Futsal: The nature of the game, injury epidemiology and injury prevention - a narrative review

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ABSTRACT

Aim

To summarise the available scientific evidence with respect to the game demands, injury epidemiology, and injury-prevention strategies in futsal.

Data Sources

Key electronic databases were searched for publications (PubMed, ScienceDirect, Scopus).

Study Selection

Peer-reviewed publications were considered eligible if they were focused on the game demands, injury epidemiology, or injury prevention in futsal.

Results

Futsal is a high-intensity game that requires substantial aerobic and anaerobic capacities of players. The injury incidence in futsal (2.03-5.90 injuries/1000 player hours) is comparable to football (2.22-5.52 injuries/1000 player hours). Injuries to the lower extremities are the most common (up to 88 % of all injuries). Most injuries are acute and caused by a contact situation, especially with another player (up to 46 % of all contact injuries). The 11+ has been shown to improve some performance measures in futsal players (jump, sprint, core strength, agility). In one study, the 11+ was found effective in reducing the number of futsal injuries (44% injury reduction).

Conclusions

Futsal is a high-intensity game with a comparable injury profile to football. Injury-prevention strategies have been poorly investigated in futsal. Future research should focus on the implementation of injury-prevention measures and the possible adaptation of the 11+ in the futsal environment.

Keywords

Futsal, injuries, 11+, injury prevention, warm-up

INTRODUCTION

Futsal is a fast-paced, dynamic sport derived from association football and played widely across the world.[1] Compared to 11-a-side football, the game is played on hard surfaces in a reduced space, usually indoors, but it can also be played outdoors. The nature of the game puts an emphasis on an individual's technique, creativity, footwork, agility, coordination, quick reflexes and fast decision-making.[2-4] High levels of physical and psychological preparation are also crucial.[5] From a biomechanical point of view, futsal is characterised by sudden changes of direction, quick accelerations and decelerations, and greater ground reaction forces compared to football.[6] Due to these demands placed on players, a comparable injury profile to football is seen.[7,8] With the growing popularity of futsal,[9] the issue of safety and injury prevention is becoming more important.[10,11] In 2016, it was estimated that over 60 million people play futsal globally, which corresponded to around 20% of people playing football worldwide.[9] This number increased from 11% reported in 2006 by FIFA.12 Injury-prevention programmes have been shown to significantly reduce the risk of injuries and to enhance the performance of athletes in several other sports (football, basketball, rugby).[13-18] One of these programmes, the 11+, was designed specifically to reduce the risk of injuries in football. It has since been validated, and shown to be effective, in both men's and women's football.[19-22]

Although there is one systematic review providing the summary of evidence-based research related to the sport of futsal, the main focus was on the development, coaching, physiological, psychological, technical and tactical elements of the sport.[23] The aim of this narrative review was to summarise the current knowledge and evidence relating to futsal in terms of the nature of the game, performance demands on players, and mainly on the injury epidemiology, and injury-prevention strategies. The purpose of the knowledge gained from this review was to determine if further research on the injury prevention in futsal was required and if current injury-prevention programmes, such as the 11+, were appropriate for the demands, injury rates and patterns in futsal.

METHODS

This review considered peer-reviewed journal publications from January 1990 (a year after the first FIFA Futsal World Cup) until May 2019. The search strategy was systematic in the design but did not follow a full systematic review methodology. The main author used several search strings and keyword searches that led to the relevant literature linked to futsal. The following keywords were chosen and used in various combinations with Boolean operators (AND and OR); futsal, performance, physiology, football, injury, epidemiology, the 11+, injury prevention. The review only included publications written in the English language, full-text or abstracts, and relevant to the review (futsal and established keywords).

The methodological quality of each paper focused on injury prevention and performance in futsal was assessed using the PEDro rating scale, a validated, 11-item scale to rate the quality of randomised controlled trials. The papers were assessed by two authors using the PEDro scale independently. Any discrepancies in the scores were discussed and a final score agreed by both authors.

The nature of the game and performance demands on players

Due to the speed, non-stop flow of the game and plenty of goalmouth action, futsal has become attractive for both spectators and players.[9] The nature of the game puts an emphasis on an individual's technique, improvisation, creativity, footwork, agility and coordination.[3,4] Reduced playing space forces players to make decisions that require speed and quick reflexes.[9] High levels of players' physical and psychological preparation are also crucial.[5] It has been reported that the fastest way to learn the fundamentals of football is in the futsal environment.[5,24] For all these reasons, futsal has been used more and more by traditional football players as a supplementary activity to improve their skills.[3,5,24] A number of world-famous players including Pele are reported to have developed their talents playing futsal.[25,26]

A number of studies have suggested that the nature of game taxes both the anaerobic and aerobic metabolic pathways.[27-29] The physiological characteristics have been analysed using laboratory testing methods and also by The Futsal Intermittent Endurance Test (FIET), a new field-testing method.[27,29] The FIET has been developed to imitate the movement demands of futsal and it is considered a valid field test to assess specific futsal aerobic endurance.[27,29] A summary of key physiological characteristics of futsal players is shown in Table 1.[30] Compared to football players, the results suggest that futsal players have higher values of the following variables; maximal heart rate (HR_{max}), the heart rate at the ventilatory threshold (HR_{VT}), the percentage of maximal heart rate (% HR_{max}), the maximum rate of oxygen consumption (VO_{2max}), oxygen consumption at the ventilatory threshold (VO_{2VT}), and the percentage of maximal oxygen consumption (% VO_{2max}).[30]

Besides the physiological demands of the game, previous studies have also focused on the physical demands and the profile of game activities based on the video analysis of movements (Table 2).[27,28] These studies have shown that futsal players cover 4-6 km on average per 1 game, with 26 % of this distance spent at high intensity and approximately 8.9 % of the total distance run at sprinting speed.[28,31,32] Futsal players also perform 9 exercise activities per 1 minute of play on average and a high-intensity effort every 23 s of play.[27,33] The work-to-rest ratio was reported to be 1:1, i.e. for every minute of "work" there is approximately 1 minute of "rest".[34]

A number of studies compared futsal and football in terms of physiological and physical demands, and these studies have found that both games require suitable aerobic power to maintain the high pace of play, especially due to the need for energy recovery between repeated sprints.[34-36] However, the intensity of game is much higher in futsal, which results in a consistent need for higher levels of anaerobic capacity, as most of the crucial moments of play last no longer than 5 seconds.[34,36] Futsal is, therefore, considered an intermittent high-intensity game that requires substantial aerobic and anaerobic capacities, along with substantial muscular power of the lower extremities to compete at a high level.[27,28,34,37,38] Despite some similarities with football, both games have significant differences that need to be considered when creating new training methods or developing injury prevention programmes.[34] The intensity and nature of futsal may also contribute to injury rates and the need for injury prevention strategies.

Injury epidemiology in futsal

With the growing population of futsal players there are several factors that contribute to increased injury risk, in particular the professionalisation of the sport, higher physical and physiological demands on players, the nature of the game, and the playing environment.[4,40,41] There have been several studies focusing on the injury occurrence in futsal (Table 3).[4,7,40-46] Referred to as a modality of football, the rate of futsal injuries has been found to be comparable to the rate in football.[7,8,40,45] Considering the total number of player hours (training and match hours together), the injury incidence in football has been reported to range from 2.03 to 5.90 injuries per 1000 player hours and the injury incidence in futsal has been showed to range from 2.22 to 5.30 injuries per 1000 player hours.[7,8,40,45] Several studies only reported the number of futsal injuries per 1000 player match hours, not including training hours.[42,44,46] In that case, the injury incidence has been reported to range from 91.5 to 208.6 injuries per 1000 player match hours.

The studies focusing on injury epidemiology in futsal have also focused on injury characteristics, such as the injured body part, type of injury, cause of injury, and severity of injury (Table 4).[4,40-44,46] The lower extremities (LE) have been shown to be the most frequently injured body part (86.5 % of all injuries), followed by the upper extremities (up to 23.7 % of all injuries), and head and trunk (up to 22.1 % of all injuries).[4,40-44,46]

Of all the injuries to the lower extremities, the ankle, knee and thigh (groin) were the sites most commonly injured.[4,40-44,46] Ankle injuries reached up to 50.6 % of all injuries, followed by thigh/groin injuries (up to 28.1 %) and knee injuries (up to 23.1 %).[4,40-44,46] The studies showed that ligament injuries (sprains and ruptures, up to 51.8 % of all injuries), skin injuries (contusions, up to 44.2 % of all injuries) and muscle injuries (strains and ruptures, up to 17.6 % of all injuries) were the most common types of injury in futsal.[4,40,42,44,46] Concerning types of injury, some studies have shown that the rate of concussion reaches a significant value in futsal (3.9 % of all injuries on average).[40,42,44] This is more than 4 times the rate of concussion in football (0.9 % of all injuries on average).[47,48] A harder ball, harder surface, and reduced space may be possible reasons for this difference.

With respect to the cause of injury, there are 2 main mechanisms, contact and non-contact.[4,40-44,46] An injury may occur during a contact (with another player, the ball, the equipment, etc.) or a non-contact situation (a fall/trip/slip, kicking the ball, a sudden change of speed or direction, planting and/or cutting, landing). Most

Table 1: Comparison of chosen physiological parameters between futsal and football players

Physiological Parameter	Futsal Players	Football Players
HR_{max} (BPM)	198 ± 8	189 ± 10.7
HR_{VT} (BPM)	177.2 ± 10.1	167.1 ± 10.8
% HR_{max} (%)	96.7 ± 2.3	88.4 ± 2.4
VO_{2max} ($ml \cdot kg^{-1} \cdot min^{-1}$)	62.5 ± 4.3	52.1 ± 4.6
VO_{2VT} ($ml \cdot kg^{-1} \cdot min^{-1}$)	58.7 ± 5.6	43.1 ± 4.6
% VO_{2max} (%)	93.9 ± 5.3	76 ± 8.4

Table 2: Futsal game activities classified by cut-off speed and values of physiological parameters based on laboratory treadmill testing

Game activity	Cut-off speed based on treadmill testing (km/h)	Cut-off speed based on treadmill testing (m/s)
Standing	0 – 0.4	0 – 0.1
Walking	0.5 – 6	0.1 – 1.7
Low-intensity running	6.1 – 12	1.7 – 3.3
Medium-intensity running	12.1 – 15.4	3.3 – 4.3
High-intensity running	> 15.5	> 4.3
Sprinting	> 18.3	> 5.1

Table 3: Summary of studies investigating injury rates in futsal

Study	Design	Injury Definition	Population	Follow-up	No. of injuries (Incidence per 1000 player hours)
Uluöz (2016)	Retrospective cohort study	Any tissue damage caused by futsal regardless of subsequent absence from games or training sessions (Junge & Dvorak, 2000)	66 Turkish female futsal players of university teams	1 competition season	93 injuries (-)
Serrano (2013)	Retrospective cohort study	Any physical complaint sustained by a player that results from a futsal match or futsal training, irrespective of the need for medical attention or time loss from futsal activities (Fuller et al., 2006)	411 Portuguese futsal players (284 males) of diverse competitive levels	Retrospective recall of 3 main injuries found during the sports career in futsal	512 injuries (-)
Gayardo (2012)	Retrospective cohort study	Injury with compromising which had presented at least one of the following consequences: decrease in the quantity or level of sports activity for at least 1 day, or which had needed medical evaluation or treatment	147 Brazilian female futsal players participating in the National League of Futsal	1 season (2010–2011)	104 injuries (-)
Angoorani (2014)	Prospective cohort study	Any physical complaint sustained by a player that results from a futsal match or futsal training, irrespective of the need for medical attention or time loss from futsal activities (Fuller et al., 2006)	55 Iranian national futsal players (23 males, 17 females, 15 U-23 males)	March 2011 to September 2012	54 injuries (2.22)
Van Hespen (2011)	Prospective cohort study	Any physical complaint associated with futsal (received during training or a match) that limits athletic participation for at least the day after the day of the onset (Faude, Junge, Kindermann, & Dvorak, 2005)	77 Dutch elite male futsal players	1 season of premier league male futsal (2009-2010)	58 injuries (3.1)
Hamid (2014)	Prospective cohort study	Any physical complaint sustained by a player that results from a futsal match, irrespective of the need for medical attention or time loss from futsal activities (Fuller et al., 2006)	468 Malaysian amateur futsal players (238 males)	1 season of the 2010 FELDA/FAM National Amateur Futsal League (141 matches)	86 injuries (91.5)
Junge (2010)	Prospective cohort study	Any physical complaint sustained by a player that results from a futsal match which received medical attention from the team physician, regardless of the consequences with respect to absence from match or training (Fuller et al., 2006)	Futsal players of 3 consecutive Futsal World Cups	3 consecutive Futsal World Cups (136 matches in total)	165 injuries (195.6)
Ribeiro (2006)	Prospective cohort study	any physical complaint arising during the match regardless of the consequences with respect to subsequent absence from matches or training (Junge, Dvorak, Graf-Baumann, & Peterson, 2004)	180 Brazilian futsal players (17-20 years old)	15th Brazilian Sub20 Team Selection Championship (23 matches)	32 injuries (208.6)

Table 4 - Summary of studies investigating injury characteristics in Futsal

Study	Injured Body Part (3 most common)	Anatomical Site (3 most common)	Type of injury (3 most common and concussion)	Cause of Injury	Severity of Injury
Uluöz (2016)	Lower extremity (57.0 %) Upper Extremity (23.7 %) Head and trunk (19.3 %)	Ankle (26.9 %) Knee (21.5 %) Low back (16.1 %)	-	Contact (58.1 %) Non-Contact (29.0 %)	1-3 days (10.8 %) 4-7 days (34.4 %) 8-28 days (25.8 %) >28 days (29.0 %)
Serrano (2013)	-	Ankle (50.6 %) Thigh (18.3 %) Knee (13.3 %)	Sprain (48.8 %) Muscular rupture (14.8 %) Fracture (8.4 %)	Non-Contact* (55.8 %) Contact* (44.2 %)	0-3 days (5.5 %) 4-7 days (10.5 %) 8-28 days (52.7 %) >28 days (31.3 %)
Gayardo (2012)	Lower extremity (86.5 %) Upper extremity (9.6 %) Head and trunk (3.8 %)	Ankle (28.9 %) Thigh (24.0 %) Knee (23.1 %)	-	Non-Contact (51.9 %) Contact (46.2 %)	0-6 days (4.8 %) 7-28 days (52.9 %) >28 days (33.7 %)
Angoorani (2014)	Lower extremity (85.2 %) Head and trunk (9.3 %) Upper extremity (5.6 %)	Ankle (40.7 %) Knee (22.2 %) Groin (13.0 %)	Sprain (51.8 %) Strain (13.0 %) Ligament rupture (7.4 %) Concussion (3.7 %)	Non-Contact* (70.4 %) Contact* (24.1 %)	1-3 days (33.3 %) 4-7 days (38.9 %) 8-28 days (14.8 %) >28 days (13.0 %)
Hamid (2014)	Lower extremity (65.1 %) Head and trunk (22.1 %) Upper extremity (12.8 %)	Knee (23.0 %) Ankle (21.0 %) Chest and back (14.0 %)	Contusion (36.0 %) Sprain (32.6 %) Strain(16.3 %) Concussion (3.5 %)	Contact (63.0 %) Non-Contact (37.0 %)	0 days (71.0 %) 1-7 days (8.0 %) 8-28 days (15.0 %) >28 days (6.0 %)
Junge (2010)	Lower extremity (69.7 %) Head and trunk (20.0 %) Upper extremity (10.3 %)	Knee (15.8 %) Thigh (13.9 %) Ankle (12.1 %)	Contusion (44.2 %) Sprain (19.4 %) Strain (17.6 %) Concussion (4.2 %)	Contact (60.6 %) Non-Contact (34.5 %)	0 days (43.0 %) 1-3 days (26.1 %) 4-7 days (4.2 %) 8-28 days (7.9 %) >28 days (1.2 %)
Ribeiro (2006)	Lower extremity (84.4 %) Head and trunk (12.5 %) Upper extremity (3.1 %)	Ankle (43.8 %) Thigh (28.1 %) Knee (12.5 %)	Contusion (31.3 %) Sprain (28.1 %) Strain (9.4 %)	Contact (65.6 %) Non-Contact (34.4 %)	0 days (65.6 %) 1-7 days (18.8 %) 8-28 days (12.5 %) >28 days (3.1 %)

* in a study by Serrano et al. (2013) and Angoorani et al. (2014), contact injuries refer to injuries caused by a contact with an opponent and non-contact injuries represent all other injuries.

of the injuries in futsal have been shown to be caused by contact situations (up to 65.6 % of all injuries), which is comparable to football (up to 73.0 % of all injuries).42-44,46,48 The most common contact injury was with another player (up to 46 % of all contact injuries).41,43 However, it was also demonstrated that non-contact injuries might reach a significant value in futsal (up to 51.9 % of all injuries).41 This might be an indication of an inadequate preparation of players before an exposure (training or a match).

Regarding the severity of injury, studies have shown that the results are influenced by the study design.[4,40-44,46] In retrospective studies, moderate (8-28 days lost) and severe injuries (>28 days lost) reached higher frequency than minor (0-3 days) or mild injuries (4-7 days lost).[4,41,43] A recall bias might be a possible reason for underestimating light/minimal and mild injuries, because more severe injuries are easier to remember.[42] In one study, the players were asked to refer to 3 main injuries in their futsal career.[4] This fact could also result in players remembering only the most severe injuries which had the highest impact in their career. Prospective studies have shown that most injuries in futsal are mild.[40,42,44,46] In football, higher rates of moderate and severe injuries have been reported.[47]

An injury can be further distinguished, whether it occurs during one specific, identifiable event (acute/trauma injury), or if it is caused by repeated micro-trauma without a single, identifiable event (overuse injury).[49] The reviewed studies show that most injuries were of an acute/traumatic nature with frequency up to 79 % of all injuries.[7,43] Overuse injuries were demonstrated to only contribute up to 26 % of all injuries. However, these injuries are very difficult to determine due to 2 objective reasons; firstly, due to the gradual onset of symptoms resulting in an overuse injury,[7,43] and secondly, because of the definition of injury, which is mostly time loss, and players might often play on with an overuse injury.[50] Significant differences were reported between the rates of overuse injuries based on the method of data collection.50

Injuries can also be classified whether they occurred during a match or training session.[49] Several studies have shown that the frequency of training injuries (up to 63.0 % of all injuries) in futsal is higher than in a match (up to 40.4 % of all injuries).[4,40,41] However,, the number of training hours is usually much higher than match hours.[40] Therefore, although the frequency of training injuries is higher, the incidence of these injuries (1.6 injuries per 1000 player hours) is much lower than the incidence of match injuries (6.3 injuries per 1000 player hours).[40] Similar results have been found in football when comparing the incidence of injuries in a match and training session.[47] Situations of higher competitiveness, commonly associated with the game, might result in a higher risk of injury, which could be a reason for the differences in the injury incidence between a match and training session.

Injury prevention and performance in futsal

Injury-prevention programmes have been shown to significantly reduce the risks of injuries and to enhance the performance of athletes in a range of sports.[13,14,16-18] The 11+ is one such programme that has been found effective and successful at preventing football-related injuries (up to 53.3 % injury reduction).[17,19,51,52] Despite its validated reduction of injury rates among football players, the 11+ was also shown to lose its effectiveness if not performed consistently and regularly.[19,20,22,51,53] Several studies have suggested that the 11+, developed by sport-related medical professionals and researchers, reduced the injury occurrence significantly only if the compliance level was high and the programme was performed more than once a week.[17,19,20,22,51-53]

Although there are several studies focusing on the injury characteristics and injury occurrence in futsal,[4,7,40-46] the implementation and evaluation of any preventive measures in futsal has been poorly investigated. As football and futsal are very similar in the game demands, this review has identified 5 studies that met the inclusion criteria for this review. These studies examined the effectiveness of the 11+ to reduce injury or improve performance in the futsal environment.[54-58] The characteristics of these studies are summarised in Table 5.

The methodological quality of each paper, except 1 study (not an RCT study design),[57]

Table 5: Summary of studies investigating injury-prevention measures in Futsal

Study	Design	Population	Follow-up	Outcome Variables
Lopes (2019)	RCT*	Amateur male futsal players IG[a]: 37 players (age: 27.0±5.1 years) CG[a]: 34 players (age: 26.0±5.1 years)	IG[a]: 10 weeks of the 11+ programme CG[a]: 10 weeks of regular futsal warm-ups	Agility test (T-test) Sprint test (30m sprint) Flexibility test (sit-and-reach test) Vertical jump test (squat jump)
Reis (2013)	RCT*	Adolescent male futsal players (age: 17.3±0.7 years) IG[a]: 18 players CG[a]: 18 players	IG[a]: 12 weeks of the 11+ programme CG[a]: 12 weeks of standard jogging and ball exercises	Isokinetic quadriceps and hamstring strength test (peak torque) Vertical jump test (squat jump) Countermovement jump test Sprint test (5m and 30m sprint) Agility test (T-test) Technical skill test (slalom-dribbling test) Balance test (single-legged flamingo balance test)
Soares (2019)	Prospective cohort study	Youth male futsal players (n = 14, age: 12.6±0.7 years)	18 weeks of the 11+ programme	Isokinetic strength test of knee flexor and extensor muscles (peak torque)
Zein (2014)	RCT*	Youth futsal players playing in high school teams (age: 16.2±0.9 years) IG[a]: 9 players CG[a]: 11 players	IG[a]: 4 weeks of the 11+ programme CG[a]: 4 weeks of routine futsal training	Core strength test (plank test) Vertical jump test (squat jump) Agility test (Illinois agility test)
Lopes (2018)	RCT*	Amateur male futsal players IG[a]: 31 players (age: 27.0±5.1 years) CG[a]: 34 players (age: 26.0±5.1 years)	IG[a]: 2 periods of 10 weeks of the 11+ programme separated by a 10-week period in-between CG[a]: 20 weeks of a combination of running, ball, and dynamic stretching exercises	Injury incidence (number of injuries per 1000 player hours) Warm-up compliance (number of sessions per week) Injury characteristics

* RCT – randomised controlled trial
a IG – intervention group; CG – control group

was assessed using the PEDro rating scale (Table 6), a validated tool to rate the quality of RCTs evaluating some specific intervention.[59] The mean quality score of the reviewed studies was 6.5 ±0.5 (out of 10). All studies satisfied the items of the PEDro scale related to random allocation of subjects, measures of at least 1 key outcome obtained from more than 85 % of the subjects initially allocated to groups, the treatment or control condition received by all subjects as allocated, the results of between-group comparisons being present for at least 1 key outcome, and both point measures and measures of variability for at least 1 key outcome. In addition, all the rated studies assured that groups were similar at baseline regarding important prognostic factors. In 2 studies the allocation of subjects was not concealed, which could result in a selection bias.[56,58] All studies failed to meet criteria for subject blinding, therapist blinding, and assessor blinding.

Four of the studies focused on the influence of the 11+ on players' performance measures,[54,56-58] and one study focused on the effectiveness of the 11+ to reduce the number of injuries in futsal.[55] In the case of the effect of the 11+ on players' performance, studies have found different results in several outcome measures. The study by Lopes et al. (2019) found no short or long-term performance enhancement in sprint (30-m sprint), flexibility (sit-and-reach test), agility (T-Test), and jump (squat jump) in the intervention group after 10 weeks of the 11+ performance (mean number of sessions per week was 1.9 ±0.1).[54] In contrast to this study, the study by Reis et al. (2013) found a significant improvement ($p < 0.05$) in squat jump (13.8%) and countermovement jump (9.9%), 5-m and 30-m sprint (8.9% and 3.3% respectively), agility (4.7%), slalom (4.8%), and balance (smaller number of falls by 30% in the non-dominant leg) performances after twelve weeks of executing the 11+ (mean number of sessions per week was 1.8 ±0.1).56 There were no changes in the control group. Significant improvement ($p < 0.05$) in agility (4.2%) was also found in the study by Zein et al. (2014) compared to the control group.[58] This study also showed an enhancement in core strength (40%) in the intervention group after 4 weeks of performing the 11+ (2 sessions per week). There was no significant improvement found in squat jump. The age of players might be one of the reasons for the differences in the results of studies. In the study by Lopes et al. (2019) the participants were adult male players up to 10 years older than the participants of other studies (Reis et al., 2013; Zein et al., 2014). There may be greater potential for improved movement patterns in younger players, because their basic patterns haven't been completely established, and they can be modified and developed more easily.[19] The duration of the intervention and warm-up routines in the control group might be other influencing factors that caused the differences in results. Unfortunately, studies didn't specify the warm-up routines in the control group in detail.

Table 6: PEDro scores

Study	Scores for PEDro Criteria											PEDro Overall Quality Score (/10)
	1	2	3	4	5	6	7	8	9	10	11	
Lopes (2019)	1	1	1	1	0	0	0	1	1	1	1	7
Reis (2013)	1	1	0	1	0	0	0	1	1	1	1	6
Zein (2014)	1	1	0	1	0	0	0	1	1	1	1	6
Lopes (2018)	1	1	1	1	0	0	0	1	1	1	1	7
Mean score ±SD												6.5 ±0.5

Two studies also analysed the influence of the 11+ on the isokinetic strength of knee flexor (hamstrings, H) and extensor muscles (quadriceps, Q) in the futsal environment.[56,57] Both studies showed a significant improvement in the isokinetic performance of flexors and extensors of the knee and a significant improvement in muscular asymmetries between the dominant and non-dominant limb of players. In a study by Reis et al. (2013), quadriceps concentric (14.7%-27.3%) and hamstrings concentric (9.3%-13.3%) and eccentric (12.7%) peak torque increased significantly ($p < 0.05$) compared to the control group.[56] This study also found an improvement of antagonist/agonist balance around the knee (functional H:Q ratio increased by 1.8%-8.5%). Similar results were shown in the other study.[57] After 18 weeks of the 11+, there was a significant improvement in the isokinetic performance of the knee's extensor and flexor muscles and decreased muscular asymmetries between the limbs of young futsal athletes. However, this study only analysed pre– to post-intervention changes without any control group.

Only one study focused on the effectiveness of the 11+ to reduce the number of injuries in the futsal environment.[55] After 20 weeks (5 months) of the 11+, with average exposure of 1.78 ±0.28 sessions per week, significant differences were found in total number of injuries (44% injury reduction, $p = 0.014$), acute injuries (47.7% injury reduction, $p = 0.007$), lower limb injuries (54% injury reduction, $p = 0.032$), and training injuries (62.1% injury reduction, $p = 0.028$) compared to the control group.[55] While the sample size used in this paper is very small, and thus caution is needed when interpreting the results, the findings suggest that futsal injuries can be reduced using a structured, neuromuscular warm-up programme.

CONCLUSION

Futsal, a five-a-side version of association football, has globally experienced significant growth. Despite some obvious similarities with football, the games have significant differences in physical and physiological demands. Due to the growing population of futsal players and the comparable injury profile to football, injury prevention has become a priority. Although the injury rates and injury characteristics have been shown to be similar to football, this review found significant differences in the rates of concussion and the severity of injuries. The frequency of concussion in futsal (3.9% of all injuries on average) has been shown to be more than 4 times higher than in football 0.9% of all injuries on average). Most injuries in futsal have been found to be mild (0-7 days), which is significantly different from football with most of the injuries being reported as moderate (8-28 days) or severe (>28 days). This review has highlighted a lack of evidence relating to the implementation and validation of injury preventive measures in futsal. There is some evidence the 11+ can improve physical performance in futsal players and one study has shown a benefit in terms of injury reduction. Further research is needed investigating the effectiveness of injury prevention measures implemented in futsal and in particular the possible use of the 11+ in the futsal environment.

ETHICAL APPROVAL

None declared.

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DECLARATION OF INTEREST

One of the authors (Mark Fulcher) is employed by New Zealand Football and is a member of the FIFA Medical Committee.

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