increase in the efficiency of the motor transfer process from the nearby parts to the distal parts as well as the function of the pulp in the abdominal and cotton area is to maintain stability and generate explosive force and increase Efficiency of some physical elements represented in strength, flexibility, balance, in addition to increasing neuromuscular facilitation and development of athletic performance.

The results of this study are similar to the study of Al-Shadfan (2001) to the existence of a close relationship between the developments of the level of physical fitness Especially muscular strength and skill performance, as players with high physical abilities are able to perform the requirements of the physical and skill game is highly efficient and they have less appearance of fatigue And the study Depfort, et al (1987) reported that strength training has positive effects on kicking performance.

4. Conclusions

The proposed preventive program, including plyometric exercises have a direct impact on the level of skill performance of young football players and developing the muscular ability by develop the speed of muscle contraction through plyometric exercises. In addition, the plyometric exercises increase the effectiveness on the nervous system and include these changes by increasing the nerve impulses towards the working muscle, and changing the mechanics of muscle performance by reducing the activity of the antagonist muscle that leads to the reduction of the phenomenon of mutual disability. Thus, the proposed preventive program reduced the risk of injuries among young football players by make the muscle reach the peak of strength, and the program it's a safe effective way to prepare the players during short-term preparation periods. The most important recommendations focus on developing a program preventive to raise the player's physical efficiency in order to prevent injuries.

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