

Effect of neuromuscular warm up on explosive strength and change of direction ability of soccer players.

(field study in JSD team)

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Abstract

The study aimed to know the effect of the neuromuscular warm-up program on explosive strength and change of direction ability of soccer players. The study included 20 players of the U17 category from JSD team of the Algerian second Amateur Championship, and were randomly divided equally into two groups, experimental and control (10 players per group). The experimental group performed FIFA 11+ injury prevention program as a neuromuscular warm up twice per week for eight weeks, while the control group just performed their regular warm-up. Sargent test was used to measure vertical jump, agility T tests to measure change of direction ability. The results showed an improvement in the explosive strength and change of direction ability in the post-test in experimental group.

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I. Introduction

Soccer is characterized by short-duration high-intensity actions that make a difference in matches results such as accelerations, sprints, jumps and change of directions (Stølen et al. 2005), and therefore, it requires a good physical preparation to achieve the highest level of fitness for athletes and the best performance. There have been many terms and types of physical preparation in recent times, until the so-called integrated physical preparation appeared, which proved to be very successful in improving both physical and technical aspects. (Kharfan, 2011; Lakhdar, 2012; Ghoual, & Bengoua, 2014).

The physical preparation is not only limited to general and specific preparation, but continuous throughout the season and throughout the players' career, and it is not limited to the main part of the training session, but also includes cool-down and warm-up. Often the warm-up role is to prepare players for training sessions or competitions, to prevent injury and enhance performance (Walker, 2016).

Injury is a part of the game, whether during training or the match. In their study, Pfirrmann et al. (2016) showed that, injury rates in matches are higher than training for both adults and youth male soccer players. Chatterjee et al. (2015) proposed three factors to prevent injuries: using protective equipment, adopting the rules of play, and specific exercise programs developed to reduce injury risk. These programs are usually called neuromuscular warm up, and usually contain stretching, strength, balance, plyometric and agility exercises (Herman et al., 2012). FIFA 11+ (Bizzini et al., 2011), Harmoknee (Kiani et al., 2010), Sportsmetrics (Noyes, & westin, 2012), and the Prevent Injury and Enhance Performance program (PEP) (Gilchrist et al., 2008), are examples to those programs. "FIFA 11+ injury prevention program has been developed by an international group of experts based on their practical experience"(Bizzini et al., 2011, P05). After a study that found no difference in the injury risk between the intervention group and control group when applying FIFA 11, it has been upgraded to "the 11+" version by increasing exercises number and intensity (Soligard et al., 2008).

FIFA 11+ contains 15 exercises divided into three parts, the first includes running and dynamic stretching exercises for eight minutes, the second part includes ten minutes of strength, plyometric, and balance exercises, in this part there are three levels for each specific exercise, the difficulty of each exercise gradually increasing with each level. This allows for progression of both the individual and the team throughout the competitive season. the third part includes two minutes of high speed running and change of direction exercises (Bizzini et al., 2011).

The physiological effects of FIFA 11+ are similar or better than a regular warm-up, and it also enhance neuromuscular control, (Impellizzeri et al., 2013) and improve static and dynamic balance in both soccer and futsal (Brito et al., 2010 ; Reis et al., 2012), and in recent studies on FIFA 11+, researchers have concluded that this program improve vertical jump (Daneshjoo et al., 2013; Costa Silva et al., 2015; Akbari et al., 2018), while zein et al. (2017) did not find an improvement in jump performance after applying FIFA 11+ for four weeks. Some studies have also proven that The program improves agility (Daneshjoo et al., 2013; Zein et al., 2017).

Although FIFA 11+ is effective in preventing injury in both male and female players (Soligard et al., 2008; Owuoye et al., 2014). It will be important to demonstrate that this program has a positive effect on the performance of the Algerian players. and for that, this research aims to know the effect of applying FIFA 11+ warm-up program for eight weeks on explosive strength and change of direction ability of U17 soccer players.

II. Method and Materials :

2.1. Participants

The study was conducted on a purposive sample of 20 male soccer players of Jijel JSD team of the Algerian second Amateur Championship. (mean $\pm$ SD: age = 16.25 ± 0.63 years, height = 174.4 ± 5.03 cm, body weight = 64.4 ± 5.57 kg), The participants were randomly divided equally into two groups, experimental and control (10 players per group). The experimental group performed FIFA 11+ program twice per week for eight weeks, while the control group just performed their regular warm-up.

Sample homogeneity and valence:

Table 1. Sample homogeneity in the variables of age, height and weight.

Characteristics	Mean	SD	Median	coefficient of skewness
Age (yr)	16.25	0.63	16	1.174
Height (cm)	174.4	5.03	173.5	0.536
Weight (kg)	64.4	5.57	65	-0.322

SD : Standard Deviation

Table 1 shows that the values of the skewness coefficient are confined to (± 3) in the variables of age, height, and weight, which indicates the presence of homogeneity of the sample in these variables.

Table 2. Comparison of study Tests Averages between Groups in pre-tests.

Variables	EG	CG	P-value
Sargent Jump test (Cm)	42.8 $\pm$ 1.81	42.7 $\pm$ 1.41	0.892
Agility T test (S)	12.37 $\pm$ 0.36	12.24 $\pm$ 0.34	0.448

Note : EG : Experimental Group, CG: Control Group, P: Probability

Table 2 Shows that there are no statistically significant differences between the experimental group and the control group in pre-tests ($p > 0.05$), This means that the sample is equivalent in the pre-tests.

2.2. Study variables

In this study, the independent variable was the neuromuscular warm up, and the dependent variable was explosive strength and change of direction ability.

2.3. Materials

All the participants were tested on Sargent jump test to measure explosive strength, and the agility T test to measure change of direction ability (Boumediene et al., 2018; Fukuda, 2019), before and after the 8-week training program.

The scientific tools conditions

a) Reliability and validity

Reliability of the tests was determined by the Pearson correlation coefficient, and validity was also inferred by the square root of the reliability.

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Table 3. Reliability and validity of the tests.

Variables	Mean $\pm$ SD	Reliability	Validity
Sargent jump test (Cm)	Test: 43.6 $\pm$ 1.14	0.941*	0.970*
	Re-test: 43.8 $\pm$ 1.3		
Agility T test (S)	Test: 12.59 $\pm$ 0.23	0.943*	0.971*
	Re-test: 12.55 $\pm$ 0.2		

Note : (*) significant at the 0.05 level

Table 3 shows that the correlation coefficients are high. This means that the tests are reliable and valid.

b) Objectivity

In this study, the researchers used easy tests that require simple materials, and they do not require complex mathematical operations, and the units of measurement for the tests are clear, and this means that there is a high degree of objectivity.

2.4. Design and Procedure

The experiment extended from the beginning of February 2019 to the beginning of April of the same year, when the pre-tests were completed on February 04, 2019, and the FIFA 11+ warm-up program was implemented from February 07, 2019 for a period of 8 weeks, and the post-tests were completed on April 11. 2019.

Tests and FIFA 11+ warm-up program were conducted by researchers with the help of the team's coach at Colonel Amirouche Stadium in Jijel State.

None of the participants had training experience with FIFA 11+ program before this study. Athletes and the coach were informed about the purpose of the study, and informed consent was obtained from the coach and all participants before the study started. The FIFA 11+ warm-up program was explained in the first training session, and it was clear to all players, because the exercises contained in the program are familiar to them.

Many tools were used to do the experiment such as cones, exercise mats, whistles, stopwatch, wall ruler, chalk, and registration form.

2.5. Statistical Analysis

All values in this study are reported as mean $\pm$ standard deviation (SD).

Statistical analyses were performed using SPSS version 25. Paired t-test was used for within-group comparison and independent t-test was used for

between-groups comparison. The significance level of the tests was considered $p \leq 0.05$.

Simple correlation coefficient (Karl Pearson) was used to investigate tests reliability, and Pearsonian coefficient of skewness for sample homogeneity.

III. Results

Table 4. Comparison of Sargent test Pre and Post-Test Averages.

Groups	Sargent test Sequence	Mean $\pm$ SD	P-value
CG	Pre-test	42.7 $\pm$ 1.41	0.193
	Post-test	43 $\pm$ 1.63	
EG	Pre-test	42.8 $\pm$ 1.81	0.000
	Post-test	44.9 $\pm$ 2.07	

Table 4 shows that there is no increase in explosive strength in the control group (CG) after the 8-week usual warm up training (Mean $\pm$ SD : 42.7 $\pm$ 1.41 in the pre-test and 43 $\pm$ 1.63 in the post-test), Therefore, it can be said that there are no statistically significant differences between the pre and post- tests in Sargent test for control group. ($p > 0.05$).

In the experimental group (EG), the analysis shows an increase in explosive strength after the 8-week FIFA 11+ training (from 42.8 $\pm$ 1.81 to 44.9 $\pm$ 2.07), Therefore, it can be said that there are statistically significant differences between the pre and post- tests in Sargent test for the experimental group. ($p > 0.05$).

Table.5: Comparison of agility T test Pre and Post-Test Averages.

Groups	Agility T test Sequence	Mean $\pm$ SD	P-value
CG	Pre-test	12.24 $\pm$ 0.34	0.299
	Post-test	12.17 $\pm$ 0.34	
EG	Pre-test	12.37 $\pm$ 0.36	0.000
	Post-test	11.46 $\pm$ 0.43	

Table 5 shows that there is no increase in change of direction ability in the control group (CG) after the 8-week usual warm up training (Mean $\pm$ SD : 12.24 $\pm$ 0.34 in the pre-test, and 12.17 $\pm$ 0.34 in the post-test), Therefore, it can be said that there are no statistically significant differences between the pre and post- tests in Agility T test for control group. ($p > 0.05$).

In the experimental group (EG), the analysis shows an increase in change of direction ability after the 8-week FIFA 11+ training (from 12.37 ± 0.36 to 11.46 ± 0.43). Therefore, it can be said that there are statistically significant differences between the pre and post- tests in Agility T test for the experimental group. ($p > 0.05$).

Table 6. Comparison of study Tests Averages between Groups in post-test.

Variables	EG	CG	P-value
Sargent Jump test (Cm)	44.9 ± 2.07	43 ± 1.63	0.036
Agility T test (S)	11.46 ± 0.43	12.17 ± 0.34	0.001

Table 6 Shows that there are statistically significant differences between the experimental group (EG) and the control group (CG) in post-tests in favor of the experimental group ($p < 0.05$)

IV. Discussion

Explosive strength

An important and novel finding of this study was explosive strength as measured by jump height was improved from FIFA 11+ injury prevention program (EG) ($P < 0.05$), but not from the usual warm up (CG).

The results of our study are in agreement with previous studies (Daneshjoo et al., 2013; Costa Silva et al., 2015; Akbari et al., 2018), in which the researchers concluded that implementing the FIFA 11+ program for eight weeks improves the jump height, While the results of our study differed with that of Zein et al. (2017), where the results showed that applying the FIFA 11+ warm-up program for a period of four weeks does not improve the vertical jump.

Consequently, the FIFA 11+ program, which lasted for 08 weeks, contributed to improving explosive strength because it contained some plyometric exercises, as le Guyader (2005) considers plyometric exercises that develop this physical quality. As these exercises target the gluteal muscles, and the latter of all types (small, medium and large) are considered one of the most important muscles working during explosive strength performance. This is confirmed by several studies (Al-Karmadi, 2016;

Chadi, & Bachir, 2019; Mokeddes et al., 2018), which all proved that plyometric exercises develop explosive strength.

The quadriceps muscle is also important to do the explosive action, as the FIFA 11+ program contains exercises that target these muscles, such as squats.

Change of direction ability

For change of direction ability, this study shows that change of direction ability performance as measured by total time was improved from FIFA 11+ ($P < 0.05$), but not from the usual warm up.

The results of our study are in agreement with previous studies (Daneshjoo et al., 2013; Zein et al., 2017), it can be said that this improvement is due to the application of the FIFA 11+ warm-up program. Plyometric exercises are considered a contributing factor to this improvement, as Moura (1988) considers that plyometric increases the elasticity of the working muscles, thus making use of the reflexed mechanical energy resulting in greater strength and speed. Several studies, such as Boukratem and Madani (2019), have found that the plyometric contributes to the development of agility.

In addition to this, there is an interference with the balance factor, which is considered one of the factors affecting the character of change of direction, according to Verstegen and Marcello (2001) that balance is the essential component of all movement skills, especially change of direction. The FIFA 11+ warm-up program contains some balance and stability exercises. Studies have already shown an improvement in static and dynamic balance when applying the FIFA 11+ program. Brito et al., 2010; Reis et al., 2012; Daneshjoo et al., 2013).

Differences between groups in the post-tests

Table 6 shows that there are statistically significant differences between the experimental and control groups in the post-test of both explosive strength and change of direction ability. This is due to the fact that the FIFA 11+ warm-up program had a greater effect than the usual warm-up of the control group, as the program contributed to improving explosive strength and

change of direction ability, especially as it is a developed program that contains sequential exercises (strength, balance, plyometric and agility).

V. Conclusion

In this study, the researchers concluded that the neuromuscular warm up (FIFA 11+ warm-up program) could contribute to improving explosive strength and change of direction ability of U17 soccer players, thus protecting them from the risk of injuries, especially anterior cruciate ligament (ACL) injury (Myer et al., 2011). It was also found that the FIFA 11+ program is better than the usual warm-up in affecting explosive strength and change of direction ability, and therefore the researchers advise that this program replace the usual warm-up.

Finally, this research is considered like any other research as it is subject to criticism, discussion and other experiments on FIFA 11+ in order to gain a deep understanding of its effects on performance.

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