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Effects of FIFA 11+ injury prevention program in reducing the Non-Specific knee injuries incidence rate among soccer players. A systematic review and meta-analysis

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Abstract

Soccer players most frequently suffer from severe leg injuries, particularly effecting the knee. Soccer players worldwide, of all ages, genders, and levels of expertise, frequently encounter with knee injuries. These injuries have a negative influence on physical activity and lost workdays, as well as high medical expenses.

Therefore, it is imperative to assess the effectiveness of various injury prevention programs in lowering the number of knee injuries related to soccer. The main aim of this study is to assess the potential effects of Federation Internationale de Football Association (FIFA) 11+ injury prevention program in reducing the non-specific knee injuries in soccer players.

Methodology: A systematic search was conducted in the PubMed, PubMed Central, Cochrane central library, Ovid Medline, Worldwide science (Organization), and APA Psycnet databases from February 2002 to February 2022. A total of 65,232 records were in databases, with 98 records from organizations, and after removing duplicate entries and completing the screening procedure, this meta-analysis included three cluster randomized control trials with 3,833 participants that matched our inclusion criteria. The major criteria for inclusion and exclusion were randomized control trials that used the FIFA 11 + injury prevention program for not less than 6 months and reported the overall incidence rate of knee injuries without addressing individual knee injuries.

Results: The FIFA11+ injury prevention program was found to be effective based on total injuries per 1000 hours of exposure, according to pooled statistics. There was significant statistical reduction in knee injury risk ratio (IRR) of 0.477 (95% confidence interval (CI), 0.367- 0.621 p=0.000). Teams using FIFA 11+ injury prevention program demonstrated up to 47% of reduction in knee injuries as compared to the control group which performed usual warm up exercises as intervention.

Conclusion: This comprehensive review and meta-analysis show how effective the FIFA 11+ injury prevention program is at preventing non-specific knee injuries in soccer players. This protocol is registered in international prospective register of systematic reviews PROSPERO (CRD42022298748).

Keywords: Athletes, Exercises, FIFA 11+ injury prevention program, knee injury, meta-analysis, soccer players

1. Introduction

Soccer (football), a game that is played all over the world, is also one of the most widely known sports to result in injuries^[1, 2]. Soccer injuries have been linked to decreased physical activity and lost work time, as well as significant medical costs^[3, 4]. Leg injuries, particularly knee injuries, are the most common and severe among soccer players^[5, 6]. Knee injuries are widespread among soccer players of all ages, genders, and skill levels around the world^[7, 8, 9].

They are responsible for 17% of all injury cases, i.e the most prevalent areas of trauma.¹⁰ Soccer clubs are concerned about any injury to a player that results in missed days and time on the injured list because of the influence on their team's competitiveness and the financial impact of poor performance^[11, 12].

During the 1999–2000 season, the financial loss due to football injuries was predicted to be at 118 million euros in the professional English football leagues [13]. The overall number of time-loss injuries and missed matches in the Australian Professional League (A-League) rose from 129 in 2008 to 1110 in 2011 [11]. The total time-loss injuries and matches lost across five A-League seasons (2008–2009 to 2013–2014) resulted in high costs (up to AUD37 million in the 2012–2013 season) [11]. Because of its significant financial impact on soccer clubs and teams performance, lowering the rate of injuries is critical for minimizing the expense of injuries as well as the risk of injuries [14, 15, 16]. Injury prevention programs based on exercise have been demonstrated to be beneficial in lowering the likelihood of sports injuries and the repercussions that come with them [17, 18].

Federation Internationale de Football Association (FIFA) Medical and Research Centre (F-MARC) developed the F-MARC, FIFA 11, and FIFA 11+ injury prevention programs in collaboration with the Santa Monica Orthopedic and Sports Medicine Research Foundation (SMSMF) and the Oslo Sports Trauma Research Centre (OSTRC) [19, 20]. The FIFA 11+ program is organized into three components that should be completed at least twice a week as a warm-up before each training session, high-speed planting and cutting, running and rigorous stretching, and core and leg strengthening [21]. These exercises strengthen the legs and core while enhancing balance, agility, and neuromuscular control in a static, dynamic, and reactive manner [21]. The aim of this program is to improve an athlete's strength while also lowering injury rates in amateur and professional football players [22]. It has been studied and proved to be helpful in preventing injuries in both male and female athletes at all levels (amateur, semi-professional, and professional) [21-25].

Crossley KM, *et al.* [26] assessed the effectiveness of injury prevention programs on injury incidence in female soccer players in a systematic review and meta-analysis published recently. Their investigation showed that exercise-based techniques reduced the likelihood of knee, ankle, and hip/groin injuries, and that using various training components led to significant overall and knee injury reductions of up to 15%–17%. to (0.57, 95% CI 0.51 to 0.64), $p=0.242$. However, in addition to FIFA11+, this study included other injury prevention programs such as Neuromuscular training (CORE intervention), Neuromuscular training (plus home-based balance training), Eccentric hamstring exercises, Neuromuscular training (PEP programme), Neuromuscular training (Frappier Acceleration Training programme), and Balance board training (home-based) etc. [26].

Thorborg *et al.* [27] analysed two specific exercise-based injury prevention programs, FIFA 11 and FIFA 11 +, they found that FIFA 11+ has a significant injury-preventing effect, reducing football injuries by 39%. The total injury risk ratio was reduced by 0.75 (95% CI 0.57 to 0.98), $p=0.04$. The main analysis was in support of the FIFA injury prevention measures. Secondary analyses revealed that

when trials implementing the FIFA 11+ preventative program were pooled, the overall injury risk ratio was reduced in favor of the FIFA 11+ prevention program (incidence rate ratio (IRR) 0.61; 95% confidence interval (CI) 0.48 to 0.77, $p=0.001$). When the studies that included the FIFA 11 preventive program were combined, no reduction was found (IRR 0.99; 95% CI 0.80 to 1.23, $p=0.940$). In the case of knee injuries, the FIFA11+ program has a reduction of (IRR 0.52; 95% CI 0.38 to 0.72, $p=0.001$, $I^2=0.0$ percent, $p=0.573$) [27]. This study analyzed the effects of FIFA and FIFA 11+ injury prevention program in reducing the overall injury rate in football in contrast, our study analyzed the effects of FIFA 11+ injury prevention program focusing on reducing only non-specific knee injuries.

Attar *et al.* [28] assessed the effectiveness of FIFA 11+ injury prevention programs for soccer players in a systematic review and meta-analysis in 2015. They found that FIFA '11+' reduced the total injury risk ratio to 0.654 (95% CI 0.537–0.798, p 0.001) and the lower extremity injury risk ratio to 0.612 (95% CI 0.475–0.788, p 0.001), both of which were statistically significant. FIFA '11', on the other hand, did not achieve statistical significance in terms of lower extremity injury reduction or overall injury reduction. In comparison to teams that do not participate in F-MARC FIFA 11+ programs, it is estimated that teams participating in the FIFA '11+' warm-up program will lower injury rates by 20 to 50 percent in the long term. In their analysis, however, no specific lower extremity injury, including knee injury, was reported [28]. A meta-analysis of the existing evidence is required to assess the effectiveness of the FIFA11+ injury prevention program in reducing the rate of non-specific knee injuries.

The goal of this study is to see how effective the FIFA11+ injury prevention program is at reducing the occurrence of non-specific knee injuries among soccer players.

2. Main text

2.1 Methods

PRISMA 2020, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses, was used to conduct this systematic review and meta-analysis [29].

2.2 Search method data sources

From February 2002 and February 2022, two independent authors, M.A.K and S.A.S, conducted a literature search in the electronic databases PubMed, PubMed Central, Ovid Medline, Cochrane central library, APA Psycnet, and Worldwide science.org. A total of 65,232 records were in databases from which 63,230 records were removed before title abstract screening due to irrelevant studies (Appendix 1), 98 records from organizations, and after removing duplicate entries and completing the screening procedure, this meta-analysis included three cluster randomized control trials with 3,833 participants that matched our inclusion criteria. The following search terms were used to identify the relevant literature: Athletes OR soccer players AND

FIFA 11+ injury prevention program OR Injury prevention program AND Knee injuries OR Knee injury.

2.3 Selection of studies

The studies were selected when they met the following criteria: 1) Exposure hours and non-specific knee injury rates which did not mention any anatomical location of the injury around or within the knee joint. 2) Total duration of study not less than 6 months 3) No pre-existing injuries reported in the soccer players 4) Performed FIFA 11 + injury prevention program in intervention group 5) Between age group of 13- 40 years male or female. 6) Must be 'usual' 'different' or 'no injury prevention program' in the control group. This review included original research articles with cluster randomized control trials that were written in English. The first author read the full text articles that were selected, and the data was compiled in a Microsoft excel sheet.

2.4 Data extraction

Data was extracted from the full text by two researchers independently. The number of knee injuries (injury rates), exposure hours, follow-up time, and compliance rate were obtained as outcome factors from the studies. The type of study and the year of study were also recorded. The Endnotes web version was used for study collection, collation, and screening. The primary outcome results from the selected studies were retrieved and compiled in Microsoft Excel before being imported into CMA v3 (Comprehensive meta-analysis software, version 3) (Biostat, inc., Englewood, NJ, USA).

2.5 Assessment of risk of bias

The methodological quality of the studies was appraised by two investigators independently. Furlan *et al.* recommended that the quality criteria and bias risk be evaluated using 12 criteria^[30]. Each component was given a point value of (+ = 1 Point or ? = 0 Points). Any study that had a score of more than 60% was deemed to be of high quality or low of risk of bias^[30]. The quality of the studies' scores is showed in Table 1.

Table 1: Illustrates the methodological quality scores of the studies that were included.

Criterion	Soligard <i>et al.</i> ^[34]	Owoeye <i>et al.</i> ^[35]	Silvers-Granelli <i>et al.</i> ^[3]
Adequate randomization	+	+	+
Allocation concealment	+	+	+
Blinding patients	-	-	+
Blinding caregiver	-	-	+
Blinding/outcome assessors	-	-	+
Incomplete outcome data addressed/drop-outs	+	+	+
Incomplete outcome data/intention-to-treat (ITT) analysis.	+	+	+
Free of suggestions of selective outcome reporting	+	+	+
Similar baseline characteristics	+	+	+
Co-interventions avoided or similar	+	+	-
Compliance acceptable in all groups	+	+	+
Similar timing of outcome assessment	+	+	+
Score maximum	12	12	12
Study score	9	9	11
Percentage	75	75	91.6
‘?’ = Yes, ‘-’ = No. For each question only ‘Yes’ received a point. No points were awarded for ‘No’			

3. Results

3.1 Statistical analysis

Comprehensive meta-analysis software, version 3 (CMA v3) was used to perform meta-analysis of the extracted data. The injury incidence rate is calculated by dividing the overall number of injuries by the total number at risk, then multiplying by 1000 to accommodate for individual athlete exposure time differences^[31]. The IRR was calculated by dividing the injury incidence rate in the intervention group by the injury rate in the control group. An IRR of 1 indicates that an intervention was successful; in contrast, an IRR of 0.30 indicates a 70% reduction^[32].

3.2 Definition of knee Injury

A tibio-femoral or patello-femoral ligament, meniscal, or other intra-articular tibio-femoral or patello-femoral injury that required medical attention and prevented regular sport participation was classified as a knee injury^[33]. In this review, a knee injury is defined as any non-specific knee injury that has been described in the literature, regardless of anatomical considerations.

3.3 Search results: A total of 65,330 records were found: 64,048 in databases, 1,184 in registers, and 98 in organizations that were not further processed. 1,972 records were screened for title and abstracts, 1,899 records were excluded after screening, 73 records were sought for retrieval, and 54 records were not retrieved, 19 records were assessed for eligibility, and 16 records were excluded for not meeting the inclusion criteria, and the remaining 3 studies were included in this meta-analysis. Figure 1 depicts how studies are chosen and added to the PRISMA flow diagram in 2020^[33].

3.4 Study Characteristics.

The study included three cluster randomized controlled trials^[34, 35, 36]. One study was carried out in Norway^[34], one of them was in Nigeria^[36], and the other one was in the United State of America^[36]. Female youth soccer players aged 13-17 were included in one study^[34], male junior soccer players aged 14-19 were included in another^[35], and male collegiate soccer players aged 18-25 were included in a third study^[36]. Table 2 summarizes the study characteristics, and Table 3 provides the injury rates and hours of exposure in the control and intervention groups.

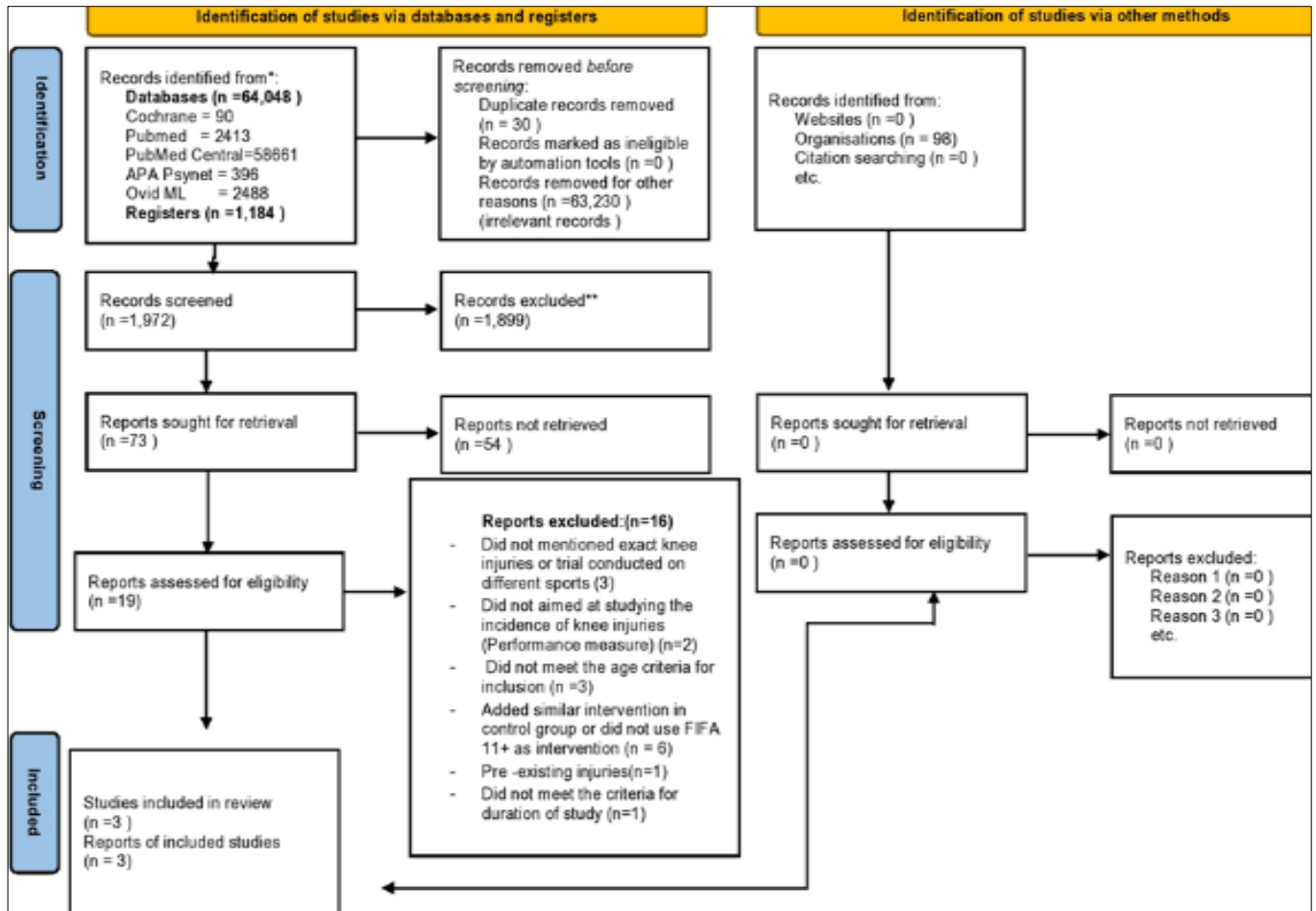


Table 2: Summarize the Characteristics of the study

Study, Location & Year	sex	Age (years)	Compliance (%)	Duration	Level /Sport	Type of Exercise in intervention group	Type of Exercise in Control group	Frequency (no. Per week)	Quality Score
Soligard <i>et al.</i> [34] Norway, 2008.	F	13-17	77	8 months	youth soccer	FIFA11+	Usual	3	9
Owoeye <i>et al.</i> [35] Nigeria, 2013.	M	14-19	74	6 months	Junior league	FIFA11+	Usual	1-2	9
Silvers-Granelli <i>et al.</i> [36] USA, 2015.	M	18-25	73	6 months	Collegiate soccer	FIFA11+	Usual	3	11

FIFA '11+' Federation Internationale de Football Association Medical injury prevention program, F female, M male.

4. Pooled data

Data from 3,833 people, 286,827 hours of exposure, and 243 knee injuries was compiled for the three studies. For the

intervention and control groups, the pooled IRR was 0.572 and 1.094 per 1000 hours of exposure, respectively. Table 3.

Table 3: Displays the injury rates per 1000 hours of exposure in the intervention and control groups of the included trials

Study	Intervention subjects	Knee injuries	Intervention Exposure hours	Knee injuries per 1000 hrs	Control subjects	Knee injuries	Control Exposure hours	Knee injuries per 1000 hrs
Soligard <i>et al.</i> [34]	1055	35	49899	0.701	837	58	45428	0.127
Owoeye <i>et al.</i> [35]	212	12	51017	0.235	204	21	61045	0.344
Silvers-Granelli <i>et al.</i> [36]	675	31	35226	0.880	850	86	44212	1.945
Pooled data	1942	78	136142	0.572	2075	165	150685	1.094

4.1 Meta-analysis.

In comparison to the control group, the FIFA11+ injury prevention group showed a 47% injury reduction per 1000 hours of exposure (IRR) of 0.477 (95% confidence interval

(CI) 0.355-0593 p=0.000). The effect of the FIFA11+ injury prevention program on the total injury risk ratio in the intervention and control groups is shown in a forest plot Fig.2.

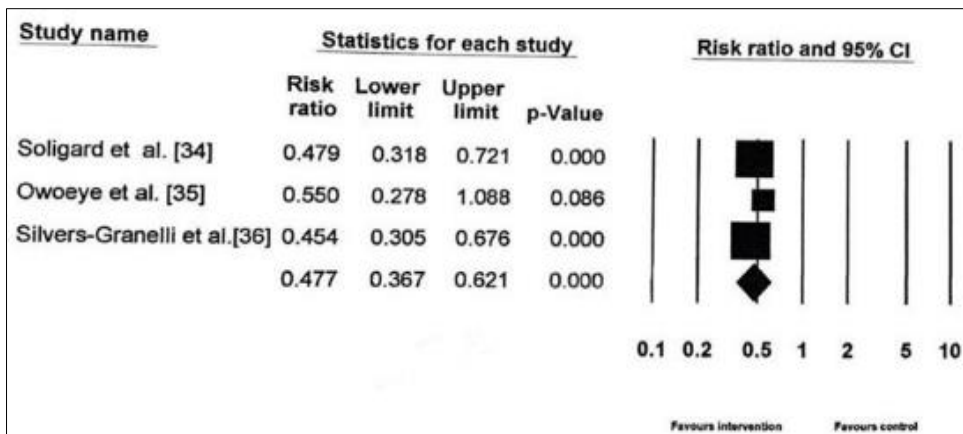


Fig 2: Forest plot of Meta-analysis

5. Publication Bias

To find evidence of publication bias, we use a typical funnel plot. Because of a little asymmetry, the funnel plot showed that there was no bias. Fig. 3. The Egger test [37] (intercept= 1.187, SE=0.42, p=0.108) was used to confirm the data's

symmetry. The overall IRR was unaffected by the Duval and Tweedie [38] trim and fill method, which was reported as (0.366), indicating that the overall point did not need to be adjusted.

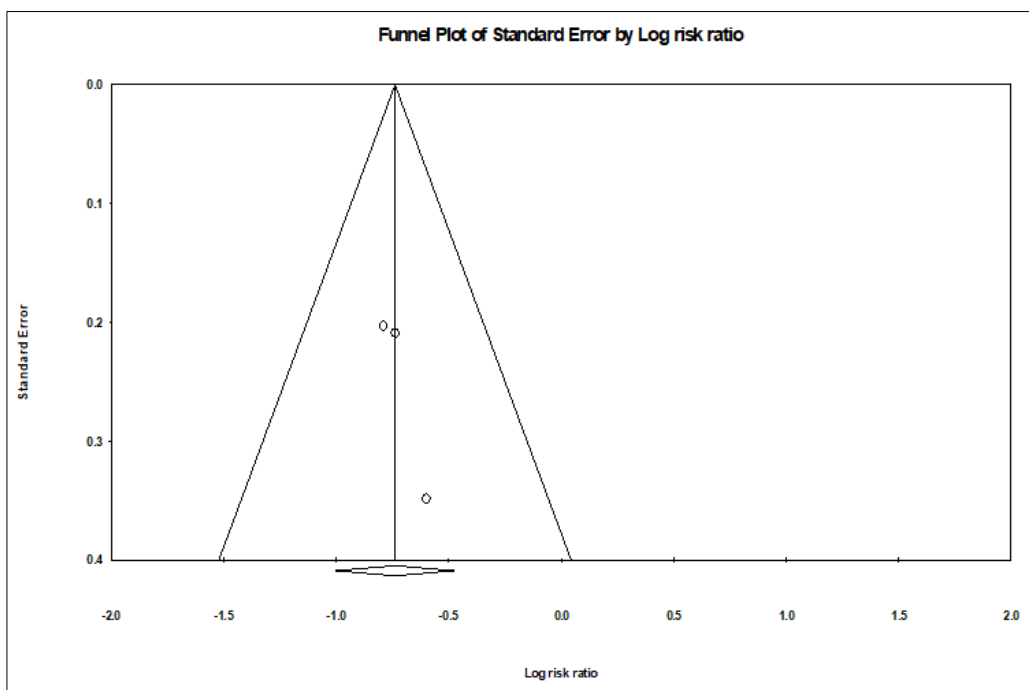


Fig 3: A funnel plot based on the study standard error and log risk was created to analyze publication bias. The pooled injury risk ratio (IRR), the study's summary measure, is represented as a diamond. The vertical tip of the diamond represents the overall effect, while the lateral tips reflect the appropriate confidence ranges.

6. Discussion

As far as we know, this is the first meta-analysis which has examine the efficiency of FIFA11+ injury prevention program in lowering the non-specific knee incidence rate among soccer players. Sadigursky *et al.* [39] conducted a systematic review which analyzed 6,344 players, with 3,307 in the intervention group and 3,037 in the control group. Given an estimated RR of 0.70 (95% Confidence interval [CI], 0.52–0.93; p = 0.01), there was a 30% reduction in injury incidence. However, while this study found a risk ratio of 0.70 (95%CI, 0.53–0.93; p = 0.02) for lower limb injuries, it did not report any specific injury patterns in the participants. The systematic review and meta-analysis by Gomes *et al.* [40] discovered that there was a considerable difference between the FIFA 11 and control groups in terms

of injury prevention. The RR was 0.64 (95% CI, 0.43 to 0.96), showing that the FIFA 11 group had a significantly lower risk of injury (P=0.03). Only six of the 11 studies included in this trials looked at injury prevention in FIFA 11 vs. control groups, while the other five trails looked at exercise performance in FIFA 11 vs. controls. In their analysis, Gomes *et al.* [40] did not consider evaluating any specific or non- specific injuries of lower extremities particularly the knee. There were numerous methodological variations between our review and previous reviews. First, we looked at how effective the FIFA11+ injury prevention program is at lowering the rate of non-specific knee injuries among soccer players. Second, the soccer players in our study were only included if they were between the age of 13 to 40 years and had no prior injuries. The three-cluster

randomized studies [34-36] included in our meta-analysis reported a compliance rate of more than 70%, indicating that the higher the FIFA 11+ injury prevention compliance rate, the lower the risk of knee injury. Soligard *et al.* [34] observed 35 out of 1055 knee injuries in the intervention group and 58 out of 837 in the control group, with an IRR of 0.55 (95% CI, 0.36-0.84; $p=0.005$) and a 77% compliance rate. As a secondary outcome, Owoeye *et al.* [35] reported 12 knee injuries out of 212 in the intervention group and 21 out of 204 in the control group IRR 0.93 (95% CI, 0.47-1.88; $p=0.848$) with a 74% compliance rate. However, while this study did not achieve statistical significance for knee injuries, there were no notable statistical changes detected when data was compiled for our meta-analysis, which can reflect the results. Silvers-Granelli *et al.* [36] found a total of 34 out of 675 knee injuries in the intervention group and 102 out of 850 in the control group, with an IRR of 0.42 (95% CI, 0.29-0.61) and a compliance rate of 73%. Furthermore, stratified data for type of knee injury revealed 3 Anterior Cruciate ligament (ACL) injuries in the intervention group compared to 16 ACL injuries in the control group, resulting in a 4.25-fold reduction in the risk of ACL injury RR,0.236 (95% CI,0.193-0.93; $P < .001$) [36]. Thorborg *et al.* [27] examined two distinct exercise-based injury prevention programs, FIFA 11 and FIFA 11+, and discovered that FIFA 11+ significantly lowers football injuries, cutting them down by 39%. While FIFA "11+" was found by Al Attar *et al.* [28] to reduce injury rates by 20 to 50%. Compared to our study, FIFA 11+ significantly decreased non-specific knee injuries, up to as 47%. In our meta-analysis, this is the only study that presents stratified data by kind of knee injury. For the purposes of data synthesis and analysis, we subtracted the number of ACL injuries from the total number of knee injuries in the intervention and control groups.

7. Strengths and Limitation

The research's strengths were that we adhered to high methodological standards and strict inclusion criteria for the studies that were included, such as excluding studies that reported pre-existing injuries, restricting the age range to 13-40 years, analyzing only non-specific knee injury incidence rates, and detecting zero percent heterogeneity in the studies. The main limitation of this study is that only three cluster randomized controlled trials were included in this analysis, and we did not assess the efficacy of other injury prevention programs other than FIFA11+. Another potential limitation of this review is that we assessed only 19 records for full text eligibility from the previously retrieved 73 records; the remaining 54 articles that were not retrieved could have certain implications that may have influenced the results of this review.

8. Conclusion

This comprehensive review and meta-analysis show how effective the FIFA 11+ injury prevention program is at preventing non-specific knee injuries in soccer players. This study has a very low level of evidence because of its uncertainty in the evidence synthesis.

9. Recommendations

More randomized controlled studies are needed to investigate the efficacy of the FIFA11+ injury prevention

program in minimizing non-specific knee injuries in soccer players, according to our recommendations.

10. Abbreviations

FIFA: Federation Internationale de Football Association.

CI: Confidence interval.

F-Marc: FIFA Medical and Research Centre; SMSMF: Santa Monica Orthopedic and Sports Medicine Research Foundation.

OSTRC: Oslo Sports Trauma Research Centre.

PEP: Prevent injury, Enhance performance.

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

CMA: Comprehensive Meta-analysis Software; ACL: Anterior Cruciate ligament.

Declarations\

Ethics approval and consent to participate

This protocol is registered in international prospective register of systematic reviews PROSPERO (CRD42022298748).

11. Consent for publication

Not applicable.

12. Availability of data and materials

All data generated or analyzed during this study are included in the published article.

13. Competing interests

The authors declare that they have no competing interests.

14. Funding

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