

The effect of 12 times training of the FIFA 11+ on fundamental movements in football academy athletes aged 14-17 as an effort to prevent injury

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Abstract

Background: Football is a very popular sport worldwide, with more than 265 million players, mostly young people (Aguilar Gómez, 2023). There are advantages to these high participation numbers but they also increase the chance of injury. **Objective:** This study aimed to examine the impact of the FIFA 11+ program, conducted over 12 training sessions, on improving fundamental movements in male football academy athletes aged 14-17. **Methods:** The research utilized a quasi-experimental design with pre- and post-tests, involving 18 male players (age: 14.78 ± 1.00 ; height: 1.59 ± 7.27 ; weight: 46.64 ± 7.95) divided into a control group (n=9) and an experimental group (n=9). The experimental group performed the FIFA 11+ program as part of their 20-minute warm-up, three times per week over 12 sessions. This program comprises 15 exercises divided into three sections. Fundamental movement abilities were assessed using the Functional Movement Screen (FMS), and data were analyzed with a paired sample t-test and Cohen's D value to determine the effect size for each group. **Results:** The results indicated no significant improvement in the control group following conventional warm-up exercises ($p=0.050$, Cohen's $D=0.770$). Conversely, the experimental group demonstrated a significant improvement with the FIFA 11+ intervention ($p=0.001$, Cohen's $D=2.287$). The effect size for the FIFA 11+ program was notably larger than for conventional warm-ups, which typically include running, stretching, and joint mobilization exercises. **Conclusion:** In conclusion, the study found that 12 sessions of the FIFA 11+ program effectively enhance fundamental movement skills in male football academy athletes aged 14-17.

Keywords: FMS, fundamental movements, injury prevention, FIFA 11+, football.

INTRODUCTION

Football is a very popular sport worldwide, with more than 265 million players, mostly young people (Aguilar Gómez, 2023). There are advantages to these high participation numbers but they also increase the chance of injury. Prevention of these injuries was closely linked to the presence of modifiable risk factors, underscoring the importance of neuromuscular control as an effective means of preventing injury (Akbari et al., 2018; Zadeh et al., 2019; Zareei et al., 2018). Vanmeerhaeghe & Rodriguez (2013) defines *neuromuscular control* as the correct activation of muscles that allows the development of complex and efficient motor actions or tasks; therefore, the correct execution of these actions is linked to a reduction in the occurrence of injuries because it is associated with improvements in articulatory movements, muscle activation patterns, strength, and balance. Suppose these need to be developed correctly and precisely. In that case, the athlete's movement quality is affected, causing biomechanical changes, imbalances between muscle groups, proprioceptive changes, and muscle fatigue (Vanmeerhaeghe & Rodriguez, 2013), which results in injury. Studies report that the incidence of injuries in football in 2008 was very scary, with three to five injuries per 1000 hours of practice and 24 to 30 injuries per 1000 hours of play (Ekstrand, 2008). The risk of injury increases in children aged 6 to 12 years due to

their development leading to participation in more complex games and activities that require greater dynamism (Caracuel-Cáliz et al., 2023) Therefore, efforts must be made to prevent the continuity of football athletes' careers from lasting longer.

It has been shown that neuromuscular training programs can have a significant effect during the pre-adolescent stage of development as long as they coincide with the development of basic motor skills, which are defined as "an organized set of basic movements that affect the combination of movement patterns of two or more parts of the body" which is also important for the development of individual motor skills (Batrakoulis et al., 2018; Sañudo et al., 2019). Many authors suggest that the use of injury prevention training based on neuromuscular control during essential stages of growth, such as infancy and adolescence, improves different abilities, such as sensing specific positions and movements of joints, strength, and balance (Hewett et al., 2012; Hrysomallis, 2007).

One program known to be effective in preventing injuries is FIFA 11+. Football teams that use such programs generally reduce their risk of injury by 30% to 70% compared to those that do not (Soligard et al., 2010). When implemented, this program significantly improved players' functional capacity in neuromuscular control, strength, static/dynamic balance, and agility skills over eight weeks (Daneshjoo et al., 2013).

Several tools allow movement assessment, such as the Fundamental Movements Screen (FMS). This series of tests mainly emphasizes quality (neuromuscular control) over quantity, as it can detect when a person is at risk of injury (Cook et al., 2006a, 2006b).

Many studies have been carried out on FIFA 11+, including for isokinetic strength (Brito et al., 2010), endurance (Edis et al., 2023), jump landing biomechanics (Zareei et al., 2018), vertical jump performance (Akbari et al., 2018), and physical fitness (Tseng et al., 2021). Studies have shown the impact of FIFA 11+ on increasing FMS scores over six weeks, but no proven improvement exists

(Baeza et al., 2017). Therefore, this study seeks to prove the impact of FIFA 11+ on increasing fundamental movements as measured by FMS. This study was conducted over 12 meetings with an involvement limit of 90% of the total meetings. Participants who do not participate in more than 10% of the total meetings are eliminated. Therefore, the aim is to investigate the effect of the FIFA 11+ program on fundamental movements during 12 meetings (4 weeks) in adolescent athletes aged 14-17 years at a football academy.

METHODS

Study Design and Participants

This research was a quasi-experiment in which there were 2 groups, namely the control and experimental groups. The population was 30 football academy players aged over 14-17 years. The sampling technique used was purposive sampling. The criteria for the participants involved were: aged over 14-17 years and had a musculoskeletal injury in the last six months, which did not involve using additional equipment. Participants who fulfill less than 90% of the training program would be excluded from research activities. The criteria for the participants involved were: aged over 14-17 years and had a musculoskeletal injury in the last six months, which did not involve using additional equipment. The criteria for the participants involved were: aged over 14-17 years and had a musculoskeletal injury in the last six months, which did not involve using additional equipment. Participants who fulfilled less than 90% of the training program would be excluded from research activities. Participants took part voluntarily, so when participating in any evaluation, parents and children had the right to read the consent form. Based on the implementation of the research, at least 2 players were found not to meet 90% of attendance, and 10 players did not meet the requirements, so they were excluded from research activities, and 18 players were obtained (Ages $14,78 \pm 1,00$); height $1,59 \pm 7,27$; body weight $46,64 \pm 7,95$) who were fully involved in research activities.

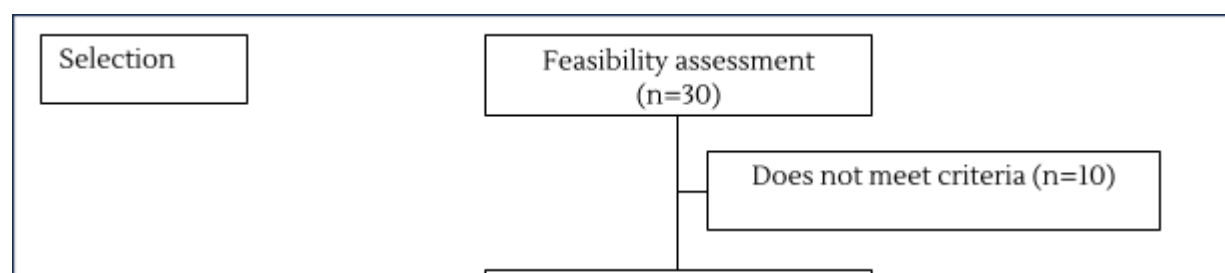


Figure 1. Flow Diagram of Study Group Randomization

Ethical approval statement

Research Instruments

All subjects were asked to fill out a form with their name, age, height, weight, weekly training volume, and previous injury records. All subjects were asked to fill out a form with their name, age, height, weight, weekly training volume, and previous injury records. *Fundamental Movements Screen* (FMS) was used to evaluate appropriate fundamental movements, where each test was recorded on video, using front and side cameras. The test was explained to the subjects before taking part, and they all wore standard shirts each time they were evaluated for the study. This research was conducted one week before the start of the training program and one week after its completion. Immediately after re-evaluating both groups, they proceeded to edit the videos, which were submitted to the evaluators along with the appropriate information about each participant without revealing their identity or which group they belonged to, using "Wondershare Filmora." Evaluators were then asked to categorize the results using the FMS. The videos were analyzed by expert physiotherapists, who recorded the scores in a Google spreadsheet.

The experimental group received the FIFA 11+ program in warm-up activities for 20 minutes. This routine was carried out three times a week for 12 meetings. The program consisted of 15 exercises divided into three parts. It should also be mentioned that the "Nordic hamstring" exercise has been removed from the program to avoid possible risks for those taking part due to the strain this exercise places on the bones and considering the participant's stage of bone maturation. Meanwhile, the control group warmed up as usual (conventional) (a routine training program from the trainer), namely running, stretching, and joint movements. The study adhered to ethical standards as outlined in the 2013 Declaration of Helsinki regulations.

Data Analysis

Data were analyzed using Jeffreys's Amazing Statistics Program (JASP) version 18.1. If $p < 0.05$ and a dominant value of 95% were considered statistically significant, the T-test was used in parallel to determine whether there was a statistically significant difference between the FMS values before and after the intervention. Cohen's D value was used to determine the effect size of each group.

RESULTS

All 14 football academy players who were eligible to participate were 14 players. Data on participant characteristics is shown in Table 1. Data from pre-test and post-test results from the experimental and control groups were then subjected to pre-requisite test analysis, namely the normality test before paired t-test analysis was carried out. In Table 2, it was known that there was an increase in the average value (mean) in both the experimental group and the control group.

Table 1. Participant Characteristics by Group (mean±sd)

	Age (year)	Height (m)	Weight (kg)	Body Mass Index
Control Group (Conventional Warm-up) (n=9)	15.11±1.67	1.58±8.40	45±8.94	17.83±2.17
Experimental Group (Program FIFA 11+) (n=9)	14.44±0.73	1.61±6.19	48.27±6.96	18.75±2.74

Table 2. Descriptive Statistics

	N	Mean	SD	SE	Coefficient of variation
Control Group Pre-test Data	9	33.111	1.269	0.423	0.038
Control Group Post-test Data	9	33.778	1.202	0.401	0.036
Experimental Group Pre-test Data	9	32.556	1.740	0.580	0.053
Experimental Group Post-test Data	9	34.778	1.716	0.572	0.049

Table 3. Test of Normality (Shapiro-Wilk)

		W	p
Control Group Pre-test Data	- Control Group Posttest Data	0.873	0.132
Experimental Group Pre-test Data	- Experimental Group Post-test Data	0.903	0.273

Note. Significant results suggest a deviation from normality.

Referring to Table 3, where the P value for the control group pre-test-post-test data (0.132) and the experimental group pre-test-post-test data (0.273) was > 0.05, it was stated that the data was normally distributed. A paired t-test was conducted to determine whether there were differences before and after receiving intervention in The FIFA 11+ program (Table 3).

Table 4. Paired Samples T-Test

Measure 1	Measure 2	t	df	p	Mean Difference	SE Difference	Cohen's d	SE Cohen's d
Control Group Pre-test Data	- Control Group Posttest Data	-2.309	8	0.050	-0.667	0.289	-0.770	0.265
Experimental Group Pre-test Data	- Experimental Group Post-test Data	-6.860	8	< .001	-2.222	0.324	-2.287	0.356

Note. Student's t-test.

In Table 4, it was known that the results of the paired samples t-test show that there was no difference before and after conventional warm-up exercises because the p-value was 0.050 > 0.05. Cohen's d value shows an effect of 0.770.

Meanwhile, the group that received intervention in the form of The FIFA 11+ program showed a difference before warm-up training with The FIFA 11+ program and after warm-up training with The FIFA 11+ program because the p-value was $0.001 < 0.05$. Cohen's d value showed an effect of 2.287. The value of Cohen's D also showed the size of the effect size given. Cohen's D value showed that the effect size generated by The FIFA 11+ program was much greater than the conventional warm-up program (a routine training program from the coach), namely running, stretching, and joint movement.

Table 5. Mean (SD) scores for FMS for the Control and Experimental groups before and after intervention.

		Control Group (n=9)	p-value	Experimental Group (n=9)	p-value
Squatting	Pre	2.33	0.347	2.60	0.008*
	Post	2.89		2.70	
Stepping	Pre	2.63	0.347	2.74	0.091
	Post	2.81		2.78	
Lunging	Pre	2.41	0.178	2.26	0.115
	Post	2.63		2.52	
Reaching	Pre	2.89	1.00	2.89	1.00
	Post	2.89		2.89	
Leg Raising	Pre	2.78	0.169	2.44	0.347
	Post	2.89		2.67	
Push-up	Pre	2.22	1.00	2.00	1.00
	Post	2.22		2.11	
Rotatory Stability	Pre	2.11	1.00	2.00	1.00
	Post	2.11		2.00	
	Post	18.44		17.66	

FMS= Functional Movement Screen; *= $p < .05$.

The results of the fundamental movement tests collected using FMS are shown in Table 5. A significant difference was found between the EG results before and after FMS intervention in Squatting, while there were no significant differences for the others.

DISCUSSION

This study aimed to determine whether The FIFA 11+ program, given during 12 meetings to football academy players aged 14-17, could improve fundamental movements. Our study showed that FIFA 11+ significantly improved fundamental movements in the experimental group compared to the control group that used conventional warm-up. These findings were also confirmed by the investigation report conducted by Nemati et al. (2017), who reported that 12 times of FIFA 11+ training in academy football players could improve FMS scores. However, research conducted by Baeza et al. (2017) states differently. In his research, the FIFA 11+ program lasted six weeks and did not significantly improve the players' basic movements. The limit of participant involvement (90% of the total planned meeting) was one of the keys to why The FIFA 11+ program effectively increased fundamental movements. Statistically, the findings in this study showed a significant increase; the average value of each test movement on the FMS also showed an increase, although several test movements did not increase (Reaching and Lunging). Referring to Table 5, statistically, the squatting movement increased significantly in the experimental group. They were squatting on the FMS test to test bilateral mobility, symmetry, function, and stability of the hips, knees, and ankles. The squat was worked out in FIFA +11 and was inspected as profound squats in FMS. The jump workout is assessed in FMS with parallel thrust developments. Push-ups, jump steps, seat thing developments, and single-leg standing adjustments are required for FMS middle soundness. Neuromuscular coordination works are utilized in FMS rotating soundness developments. Sideway exercises and bench items to strengthen thigh muscles can help the participant properly perform the active straight leg raise movement of the FMS.

The FIFA 11+ encourages the correct change of basic motion from an incorrect movement created by the athlete. FMS educates football academy athletes to carry out effective basic movements that reduce the potential for injury. FIFA 11+ not only corrects basic movements but can also improve core

stability and balance (Bizzini et al., 2013; Daneshjoo et al., 2012b, 2012a) and proprioception (Seyedi et al., 2023).

The benefits of the FIFA 11+ program were not only to improve fundamental movements, but scientific evidence showed that the FIFA 11+ program can increase muscle strength and improve balance in the knee extensors and flexors (Brito et al., 2010), improving jump landing mechanics to reduce the risk of ACL injury (Zareei et al., 2018), reduces injuries by up to 65% (Al Attar, Bizzini, et al., 2021), improve balance and leg muscle strength in children aged 9-12 years (Sumartiningsih et al., 2022), and reducing upper extremity injuries in Goalkeepers (Al Attar, Faude, et al., 2021).

Comparable evaluations of the FIFA 11 and FIFA 11+ programs in grown-up football players have appeared to a critical diminishment in harm chance, with football wounds diminishing by 39% (Barengo et al., 2014; Sadigursky et al., 2017; Tseng et al., 2021). These discoveries emphasize the considerable effect of FIFA's harm avoidance activities in relieving harm rates in both grown-up and child football players.

The findings of our study, which were also confirmed by other studies, confirm that injury prevention programs are significant in the continuity of an athlete's career. Injuries significantly impact athletes, leading to a range of negative physical and psychological effects. These consequences can hinder their performance, mental health, and overall well-being. Understanding these effects is crucial for developing effective rehabilitation strategies. Injuries can result in a loss of athletic identity, causing feelings of worthlessness and decreased motivation during recovery (Husain, Almashouk, & Jahrami, 2024; Gervis et al., 2022). Injured athletes may isolate themselves from their peers, exacerbating feelings of loneliness and depression (Husain et al., 2024). The disadvantages experienced by athletes who suffer injuries were that they could not participate in training sessions and matches and could also stop being athletes. A case was experienced by Julian Nagelsman, who suffered a knee injury after joining the Augsburg youth team, and ultimately, he had to retire early due

to the injury he experienced. This was a scourge for athletes, especially football athletes, so it is mandatory for a coach to implement an injury prevention program through warm-up (FIFA 11+).

Limitations of the study

One of the limitations of this study was that it only involved participants in the broad age range, namely 14-17 years, with a minimal number of participants and only male participants. A study could involve large numbers of participants and investigate female athletes at football academies, considering that the development of women's football has shown its existence in various countries.

CONCLUSION

Our findings report that 12 FIFA 11+ program training sessions can improve fundamental movements in football academy athletes aged 14-17. This research also needs to be applied among female athletes, considering that women's football exists in several countries. Implementing FIFA +11 allows coaches to teach their players to do exercises with the right movement patterns to prevent future injuries.

Implementing an effective injury prevention program for football players requires a multifaceted approach that considers training, context, and stakeholder engagement. A successful program not only addresses the physical aspects of injury prevention but also incorporates strategies for effective implementation and adherence among players and coaches. Some recommendations for essential steps in injury prevention include identifying injury risks, regularly performing specialized warm-up exercises, increasing strength and flexibility, training in proper technique, implementing adequate rest and recovery, and monitoring training loads.

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DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [author initials], upon reasonable request.

FUNDING

This research did not receive external funding.

CONFLICT OF INTEREST

The author affirms that this research was conducted with complete independence and integrity and is free from any conflicts of interest with any organization, institution, or individual. No financial, professional, or personal affiliations could have influenced the study's design, data collection, analysis, or interpretation. This declaration ensures the objectivity and credibility of the research findings, reinforcing its contribution to sports injury prevention and athlete safety.

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