# The FIFA 11+ Kids Injury Prevention Program Reduces Injury Rates Among Male Children Soccer Players: A Clustered Randomized Controlled Trial

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**Background:** The Fédération Internationale de Football Association (FIFA) 11+ Kids is an exercise-based injury prevention program developed by an international group of experts to prevent injuries among child soccer players.

**Hypothesis:** It was hypothesized that the FIFA 11+ Kids program would be more effective than performing a typical warm-up regimen in reducing overall injuries among soccer players aged 7 to 13 years.

**Study Design:** A clustered randomized controlled trial.

**Level of Evidence:** Level 1.

**Methods:** A total of 94 boys' soccer teams, including 780 players, were randomly allocated into an experimental or control group. Complete datasets were collected from 45 teams (377 players) and 43 teams (363 players) in the experimental and control groups, respectively. The experimental group underwent the FIFA 11+ Kids program as a warm-up during training sessions and matches at least twice a week, and the control group continued performing their usual warm-ups. Participants were prospectively followed during 1 season (6 months). The primary outcomes included the incidence of overall and recurrent injuries and their mechanism and severity. The secondary outcome was the rate of compliance with the intervention program.

**Results:** A total of 43 injuries were reported in the experimental group in 50,120 hours of exposure (0.85 injuries/1000 exposure hours). A total of 86 injuries were reported in the control group in 42,616 hours of exposure (2.01 injuries/1000 exposure hours). The injury risk ratio was 0.43 (0.29-0.61), suggesting that the experimental group experienced 57% fewer injuries than those in the control group.

**Conclusion:** The FIFA 11+ Kids program reduced overall injury rates in children playing soccer more than the usual warm-ups.

**Clinical Relevance:** The results of this study provide evidence for children's coaches to consider including the FIFA 11+ Kids program in their warm-up regimen. Such a program may prevent injury risk and decrease absenteeism and injury-related financial burdens.

**Keywords:** children; football; injury incidence; sports; warm-up

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Soccer is among the most popular sports worldwide, especially among children and adolescents.[11] Most injuries (58%) in this sport occur in those aged <18 years,[13] and around three-quarters of them occur in young soccer players (<14 years).[13] The characteristics of these (soccer-related) injuries among children aged 7 to 12 years are different from those among youth and adult players.[31] However, the denominator is very high for the pediatric and adolescent age group (the injury rate in young children is fairly low). For example, upper limb and bone injuries are relatively more common in children aged 7 to 12 years than in adults.[12,33] However, epidemiological data on soccer injuries are rare in this age group,[14] and only 1 study (prospective large-scale study) has focused on injuries in children playing soccer.[32,33]

To counteract possible injury-related risks in children's sports, the implementation of injury prevention programs is necessary. Exercise-based injury prevention programs are effective in youth/adolescent sports.[29] Several studies have investigated and evaluated exercise-based injury prevention programs such as the Fédération Internationale de Football Association (FIFA) 11+ injury prevention program for athletes aged ≥14 years and found reductions (32%-72%) in the incidence of all lower limb injuries.[3,5,20,26,37,38] Furthermore, several systematic reviews provided additional evidence of the effect of the FIFA 11+ injury prevention program, specifically in youth amateur soccer.[1,2,9,21] Injury prevention programs, including 11+ Kids, have reduced injury rates and improved motor performance.[3-5,8,18,23,27,29-31,43]

The financial cost of injury is another essential consideration. Using injury prevention strategies and programs in this age reduces healthcare costs by more than 50% over 1000 exposure hours.[34] Rössler et al[31] and Zarei et al[42] have conducted randomized controlled trials (RCTs) using the FIFA 11+ Kids injury prevention program (to our knowledge, these are the only studies in children's soccer and other sports). Both studies found that the intervention group gained significantly better results in injury reduction than the control group. Still, these studies have been limited to teams in Europe and Iran, respectively.

Extrinsic risk factors have been analyzed, and it can be confirmed that they have an impact on the performance of pediatric and adolescent athletes. These factors include training in variable environmental conditions that are weather- and terrain-related.[7] An increase in temperature can be correlated with sweat loss, which may lead directly to dehydration; differences in sweat losses among players are likely to preclude a direct relation between dehydration and muscle fatigue during a match.[36] It has been found that there is a strong relationship between hot and/or sunny weather conditions (the typical weather in Saudi Arabia) and the rate of injuries.[7] The playing surface and the athlete's environment are significant factors to consider when studying the nature and incidence of soccer injuries.[25] Therefore, it is necessary to investigate the efficiency of the FIFA 11+ Kids injury prevention program on children of different populations, where diverse types of weather, terrain, and sports cultures may influence efficiency.

This study aimed to evaluate the effect of the FIFA 11+ Kids injury prevention program on reducing the incidence of upper and lower limb injuries among male Saudi Arabian soccer players aged 7 to 13 years. We hypothesized that this program would be more effective than performing a typical warm-up regimen in reducing overall injuries among male Saudi Arabian soccer players aged 7 to 13 years.

## METHODS

### Study Design and Participants

The study design was a clustered RCT (CRCT). The reporting of this study followed the Consolidated Standards of Reporting Trials (CONSORT) guidelines.[35] The definitions and data collection methods used in this trial followed international guidelines for surveillance of soccer injuries.[17] The trial protocol was registered with the Australian New Zealand Clinical Trials Registry (Registry Number: ACTRN12618001117202). The study received ethical approval from the Umm Al Qura University (approval number: HAPO02K012202010468).

Children's soccer teams at the amateur league level in different regions of Saudi Arabia were invited to participate. The invitations were sent to the eligible teams through the Saudi Federation of Sports Medicine and the Saudi Soccer Federation. Our study inclusion criteria were (1) teams registered in the local soccer association and undergoing regular training at least twice a week and (2) children aged 7 to 13 years and registered in the team. Participants and/or their guardians/parents were also asked to complete a health declaration form. Participants were excluded from the study if they had a history of upper and lower limb injury requiring medical attention in the past 6 months, systemic diseases, cardiovascular disease, neurological disorders, bone fractures, and/or surgery in the previous year (Figure 1).

### Randomization and Blinding

The eligible teams received an informed consent form and an information sheet about the project before study initiation. Once the teams agreed to participate, the children, their guardians/parents, and coaches signed the informed consent, and the baseline measurements were collected. Teams from the participating clubs were then randomized to the experimental group or control group using a randomization table created by computer software (ie, computerized sequence generation).

The randomization process was undertaken after enrolling and identifying every team, thus achieving concealed allocation. All teams of the same club were randomized into the same group (clustered allocation with the club serving as a cluster) to minimize the risk of contamination. Teams and the assessor in the experimental group were unaware of the experimental intervention hypothesis and whether they were different from the usual warm-up. Teams and the assessor in the control group were also blinded.

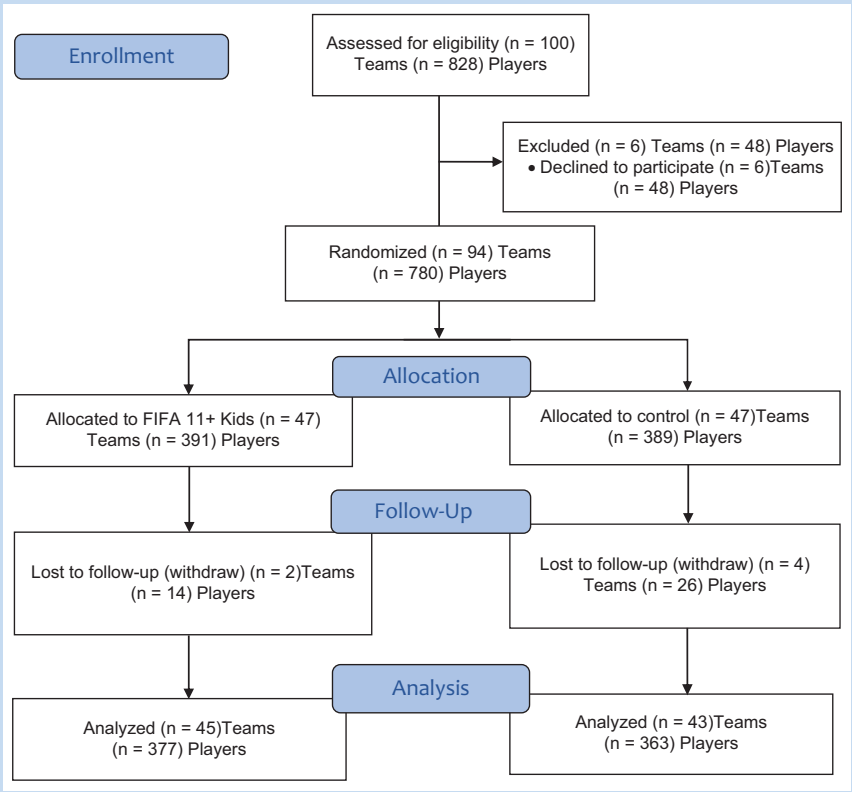


Figure 1. Design and flow of participants through the trial. FIFA, Fédération Internationale de Football Association.

## Procedure

Before commencement of the study, a minimum of 3 meetings (2-4 hours) were conducted by a researcher with each team's coaches and medical staff (team physician and team physical therapist) to inform them of the study's objectives and procedures, and to provide them with on-field practical training of the FIFA 11+ Kids injury prevention program. Coaches and medical staff tracked individual players and recorded overall injuries and exposure times. Medical staff reported sustained injuries in the experimental and control groups during training and matches by submitting the Sports Injury Tracker's information in compliance with the Australian Sports Injury Data Dictionary (Sports Medicine Australia) soccer injury reporting form weekly in English.[6]

## Intervention

The teams in the experimental group were instructed to replace their previous standard warm-up exercises with the FIFA 11+ Kids injury prevention program at the beginning of each training session throughout the season (6 months: August 2018-January 2019). The FIFA 11+ Kids injury prevention program was developed by various international experts and is specially designed for children, effectively preventing overall injuries in players aged 7 to 13 years.[31,33] The development of the FIFA 11+ Kids injury prevention program structure was based on the original adult FIFA 11+ injury prevention program.[3,5,30,31] However, the FIFA 11+ Kids injury prevention program differs from the FIFA 11+ injury prevention program for adults. The FIFA 11+ Kids injury prevention program focuses primarily on improving overall balance and coordination, and strengthening the upper and lower extremities and core muscles. The program also includes exercises that help children learn how to fall and roll to protect their head, neck, and upper extremity from injury.[18,30,33,42,44] According to this program, the manual contains 7 exercises, each with 5 levels of difficulty, and is suggested to be performed as a warm-up before training sessions.[16] The difficulty of each exercise was developed in consideration of the level of performance related to the age and maturity of children aged 7 to 13 years and for general differences in their motor skills. The program took 15 to 20 minutes and was performed biweekly.[30] More details are included in Table 1 and in the FIFA 11+ Kids injury prevention program manual.[18]

The control group continued using their usual or standard warm-up program. The usual warm-up is defined as a set of any basic exercises performed before a performance or practice to prepare the athlete for vigorous physical activity.

## Outcome Measures

The primary outcomes were the incidence of overall injury; upper and lower extremity injuries; and injury by mechanism (contact and noncontact), type (initial and recurrent), and

Table 1. The FIFA 11+ Kids injury prevention program's exercise prescription: sets and focus

| Exercise | Level | Sets | Focus |
|---|---|---|---|
| **(1) "Alertness" running game** | Listen for the stop command | 3 sets with 5 stop commands per set | Improving balance and coordination |
| | Watch for the stop command | 3 sets with 5 stop commands per set | |
| | Ball in the hands and listen for the stop command | 3 sets with 5 stop commands per set | |
| | Ball in the hands and watch for the stop command | 3 sets with 5 stop commands per set | |
| | Dribble with the ball and listen for the stop command | 3 sets with 5 stop commands per set | |
| **(2) Skating jumps** | Learning how to land | 2 sets of 10 jumps (5 per leg) | Stability of foot and knee joints. |
| | Ball in both hands | 2 sets of 10 jumps (5 per leg) | |
| | Balancing with the ball in 1 hand | 2 sets of 10 jumps (5 per leg) | |
| | Dropping the ball onto the ground | 2 sets of 10 jumps (5 per leg) | |
| | Dynamic balancing with ball | 2 sets of 10 jumps (5 per leg) | |
| **(3) Single-leg stance** | Throwing the ball | 1 set on each leg, 5 throws per player | Maintaining balance when given additional tasks |
| | Throwing the ball and moving it around the free leg | 1 set on each leg, 5 throws per player | |
| | Passing game | 1 set on each leg, 5 passes per player | |
| | Throwing the ball and passing back without touching the ground | 1 set on each leg, 5 passes per player | |
| | Testing the partner's balance | 1 set on each leg for 20 s each | |
| **(4) Press-ups** | Tunnel | 2 sets, with each child rolling the ball once (maximum 8 players per group) | Strengthening the core and arm muscles |
| | Forearm support; shin resting on ball | 3 sets of 15 s each | |
| | Rolling the ball around the hands | 3 sets of 15 s each | |
| | Rolling the ball between hands and feet | 3 sets of 15 s each | |
| | Hands on the ball | 3 sets of 15 s each | |

*(continued)*

Table 1. (continued)

| Exercise | Level | Sets | Focus |
|---|---|---|---|
| **(5) Single-leg jumps** | Forwards | 2 sets of 5 jumps on each leg | Strengthening the leg muscles, improving balance and coordination |
| | Back and forth | 2 sets of 5 jumps on each leg | |
| | Sideways | 2 sets of 5 jumps on each leg | |
| | The coach indicates the direction | 2 sets of 5 jumps on each leg | |
| | The coach indicates the direction, ball in both hands | 2 sets of 5 jumps on each leg | |
| **(6) Spiderman** | Stroking the ball | 3 sets of 15 s each | Strengthening the core muscles and the hamstrings |
| | A proper stretch | 3 sets of 15 s each | |
| | The crab | 3 sets (5-10 meters, depending on ability) | |
| | Dribbling | 3 sets (5-10 meters, depending on ability) | |
| | Ball bearing | 3 sets (3-7 meters, depending on ability) | |
| **(7) Sideways roll** | Squatting position | 5 rolls per side | Learning how to fall and roll (to protect the head, neck and upper extremity) |
| | Slowly from a standing position | 5 rolls per side | |
| | Dynamically from a standing position | 5 rolls per side | |
| | From a slow walk | 5 rolls per side | |
| | From a faster forward movement | 5 rolls per side | |

FIFA, Fédération Internationale de Football Association.

severity (minor, 1-7 days lost; moderate, 8-21 days lost; and severe, ≥21 days lost). Injury rates were summarized as the number of injuries per 1000 player-hours for matches and training. Exposure time in hours was calculated for each team for over 6 months. The secondary outcome was the rate of compliance with the intervention program. Compliance with the intervention program was evaluated by measuring player participation rate using an attendance log. The team level of compliance with the intervention program was calculated by dividing the number of sessions attended by the total number of prescribed sessions, multiplied by 100. The investigator scheduled weekly visits for 1 team selected randomly from each group throughout the study period to motivate the teams and ensure that the program was being followed consistently and accurately.

An injury was reported if it prevented the player from participating completely in the subsequent soccer match or training session.[17] Furthermore, our study included any injury to

Table 2. Teams: hours of exposure

| Exposure variables | Total (hours) | | Mean (SD) | | Mean difference (95% CI) |
|---|---|---|---|---|---|
| | Exp | Con | Exp | Con | Exp minus con |
| Match exposure | 11,352 | 10,984 | 1892 (1303.31) | 1830.67 (1311.86) | 61.33 (0-576) |
| Training exposure | 38,768 | 31,632 | 6461.33 (3990.64) | 5272 (3522.25) | 1189.33 (168-3024) |
| Overall exposure | 50,120 | 42,616 | 8353.33 (5290.16) | 7102.67 (4829.99) | 1250.67 (0-3600) |

Con, control group; Exp, experimental group.

any part of the upper and lower extremities (ie, any body part from the head to the toes).

### Statistical Analysis

An electronic spreadsheet was used to compute exposure time and incidence rate measures. The recorded data were then exported, and statistical analyses were conducted using IBM SPSS Statistical Package for the Social Sciences version 21 (IBM Corp). Poisson regression analysis with General Estimating Equation (GEE) modeling was used to compare the total injury sustained, incidence of injury based on location, and the type of injury between the experimental and control groups.

A binary logistic regression analysis was performed using the GEE model to compare the incidence of injury rates between the groups. A cumulative logistic regression analysis was conducted to compare the injury severity between the groups. Furthermore, a GEE binomial regression analysis was used to test the age group interaction with intervention on injury incidence. Injury risk ratio (IRR) with 95% CI were used. Detailed statistical analyses and the data files are provided in the Appendices (available in the online version of this article).

A post hoc power calculation was performed using the G*Power software version 3.1.9.2 (Universität Düsseldorf).[15] The *Z*-test (logistic regression) was used, with a total of 89 teams (group 1 = 43; group 2 = 46), the significance level of 0.05, and an odds ratio of 9.43 for injury incidence achieved a power of 99%.

## RESULTS

### Flow of Participants

A total of 100 teams (828 players) progressed through the assessment of their eligibility throughout the precompetition season from May to July 2018. Before starting the competition season, 6 teams refused to participate further in the study. Therefore, the remaining 94 teams (780 players) were assigned randomly to either the experimental (47 teams, 391 players) or the control (47 teams, 389 players) group. A total of 88 teams (740 players) completed the study, and 6 teams (2 experimental group; 4 control group) withdrew from the study because of limits on their training time. Complete datasets were collected from 45 teams (377 players) and 43 teams (363 players) in the experimental and control groups, respectively. Data from all the 6 withdrawn teams before dropout were collected and included in Appendix 1 (available online). However, the dropout data were excluded from the analysis.

### Effect of the Intervention

#### Overall Injury Rate per 1000 Player-Hours

A total of 43 injuries (0.85 injuries/1000 exposure hours) were reported during 1 season in 50,120 hours of exposure by the experimental group participants, and 86 injuries were reported by those in the control group in 42,616 hours of exposure (2.01 injuries/1000 hours) (Tables 2 and 3).The IRR was 0.43 (95% CI, 0.29-0.61),which suggests that the experimental group experienced 57% fewer injuries than those in the control group.

#### Overall Injuries Based on Location

According to the results from the GEE Poisson regression, the prevention program in the experimental group led to a significant reduction of injury ($P = 0.001$) in the knee, lower leg, and ankle compared with the control group.

#### Incidence of the Initial Injury

The injury rate was significantly lower in the experimental group ($P = 0.001$) than in the control group (Table 3). Moreover, the odds of a player within teams in the control group being injured was 2.07 times higher than that in the intervention group. The initial IRR was 0.43 (95% CI, 0.30-0.63), indicating 57% fewer injuries in the experimental group.

#### Incidence of Recurrent Injury

There was no significant difference between the control and experimental groups in the incidence of recurrent injuries ($P = 0.52$) (Table 3). Furthermore, the odds of recurrent injury were 2.68 times higher in the control group (5 recurrent injuries) than in the experimental group (2 recurrent injuries). The recurrent IRR was 0.34 (95% CI, 0.07-1.75)

#### Incidence of Injury Mechanism

The contact, noncontact, and overuse injury rates were significantly lower in the experimental group than in the control

Table 3. Injury rates by body region/specific structure, provisional diagnosis, mechanism of injury, type of injury, and provisional severity assessment (defined as time loss in days) for the experimental and control groups

| | Exp Injuries (n) | EXP Incidence (injuries/1000) | Con Injuries (n) | Con Incidence (injuries/1000) | IRR [95% CI] |
|---|---|---|---|---|---|
| **Body region/specific structure** | | | | | |
| **Head and neck** | | | | | 0.57 [0.09, 3.39] |
| Scalp | 1 | 0.020 | 2 | 0.047 | |
| Neck soft tissue | 1 | 0.020 | 1 | 0.023 | |
| **Thorax** | | | | | 0.43 [0.04, 4.69] |
| Soft tissues - posterior muscles | 0 | 0.000 | 1 | 0.023 | |
| Soft tissues - anterior and lateral muscles | 1 | 0.020 | 1 | 0.023 | |
| **Abdomen** | | | | | 0.43 [0.04, 4.69] |
| Abdominal muscles | 0 | 0.000 | 1 | 0.023 | |
| Skin | 1 | 0.020 | 1 | 0.023 | |
| **Lower back** | | | | | 0.43 [0.04, 4.69] |
| Soft tissues - posterior muscles | 1 | 0.020 | 1 | 0.023 | |
| Soft tissues - ligaments and tendons | 0 | 0.000 | 1 | 0.023 | |
| **Pelvis** | | | | | 0.21 [0.02, 1.90] |
| Hip bones (iliac, pubic, sacrum) | 0 | 0.000 | 1 | 0.023 | |
| Groin muscles | 1 | 0.020 | 3 | 0.07 | |
| **Shoulder** | | | | | 0.28 [0.03, 2.72] |
| Anterior soft tissues (joint capsule, tendons, and ligaments) | 0 | 0.000 | 1 | 0.023 | |
| Posterior soft tissues (joint capsule, tendons, and ligaments) | 0 | 0.000 | 1 | 0.023 | |
| Skin | 1 | 0.020 | 1 | 0.023 | |
| **Upper arm** | | | | | 0.28 [0.03, 2.72] |
| Anterior muscles and soft tissues | 0 | 0.000 | 1 | 0.023 | |
| Posterior muscles and soft tissues | 0 | 0.000 | 1 | 0.023 | |
| Skin | 1 | 0.020 | 1 | 0.023 | |
| **Elbow** | | | | | 0.28 [0.03, 2.72] |
| Ulnar-humeral joint | 0 | 0.000 | 1 | 0.023 | |
| Lateral soft tissues | 0 | 0.000 | 1 | 0.023 | |
| Skin | 1 | 0.020 | 1 | 0.023 | |

*(continued)*

Table 3. (continued)

| | Exp Injuries (n) | EXP Incidence (injuries/1000) | Con Injuries (n) | Con Incidence (injuries/1000) | IRR [95% CI] |
|---|---|---|---|---|---|
| **Forearm** | | | | | 0.28 [0.03, 2.72] |
| Ulna | 0 | 0.000 | 1 | 0.023 | |
| Lateral soft tissues | 0 | 0.000 | 1 | 0.023 | |
| Blood vessels | 1 | 0.020 | 1 | 0.023 | |
| **Wrist, hand, and fingers** | | | | | 0.85 [0.17, 4.21] |
| Bones (metacarpals, phalanges) | 0 | 0.000 | 1 | 0.023 | |
| Soft tissues (ligaments, tendons) | 1 | 0.020 | 1 | 0.023 | |
| Skin | 2 | 0.040 | 1 | 0.023 | |
| **Thigh** | | | | | 0.43 [0.13, 1.41] |
| Anterior muscles (quadriceps) | 2 | 0.040 | 4 | 0.094 | |
| Posterior muscles (hamstrings) | 2 | 0.040 | 4 | 0.094 | |
| **Knee** | | | | | 0.43 [0.19, 0.95] |
| Tibiofemoral joint | 1 | 0.020 | 2 | 0.047 | |
| Patellofemoral joint | 1 | 0.020 | 2 | 0.047 | |
| Superior tibiofibular joint | 1 | 0.020 | 2 | 0.047 | |
| Soft tissue - cartilage (meniscus) | 1 | 0.020 | 2 | 0.047 | |
| Soft tissue - ligaments, tendon, or joint capsule | 1 | 0.020 | 2 | 0.047 | |
| Blood vessels | 2 | 0.040 | 4 | 0.094 | |
| Skin | 2 | 0.040 | 4 | 0.094 | |
| **Lower leg** | | | | | 0.38 [0.12, 1.23] |
| Tibia | 0 | 0.000 | 1 | 0.023 | |
| Fibula | 0 | 0.000 | 1 | 0.023 | |
| Anterior compartment muscles | 1 | 0.020 | 2 | 0.047 | |
| Posterior compartment muscles | 1 | 0.020 | 2 | 0.047 | |
| Calf muscles (gastrocnemius and soleus) | 1 | 0.020 | 1 | 0.023 | |
| Skin | 1 | 0.020 | 1 | 0.023 | |
| Blood vessels | 0 | 0.000 | 1 | 0.023 | |

*(continued)*

Table 3. (continued)

| | Exp Injuries (n) | EXP Incidence (injuries/1000) | Con Injuries (n) | Con Incidence (injuries/1000) | IRR [95% CI] |
|---|---|---|---|---|---|
| **Ankle** | | | | | 0.43 [0.17, 1.05] |
| Talocrural joint | 1 | 0.020 | 2 | 0.047 | |
| Inferior tibiofibular joint | 1 | 0.020 | 2 | 0.047 | |
| Soft tissue - ligaments and joint capsule | 1 | 0.020 | 2 | 0.047 | |
| Soft tissue posterior tendons (Achilles) | 1 | 0.020 | 3 | 0.07 | |
| Soft tissue anterior/lateral tendons (tibialis anterior, peroneii, extensor hallicis) | 0 | 0.000 | 2 | 0.047 | |
| Blood vessels | 1 | 0.020 | 1 | 0.047 | |
| Skin | 2 | 0.040 | 2 | 0.047 | |
| **Foot and toes** | | | | | 0.57 [0.20, 1.59] |
| Tarsal bones | 1 | 0.020 | 1 | 0.047 | |
| Metatarsal bones and phalanges | 1 | 0.020 | 1 | 0.047 | |
| Soft tissue - plantar fascia and muscles | 1 | 0.020 | 2 | 0.047 | |
| Metatarsophalangeal joints | 1 | 0.020 | 1 | 0.047 | |
| Ligaments, tendons | 1 | 0.020 | 2 | 0.047 | |
| Skin | 1 | 0.020 | 2 | 0.047 | |
| **Provisional diagnosis** | | | | | |
| Abrasion/graze | 5 | 0.100 | 10 | 0.235 | 0.43 [0.15, 1.24] |
| Sprain | 4 | 0.080 | 9 | 0.211 | 0.38 [0.12, 1.23] |
| Strain | 5 | 0.100 | 8 | 0.188 | 0.53 [0.17, 1.62] |
| Open wound/laceration/cut | 3 | 0.060 | 4 | 0.094 | 0.64 [0.14, 2.85] |
| Bruise/contusion | 6 | 0.120 | 10 | 0.235 | 0.51 [0.19, 1.40] |
| Inflammation/swelling | 7 | 0.140 | 10 | 0.235 | 0.60 [0.23, 1.56] |
| Fracture (including suspected) | 3 | 0.060 | 9 | 0.211 | 0.28 [0.08, 1.05] |
| Dislocation/subluxation (including suspected) | 3 | 0.060 | 6 | 0.140 | 0.43 [0.11, 1.70] |
| Overuse injury to muscle or tendon | 5 | 0.100 | 16 | 0.375 | 0.27 [0.10, 0.73] |
| Blisters | 2 | 0.040 | 2 | 0.047 | 0.85 [0.12, 6.04] |
| Concussion | 0 | 0.000 | 2 | 0.047 | 0.17 [0.01, 3.54] |

*(continued)*

Table 3. (continued)

| | Exp Injuries (n) | EXP Incidence (injuries/1000) | Con Injuries (n) | Con Incidence (injuries/1000) | IRR [95% CI] |
|---|---|---|---|---|---|
| **Mechanism of injury** | | | | | |
| Contact | 26 | 0.519 | 44 | 1.032 | 0.50 [0.31, 0.82] |
| Noncontact | 12 | 0.239 | 26 | 0.61 | 0.39 [0.20, 0.78] |
| Overuse | 5 | 0.100 | 16 | 0.375 | 0.27 [0.10, 0.73] |
| **Type of injury** | | | | | |
| Initial | 41 | 0.818 | 81 | 1.901 | 0.43 [0.30, 0.63] |
| Recurrent | 2 | 0.04 | 5 | 0.117 | 0.34 [0.07, 1.75] |
| **Provisional severity assessment (Time loss, days)** | | | | | |
| Mild (1-7 days modified activity) | 23 | 0.459 | 47 | 1.103 | 0.42 [0.25, 0.69] |
| Moderate (8-21 days modified activity) | 17 | 0.339 | 30 | 0.704 | 0.48 [0.27, 0.87] |
| Severe (>21 days modified or lost) | 3 | 0.060 | 9 | 0.211 | 0.28 [0.08, 1.05] |
| **All injuries** | 43 | 0.858 | 86 | 2.018 | 0.43 [0.29, 0.61] |

Con, control group; Exp, experimental group; IRR, injury risk ratio.

group ($P$ = 0.001) (Table 3). Moreover, the odds of a player within teams in the control group being injured were higher (1.60; 2.58, respectively) than those in the intervention group. The contact IRR was 0.50 (95% CI, 0.31-0.82), noncontact IRR was 0.39 (95% CI, 0.20-0.78) and overuse IRR was 0.27 (95% CI, 0.10-0.73).

### Incidence of Injury Severity

For injured players, a GEE cumulative logistic regression did not indicate that the injury's severity would depend upon whether the player's team participated in the intervention, as there was no significant difference in the overall severity of injury between the 2 groups ($P$ = 0.97). However, the mild IRR was 0.42 (95% CI, 0.25-0.69), moderate IRR was 0.48 (95% CI, 0.27-0.87), and severe IRR was 0.28 (95% CI, 0.08-1.05) (Table 3).

The deidentified individual participant data are presented in Appendix 1 (available online). For further transparency, a detailed statistical analysis report is presented in Appendix 2 (available online).

## Age Group

The teams were divided into 3 age groups (years): 8 to 9 years (n = 26), 10 to 11 years (n = 31), and 12 to 13 years (n = 37). No significant difference in the incidence of injuries was found between the 3 age groups ($P$ = 0.05). There was a significant interaction between age group and intervention ($P$ = 0.001). Figure 2 displays the difference in the effect of the intervention across the 3 age groups of players.

## Compliance with Intervention

The level of team compliance with the intervention was 94% in the experimental group (45 teams), with 45/48 training sessions completed. The compliance level of the control group (43 teams) was 89%, with 43/48 training sessions completed. The GEE binomial regression indicated no significant difference in the team compliance level between the experimental and control groups ($P$ = 0.44). However, the odds of compliance of the control group were only 0.48 times (95% CI, 0.07-3.06) lower than those of the experimental group.

# DISCUSSION

In this study, lower limb injury incidence reductions in young athletes (aged 7-13 years) were similar to those in other studies that used a similar warm-up program. A study by Rössler et al[31] found a 48% reduction in total injury rates, with a 55% reduction in lower extremity injury rates in young soccer players. The number of total injuries sustained by the control group players was approximately 41% greater (235 vs 139 injuries) than their experimental group counterparts. Similarly, in this study, the total number of injuries sustained by the young players in the control

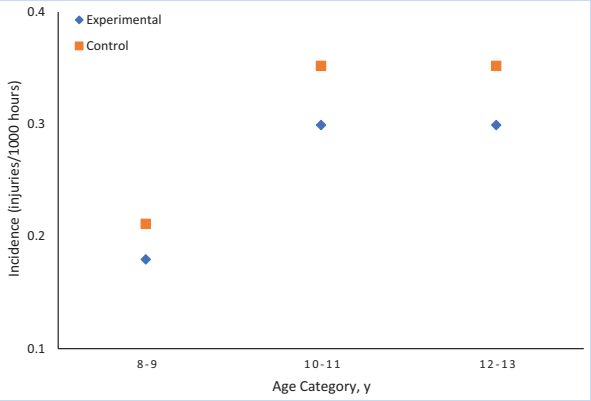


Figure 2. Profile plot showing the difference in the effect of the intervention across 3 different age groups of players.

group was 50% greater (86 vs 43 injuries) than their experimental group counterparts. Both studies had the control group teams continue using their usual warm-up before starting each session, which may have had different exercises, accounting for this difference. Nonetheless, both studies have shown a significant reduction in the number of total injuries, supporting the effect of this injury prevention program.

Our results demonstrated the effectiveness of the FIFA 11+ Kids prevention program in reducing the incidence of lower extremity injuries, including knee injuries, in young (7-13 years) male athletes. A previous RCT found that young female athletes involved in other specialized prevention programs had a lower rate of lower extremity injuries than the control group.[22] Another study on young female players reported the effectiveness of another comparable program in reducing noncontact anterior cruciate ligament injuries.[19]

The typical weather (sunny and hot) in Saudi Arabia does not appear to have affected our findings. The results agree with the findings of studies of similar programs in different countries (Europe, Iran, and the United States) with different weather conditions.[19,22,42] It appears that injury prevention programs reduce the incidence of lower extremity injuries regardless of climate. However, the above comparisons between our study and other studies should be interpreted with caution due to the differences among the studies in their objectives and different inclusion criteria (ie, older age groups). Therefore, future studies are needed to determine which key components among these different interventions, and which program, are most effective in preventing injuries and require less time and effort.

This study provided evidence of a low incidence of contact injuries, initial injuries, and minor and moderately severe injuries. A similar study also showed a significant decrease in the number of contact injuries, severe injuries, and injuries sustained during both training and competition by using the experimental protocol.[10] In addition to that, previous studies have provided evidence that this prevention program is efficacious in reducing risks of injury, especially lower extremity injuries, which are the most common and most severe injuries in youth soccer.[10,14,28,31,42] This further demonstrates the necessity for comprehensive injury prevention programs such as FIFA 11+ Kids.

In the case of recurrent injury rates, no significant difference was found after using the program. Some studies have revealed that improving balance and coordination and physical fitness components like muscular strength and endurance can play a large role in preventing initial injuries, but that may not have the same effect on recurrent injuries as they were shown to have on a different injury pattern.[39,40] Among young high school athletes, girls were found to have higher rates of recurrent injuries than boys in soccer,[40] which supports the notion that sex may influence injury pattern, especially in adolescence.[14] Conversely, previous injuries to the lower extremity would hinder appropriate reactions to perturbations,[24] which may increase the risk of future injuries. Since the FIFA 11+ Kids injury prevention program has positive effects on the neuromuscular performance and motor coordination, which in turn has positive effects on the response to perturbations and protective effects from contact injuries, it can prevent initial injuries, as observed in this study, if used intensively and regularly.[30,41,42]

Injury severity was categorized into 3 groups (minor, moderate, and severe) based on the number of days lost owing to injury. No relationship was found between the severity of the injury and the experimental protocol; however, Rössler et al[31] reported a 74% reduction in severe injuries after using a similar experimental protocol. This reduction in severe injuries was greater than in other studies with older athletes.[29] The mean age of the players in a similar study was 10.8 years (SD, 1.4) as opposed to this study with a greater number of older children aged 12 to 13 years.[31] More research is needed to determine whether a smaller age range is needed to explore the effect of this prevention program on adolescent development.

Our results showed no significant difference in the level of team compliance with the intervention between the experimental and control groups. However, Rössler et al[31] found that injury incidence decreased with increasing compliance. Compliance was found to lead to injury reduction in both research and real-life settings by many other studies as well.[41] A previous compliance analysis demonstrated a dose-response relationship between the rate of injury and utilization frequency of this prevention program.[32] Researchers deduced that benefits could be achieved using the program once a week, and using it more often could maximize those benefits.[41]

There are major limitations to the current study. First, only male soccer players aged 7 to 13 years were recruited in this study because no females were involved in organized soccer in Saudi Arabia at the time of this trial. Thus, our findings cannot be generalized to young female soccer players. Second, analysis did not consider engagement in other sports or playing soccer outside the team. Including all physical activities may vary injury rates based on the change in exposure time data. Third, we could not ensure the comparability of treatment groups as

the collected baseline measurements included only the number of teams and players as well as their age. However, as long as the participants were randomized to the groups, this will produce comparable groups and eliminate a source of bias in the treatment assignment. Fourth, 6 teams did not complete the study; therefore, dropout and adherence to the interventions should be addressed in future research.

## CONCLUSION

The results of this study showed approximately a 57% reduction in total injury rates after using the FIFA 11+ Kids injury prevention program for 6 months in Saudi Arabian male soccer players aged 7 to 13 years. There was also a decrease in the number of minor and moderate injuries and lower extremity injuries—the most common injuries in soccer. These findings reinforce the importance of implementing injury prevention programs for boys/children playing soccer.

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