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REVIEW ARTICLE

Football Injuries in Children and Adolescent Players: Are There Clues for Prevention?

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Abstract Football (soccer) is the world's most popular sport with most players being younger than 18 years. Playing football can induce beneficial health effects, but there is also a high risk of injury. Therefore, it is necessary to implement measures for preventing injuries. The present review analyzes and summarizes published scientific information on the incidence and characteristics of football injuries in children and adolescent players to arrive at sound conclusions and valid considerations for the development of injury-prevention programs. A literature search was conducted up to November 2012. Fifty-three relevant scientific publications were detected. Thirty-two studies fulfilled the inclusion criteria for pooled analysis. Additional information from the remaining 21 studies was considered where appropriate to obtain a broader perspective on the injury problem in children and youth football. Training injury incidence was nearly constant for players aged 13–19 years, ranging from 1 to 5 injuries per 1,000 h training. Match injury incidence tended to increase with age through all age groups, with an average incidence of about 15 to 20 injuries per 1,000 match hours in players older than 15 years. Between 60 and 90 % of all football injuries were classified as traumatic and about 10–40 % were overuse injuries. Most injuries (60–90 %) were located at the lower extremities with the ankle, knee, and thigh being mostly affected. The frequency of upper-extremity and head/face injuries was higher in those studies that analyzed match injuries only. The most common injury types were strains, sprains, and contusions (10 up to 40 % each). There is some evidence that the risk of traumatic injuries and, in particular, of sustaining a fracture, contusion, or concussion was higher during match play than in practice sessions. Fractures were more frequent in children younger than 15 years than in older players. About half of all time-loss injuries led to an absence from sport of less than 1 week, one third resulted in an absence between 1 and 4 weeks, and 10 to 15 % of all injuries were severe. Separate data for players under the age of 11 years are almost absent. Maturation status seems to have an influence on injury characteristics, although evidence is not conclusive at this time. Three main areas seem to be of particular relevance for future prevention research in young football players: (1) the substantial number of severe contact injuries during matches, (2) the high number of fractures in younger players, and (3) the influence of maturation status and growth spurts.

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1 Introduction

Football (soccer) is the world's most popular sport with respect to active players as well as to spectators [1]. The International Federation of Association Football (FIFA) survey in 2006 estimated that approximately 265 million people were playing football worldwide. The viewing audience (in-home and out-of-home viewers) of the final of the 2010 FIFA World Cup South Africa™ was estimated to be in excess of one billion people [2]. Every 4 years, the world becomes transfixed on a small fraction of the playing population that is made up of professionals, but by far, the highest proportion of participants (22 of 38 million officially registered players) are under the age of 18 years.

From 2000 to 2006, the number of registered youth players increased by 7 % worldwide [1].

During recent years, it has been shown that playing football can induce considerable beneficial effects on health risk factors as well as on cardiovascular and neuromuscular fitness from childhood to older age [3–7]. Thus, playing football has a great potential to support a healthy lifestyle. However, football is a high-intensity sport with frequent changes in movement, velocity, and direction as well as high impacts and many situations of direct contact between players, which pose the risk of injury. Hence, there are also potential negative outcomes both for individual players as well as for the healthcare system [8–13]. Adverse events may discourage children from playing football or may lead parents to forbid their children to play football. Therefore, it is necessary to implement preventive measures to reduce the risk of injury, and, thus, to support the health benefits associated with playing football.

Sound epidemiological data on the frequency and characteristics of football injuries are a necessary prerequisite to develop and evaluate promising prevention programs [14, 15]. Many epidemiological studies on football injuries in professional and adult players of both sexes have been conducted [16–21], and a consensus regarding methodological standards for epidemiological studies on football injuries was published in 2006 [22]. Information regarding children and youth players seems less clear. Giza and Micheli [23] summarized most of the existing literature with regard to football injuries up to 2001 emphasizing the pediatric population. The included publications varied considerably with regard to methodological quality and approach, injury definition, and various other influencing factors, and, thus, the conclusions were very general [23]. Several new studies on injuries in children's and youth football have been published during the past decade. Thus, the present review aimed at analyzing, updating, and summarizing the published epidemiological data on football injuries in children and adolescent players ($\leq$19 years) to arrive at comprehensive conclusions and valid considerations for the development of injury-prevention programs in children's and youth football as well as for directions of future research in this area. A particular objective was to analyze available information on injury incidence, mechanisms, location, and type of injuries as well as injury severity.

2 Literature Search and Analysis

A literature search was conducted using the Medline database PubMed up to November 2012. In order to obtain the widest range of injury topics, the keywords "soccer" or "football" together with "injur*" in combination with "youth," "junior*," "adolescen*," "pediatric," or "child*" were used in Boolean logic for query. All titles ($N = 833$ without duplicates) were reviewed (OF and RR), and publications that were obviously not appropriate (e.g., case studies, clinical evaluation and treatment, rehabilitation, etc.) were excluded. The abstracts of the remaining articles were read to determine if relevant data were presented. Citation tracking of key primary and review articles was also undertaken to obtain further pertinent articles.

Studies were included in a pooled analysis if they were published in an international peer-reviewed journal and if injury incidence was reported relative to the hours of football exposure. Studies analyzing injuries in different sports or age groups were included in this analysis when separate data for football injuries in players younger than 19 years of age were available. Studies using retrospective questionnaire analysis were not included in the pooled analysis. After the evaluation of titles, abstracts, and full-texts, 53 scientific publications remained that were relevant with regard to the objective of the present review. Of those, 32 fulfilled the criteria as outlined above (Table 1). While several studies for players older than 13 years were published, only few studies analyzed injuries of younger children, and comprehensive data on football injuries of girls were also lacking. Twenty-one studies reported injury rates either in relation to the number of athletes exposed or as simple frequencies and therefore did not fulfill the inclusion criteria for the pooled analysis (Table 2). Additional information from those studies, however, was also regarded where appropriate to obtain a broader perspective on the injury problem in children and youth football. Three studies investigated preventive measures in the targeted age group [24–26], and the data of the control groups were included in this review. Two further studies [27, 28] used data reported in previous publications [25, 29], and, thus, were not included in the present analysis.

The present review is mainly based on the results of the 32 studies summarized in Table 1. All relevant information in these studies with regard to the objectives of the present review were extracted by two authors (OF and RR) and analyzed. For the analysis of injury mechanisms, body parts, and injury types, studies were separately evaluated when only tournament data (i.e., only match injuries) were reported. If possible, relevant information (incidences or relative frequencies) were calculated from original data. Confidence intervals (95 % CI) for match and training incidences were calculated.

3 Incidence of Injury

The overall injury incidence varied mostly between 2 and 7 injuries per 1,000 h of football for players aged

Table 1 Summary of studies on injury characteristics in children's and youth football reported as outdoor injury rates per 1,000 h of football

Reference	Country	Study design	Duration of data collection	Injury definition	Number of players (teams)	Level of play	Age in years	Sex	Number of injuries
Aoki et al. [45]	Japan	Prospective cohort study	1 year (January–December)	Time loss (more than 1 week absent)	301 (6 teams)	NA	12–17	NA	425
Backous et al. [55]	USA	Prospective cohort study	Five 1-week football camps	Time loss (at least one practice session or match)	1,139	Subelite	6–17	Male and female	216
Brito et al. [34]	Portugal	Prospective cohort study	One season (August–June)	Time loss (more than 1 day absent)	674 (28 teams)	Subelite	11–18	Male	199
de Loes and Goldie [74]	Sweden	Prospective study of sports injuries in a municipality	1 year (1984)	Attendance to a physician and registration as sports injury	1,342	Subelite	8–18	Male and female	66
Elias [41]	USA	Prospectively recorded injuries during tournaments	1988–1997	Medical attention (presentation to Cup medical facility)	~89,500 players (5,373 teams)	Subelite	Under-12 to under-19	Male and female	3,548
Emery et al. [11]	Canada	Prospective cohort study	One outdoor season (13 weeks)	Medical attention and/or incomplete session and/or missing next training/match	317 (21 teams)	Subelite	12–18	Male and female	78
Froholdt et al. [44]	Norway	Prospective cohort study	One season (April–October)	Medical treatment or missing part of training/match	1,879 (121 teams)	Subelite	6–16	Male and female	200
Inklaar et al. [40]	The Netherlands	Prospective cohort study	Second half of a season	Reduction in football activity or need for treatment or adverse effects	232 (18 teams)	Subelite	13–18	Male	43
Johnson et al. [33]	Great Britain	Prospectively recorded injuries	2001–2007	Not specified, probably medical attention	292	Subelite	9–16	Male	476
Junge et al. [35]	New Zealand	Prospective cohort study	One season (March–August)	All physical complaints associated with football and separate analysis for time-loss injuries	145 (12 school teams)	Subelite	14–18	Male	261 (81 time-loss injuries)
Junge et al. [26]	Switzerland	Prospective intervention study (data for control group only)	1 year	Physical complaints caused by soccer lasting for more than 2 weeks or time loss (match or training session)	93 (7 teams)	Subelite	14–19 (mean 16.3)	Male	111
Junge et al. [59]	Czech Republic, France, Germany	Prospective cohort study (includes data of [38])	1 year	Time loss (at least 1 week)	311	Subelite	14–18	Male	187
Kakavelakis et al. [36]	Greece	Prospective cohort study	1 season (August–June)	Time loss (more than 1 day after onset)	514 (24 clubs)	Subelite	12–15	Male	209

Table 1 continued

Reference	Country	Study design	Duration of data collection	Injury definition	Number of players (teams)	Level of play	Age in years	Sex	Number of injuries
Kibler [61]	USA	Prospective injuries surveillance	Weekend tournaments (1987–1990)	Removed from or missing a game due to an injury or medical attention	NA	Subelite	12–19	Male and female	179
Le Gall et al. [31]	France	Prospectively recorded injuries	1998–2006	Time loss (more than 1 day absent)	119	Elite; national training center	15–19	Female	619
Le Gall et al. [30]	France	Prospectively recorded injuries at national football institute	10 seasons (1995–2005)	Time loss (at least 48 h)	233	Elite national team	Under-14 (mean 13.3; SD 0.3)	Male	588
Le Gall et al. [32]	France	Prospectively recorded injuries at national football institute	1993–2003	Time loss (at least 48 h)	528	Under-14, -15, and -16 elite national teams	13–15	Male	1,152
Maehlum et al. [43]	Norway	Analysis of injuries	6-day tournament	First-aid treatment (medical attention)	(1,348 teams)	Subelite	11–18	Male and female	411
McNoe and Chalmers [46]	New Zealand	Prospective cohort study	One winter season (April–September)	Medical attention/self-treatment or missing subsequent training/match	539	Community level	13–17	Male and female	822
Müller-Rath et al. [48]	Germany	Retrospective analysis of documented injuries	Two seasons	Time loss (match or training session)	First season: 20 (1 team), second season: 27 (1 team)	Elite	16–18	Male	48
Nielsen and Yde [39]	Denmark	Prospective cohort study	One season (January–November)	Time loss (at least one practice session or match)	30 (2 teams)	NA	16–18	Male and female	27
Nilsson and Roaas [47]	Norway	Analysis of injuries	6-day tournaments (1975 and 1977)	First-aid treatment (medical attention)	25,000 (1,549 teams)	Subelite	11–18	Male and female	858
Peterson et al. [38]	Czech Republic	Prospective cohort study	1 year	Any tissue damage caused by football regardless of the consequences	180	Subelite	14–18	Male	363
Rosenbaum et al. [63]	USA	Prospective injuries surveillance	2-day tournaments (2006 and 2008)	Medical attention (tent or on-field)	3,350 (243 teams)	Subelite	9–18	Male and female	68
Schmidt-Olsen et al. [68]	Denmark	Retrospective analysis of prospectively registered injuries	One season (10 months)	Handicaps a player during playing or requires special attention or prevents play	496 (3 clubs)	Subelite	12–18	Male	312

Table 1 continued

Reference	Country	Study design	Duration of data collection	Injury definition	Number of players (teams)	Level of play	Age in years	Sex	Number of injuries
Schmidt-Olsen et al. [42]	Norway	Prospective injury surveillance	5-day tournament (1984)	First-aid treatment (medical attention)	6,600 (410 teams)	Subelite	9–19	Male and female	346
Söderman et al. [37]	Sweden	Prospective cohort study	One outdoor season (April–October)	Time loss (absent from at least one practice session or game)	153 (10 teams)	Subelite	14–19	Female	79
Soligard et al. [25]	Norway	Prospective intervention study (only data of the control group)	One season (March–October)	Time loss (next match or training session)	837 (41 teams)	Subelite	13–17 (mean 15.4; SD 0.7)	Female	215
Spinks et al. [75]	Australia	Prospective cohort study	12 months	First-aid treatment	744	Primary school children	5–12	Male and female	20
Steffen et al. [29]	Norway	Prospective cohort study	1 season (March–October)	Time loss (no full participation for at least 1 day)	2,020 (109 teams)	Subelite	Under-17 (mean 15.4; SD 0.8)	Female	526
Timpka et al. [65]	Sweden	Prospective cohort study	One season	Medical attention and/or incomplete match and/or missing next match	1,800 (93 teams)	Subelite	13–16	Male	44
Yde and Nielsen [60]	Denmark	Prospective cohort study	One season (February–October)	Time loss (at least one practice session or match)	152 (1 club)	Subelite	<10–18	Male	62

NA data not available or not applicable, *SD* standard deviation

Table 2 Summary of studies on injury characteristics in children's and youth football: reported injury rates per athlete's exposure, reported indoor injuries, or retrospective questionnaire analysis

Reference	Country	Study design	Duration of data collection	Injury definition	Number of individuals (number of groups)	Population characteristics	Age in years or school level	Sex	Number of injuries
Adams and Schiff [9]	USA	Population-based descriptive study	July–December 2000	Presentation to emergency department	Estimated 144,604	Injured players, level NA	5–19	Male and female	Estimated 144,604
Baxter-Jones et al. [56]	Great Britain	Retrospective interview analysis	2 years (1987–1989)	Medical attention or reduction in the amount of sports activity	64	Elite players	8–16 years	Male and female	NA
Berger-Vachon [58]	France	Injuries reported to Rhône-Alpes Soccer Association insurance company	One season (September–May)	Any incident reported to the Rhône-Alpes Soccer Association	NA (all teams)	Subelite teams of Rhône-Alpes Association	8–17	Male and female	1,214
Dahlström et al. [101]	Sweden	Retrospective postal survey on injuries	One season (December 2005–November 2006)	Medical attention or time loss (at least one training session or match)	767 (4 clubs)	Subelite players	8–18	Male and female	NA
Darrow et al. [70]	USA	Cohort study	2 academic years	Medical attention and time loss of more than 21 days	NA (100 representative high schools)	High school players	High school	Male and female	183
Emery and Meeuwisse [24]	Canada	Cluster randomized controlled trial (only data of the control group)	One indoor season (October–March)	Medical attention and/or removal from a session and/or time loss from full soccer team participation	364 (28 teams) indoor	Subelite	13–18	Male and female	79
Emery and Meeuwisse [49]	Canada	Prospective cohort study on indoor injuries	One indoor season (20 weeks)	Medical attention and/or incomplete session and/or missing next training/match	102 (9 teams) +40 individual participants	Subelite	13–17	Male and female	35
Gianotti et al. [8]	USA	Descriptive analysis of hospital presentations	1994–2004	Presentation to hospital	32,149	Injured players, level NA	5–19	Male and female	32,149
Hoff and Martin [51]	USA	Retrospective questionnaire	One season (exact duration NA)	Missing (part of) game/practice or limited playing ability	455 (49 teams)	Subelite	8–15	Male and female	46 (outdoor) 74 (indoor)
Kucera et al. [66]	USA	Prospective cohort study	1997–2000	Missing part of next training session or match	1,483 (212 teams)	Subelite players	9–18	Male and female	905
Kujala et al. [102]	Finland	Data from national sports injury insurance registry	1987–1991	Reported to insurance company	NA	Injured players, subelite	Up to 19	Male and female	4,065

Table 2 continued

Reference	Country	Study design	Duration of data collection	Injury definition	Number of individuals (number of groups)	Population characteristics	Age in years or school level	Sex	Number of injuries
Leininger et al. [10]	USA	Descriptive analysis of nationally representative football injuries	1990–2003	Presentation to emergency department	41,278	Injured players, level NA	2–18	Male and female	41,278
Lindenfeld et al. [50]	USA	Prospective observation in an indoor football arena	7 weeks	Leaving game or stop playing due to an injury or medical attention	NA	Subelite	Up to 18 years	Male and female	33
Powell and Barber-Foss [72]	USA	Observational cohort study	Academic years (1995–1997)	Any injury causing cessation of participation, fractures, dental injuries, and mild brain injuries (not necessarily resulting in cessation of exercise; NAIRS definition)	2,963	Injured players; high school level	NA	Male and female	3,536
Price et al. [57]	Great Britain	Prospective cohort study	Two seasons (1999–2001)	Time loss (at least 48 h)	4,773 (29 football club academies)	Subelite players	9–19	NA	3,805
Radelet et al. [103]	USA	Prospective cohort study	2 years (1999/2000)	Coach on field, first-aid treatment or removal from participation	482 (40 teams)	Subelite players	7–13	Male and female	47
Rechel et al. [69]	USA	Cohort study	1 academic year	Medical attention and time loss of more than 1 day	NA (100 representative high schools)	High school players	High school	Male and female	706
Schiff [67]	USA	Retrospective questionnaire	One season	Time loss (at least 1 day absence)	103 (10 teams)	Community level	11–14	Female	NA
Schmikli et al. [104]	The Netherlands	National survey on injuries and physical activity	6 years (2000–2005)	Physical damage or physical hindrance related to football training or competition	1,241	Subelite players	4–17	Male	104
Sullivan et al. [105]	USA	Prospective cohort study	One season	Any medical problem resulting from football and preventing participation	1,272 (80 teams)	Subelite players	7–18	Male and female	34
Yard et al. [62]	USA	Descriptive epidemiologic study	2005–2007	Medical attention and restricted participation	NA (100 high schools)	High school players	High school	Male and female	1,524

NA data not available or not applicable, *NAIRS* national athletic injury/illness reporting system

13–19 years. Overall incidence is dependent on the ratio of training and match exposure, and, thus, separate data for practice and games should be reported and analyzed [22]. Table 3 provides an overview on training and match incidences of outdoor injuries as related to age groups and sex. Training injury incidence was nearly constant for players aged 13–19 years, with most numbers ranging from 1 to 5 injuries per 1,000 h of training [25, 29–39], while younger players had lower incidences. Match injury incidence tended to increase with age through all age groups, with an average incidence of about 15 to 20 injuries per 1,000 match hours in players older than 15 years [26, 35, 38, 40–43]. The ratio of match to training injuries varied between 1.2 [11] and 11.5 [44], with most numbers between 3 and 6 [25, 26, 31, 32, 34, 35, 37–39, 45, 46]. No relevant differences in injury incidence of boys and girls were apparent.

Some of these conclusions were based on only very little available information. Exact data on training injuries were rare, in particular for girls and children younger than 13 years. Some studies reported data for the under-13 category, but separate and reliable information for players 11 years and younger was almost completely missing. The summarized figures are rough estimates, and the exact numbers differed considerably between studies. The sometimes huge variations are most likely due to methodological differences in injury definitions, data collection strategies, and observation periods. For instance, Nilsson and Roaas [47] analyzed all injuries that received first-aid treatment during a 6-day tournament in Norway. The high number of minor injuries (which mostly do not result in time loss) caused the high injury rate in this particular study. If minor blisters and abrasions were excluded from analysis, the incidence was considerably lower and within the range of the values reported in other investigations [47].

Most studies analyzed subelite players. Only a few studies investigated players of the highest level of the game [30–32, 48]. Le Gall and coworkers looked at injuries at the French National Football Institute and reported overall injury incidences of about 5 to 6 injuries per 1,000 h of football in male under-14 to under-16 players [30, 32] as well as in female under-17 and under-19 players [31]. Training incidences were about 4 to 5 injuries per 1,000 training hours for both sexes, and match incidences were between 10 and 14 injuries for the boys and 22.4 injuries per 1,000 match hours for the older girls. Müller-Rath et al. [48] reported a low overall injury rate of 2.4 injuries per 1,000 playing hours in one team in the highest German under-19 division. Unfortunately, separate information for training and match injuries was not presented. In summary, injury incidence in elite youth players is mostly in the upper range of reported values for subelite players. In this regard it has to be mentioned that medical service in elite youth players is more comprehensive as compared to the subelite level, and, thus, the probability that all injuries were documented and appropriately treated is more likely. Therefore, it seems justified to conclude that elite youth players might have a similar injury risk as subelite players.

In comparing injuries occurring during indoor and outdoor football, a conclusive appraisal is not yet possible. In 2006, Emery and Meeuwisse [49] observed no relevant differences between indoor and outdoor football. Another investigation reported extraordinary high injury rates for playing indoors (up to 60 injuries per 1,000 match hours for under-15 girls) [50]. In addition, Hoff and Martin [51] found about 4.5 times higher incidences for playing indoors as compared to outdoors. The latter two studies were published a long time ago, and indoor football arenas have changed considerably since then (e.g., through the development of modern surfaces). Recent studies showed no relevant differences in injury incidence rates between natural grass and artificial turf when playing outdoors in adolescent and adult players [29, 52–54]. Further research seems warranted to clearly assess whether incidence rates playing indoors are higher.

Four studies analyzed injury risk with regard to maturity status in pubescent children [30, 33, 55, 56]. Although not significant, injury incidence was found to be higher in early maturing as compared to late-maturing players in two studies [30, 33]. In addition, Backous et al. [55] reported that skeletally mature but muscularly weak boys were more susceptible to injury compared to peers of the same chronological age. Early maturing players showed a higher number of tendinopathies, groin injuries, and reinjuries, whereas late-maturing boys had significantly more osteochondroses, and a higher incidence of severe injuries leading to an increased injury-related lay-off time [30]. In contrast to those studies, Baxter-Jones et al. [56] observed no influence of pubertal status on the number and severity of injuries in high-level youth football players. Considering that about one third of all players of one age category were not within their normal maturity category [33], it seems warranted that the influence of maturity status on injury characteristics be investigated in more detail in future studies. This is well justified because the valid assessment of maturity status is expensive and difficult and various different methods were applied in the mentioned studies. For instance, the early study of Backous et al. [55] used height and grip strength to estimate maturity status, and, thus, the obtained results need to be interpreted very carefully. Moreover, it is possible that late-maturing boys are underrepresented within a specific population whereas early maturing boys are overrepresented. In future, this has to be critically considered and standard methodological and statistical procedures have to be established to assess the

Table 3 Outdoor injuries per 1,000 h of training and match play with regard to age group and sex

Age range (age group)[a]	Both sexes		Boys		Girls	
	Match	Training	Match	Training	Match	Training
17–19 years (under-19)	1.5 (0.8, 2.7) [11]	0.2 (0.0, 1.1) [11]	7.1 (3.7, 10.4) [34]	1.2 (0.5, 1.9) [34]	10.6 (9.5, 11.9) [41]	4.6 (4.2, 5.1) [31]
			8.6 (6.4, 11.6) [43]	3.6 [39]	15.9 (11.2, 22.5)[43]	
			13.5 (12.5, 14.5) [41]	4.7 (3.8, 5.8) [38]	22.4 (19.6, 25.6) [31]	
			14.4 [39]		47.2 (33.0, 67.5) [42]	
			20.6 (16.4, 25.9) [42]			
			23.6 (19.5, 28.6) [38]			
			28.3 (18.3, 43.9) [40]			
15/16 years (under-17)	9.9 (6.8, 14.5) [11]	1.2 (0.4, 3.7) [11]	2.1 (1.5, 2.9) [65]	1.1 (0.4, 1.8) [34]	8.3 (7.5, 9.2) [29]	1.1 (0.9, 1.3) [29]
			3.7 (0.4, 7.0) [34]	3.7 (2.4, 5.6) [35]	9.1 (6.7, 12.4) [37]	1.5 (1.1, 2.1) [37]
			14.2 (12.0, 16.8) [32]	3.8 (3.3, 4.3) [32]	9.6 (8.1, 11.3) [25]	2.4 (1.9, 3.0) [25]
			16.1 (8.9, 29.1) [40]	4.1 (3.3, 5.1) [38]	17.7 (16.2, 19.2) [41]	
			16.1 (15.0, 17.2) [41]	5.7 (4.4, 7.3) [26]	38.6 (30.8, 48.4) [42]	
			16.2 (12.6, 20.9) [35]			
			19.2 (15.9, 23.1) [42]			
			19.6 (15.8, 24.2) [38]			
			20.0 (15.2, 26.3) [26]			
13/14 years (under-15)	8.5 (5.6, 12.8) [11]	7.2 (4.2, 12.1) [11]	2.6 (1.4, 5.0) [65]	0.7 (0.5, 1.4) [34]	16.9 (15.5, 18.5) [41]	
			5.6 (4.6, 6.8) [36]	3.3 (2.7, 4.0) [36]		
			6.1 (2.8, 9.4) [34]	3.7 (3.3, 4.2) [32]		
			9.5 (7.9, 11.5) [32]	4.1 (3.7, 4.6) [32]		
			10.4 (8.6, 12.5) [32]	4.7 (4.3, 5.2) [30]		
			11.8 (10.1, 13.7) [30]			
			11.8 (10.9, 12.8) [41]			
			12.8 (6.4, 25.6) [40]			
<13 years (under-13)			2.0 (1.3, 5.4) [34]	0.5 (0.2, 1.2) [34]	0.9 (0.5, 1.6) [42]	
			9.3 (6.8, 12.7) [43]	1.4 (1.3, 1.6) [33]	12.6 (11.0, 14.5) [41]	
			9.4 (7.1, 12.6) [42]			
			10.5 (9.0, 12.2) [33]			
			11.2 (10.0, 12.5) [41]			

Table 3 continued

Age range (age group)[a]	Both sexes		Boys		Girls	
	Match	Training	Match	Training	Match	Training
No specific age group	2.4 (2.0, 2.8) [61]	0.5 (0.3, 0.6) [44]	5.4 (4.4, 6.6) [44]	0.5 (0.3, 0.8) [44]	4.6 (3.2, 6.6) [44]	0.4 (0.2, 0.8) [44]
	5.2 (4.3, 6.1) [44]	6.8 (5.4, 8.5) [46]	7.3 (5.0, 10.7) [63]	1.7 [60]	7.6 (5.6, 10.3) [63]	7.0 (4.1, 11.8) [46]
	7.4 (5.8, 9.4) [63]		9.1 (7.2, 11.5) [43]	6.8 (5.3, 8.7) [46]	13.0 (8.8, 19.2) [43]	
			9.9 [60]		20.5 (16.6, 25.3) [43]	
	39.3 (35.2, 43.9) [46]		11.2 (9.3, 13.4) [43]		44.0 [47]	
			23.0 [47]		51.7 (41.4, 64.6) [46]	
			36.8 (32.4, 41.8) [46]			

95 % confidence intervals are given in parentheses

[a] Age group was either defined by the reported average age of the cohort or if the age group was explicitly given

association between maturity status and injury risk in more detail.

Few studies used population-based descriptive approaches to analyze injury risk from several thousand presentations to American emergency departments [8–10]. These data are of interest because they provide a broader perspective. However, it must be stressed that minor injuries, which are frequent in football, were not included in these analyses because such injuries usually are not presented to emergency departments. Injury risk was reported to be on average between 1.5 and 2.5 injuries per 1,000 children per year [9, 10], and injury rates increased with age [9, 57, 58]. Over a period of 13 years, the rate of injuries presented to an emergency department for children older than 5 years varied from just below 6 (1990) to 7.6 (2000) injuries per 1,000 football participants [10]. Gianotti et al. [8] showed that 60 % of all football injuries presented at an emergency department resulted from unorganized football.

4 Mechanisms of Injury

About 40 to 60 % of all injuries were due to contact with another player or with an object (e.g., ball, ground, or posts; Table 4) [11, 29, 35, 55, 59–61]. Yard et al. [62] reported that contact injuries were dominant during match play whereas noncontact injuries more frequently occurred during practice sessions. This is in line with the findings of Price and colleagues [57] who observed that most training injuries were caused by running while match injuries were predominantly caused by tackling and collision. Gianotti et al. [8] found that player-to-player contact increased with age, whereas contact with a structure, object, or the ball decreased. Between 60 and 90 % of all football injuries in young players were classified as traumatic (i.e., caused by a single traumatic event), and about 10 to 40 % were overuse injuries (i.e., the result of repetitive microtraumata without a clearly identifiable event; Table 4) [11, 25, 26, 29, 31, 35–37, 40, 44, 48, 59, 63]. This considerable range might be due to variations in the definition of overuse injuries, and the difficulty in assessing whether there was an acute underlying event [64]. Those studies that analyzed injuries during tournaments (i.e., match injuries only) reported the highest frequencies of traumatic injuries and the lowest rates of overuse injuries (Table 4) [42, 63]. Similarly, the number of recurrent injuries was reported to be about 4 % in three studies [30, 31, 34], whereas three other studies observed recurrence rates of nearly 20 % and higher [29, 63, 65]. Again, this variability might be attributed to inconsistencies in the definition of a recurrent injury, and the difficulty in diagnosing it when medical service is not very comprehensive as is the case in youth football at a subelite level. Uniform definitions that are feasible in

Table 4 Distribution of injury mechanisms

Reference	Mechanism of injury (%)			
	Contact	Overuse	Trauma	Recurrent
Studies analyzing injuries over a season (match and training injuries combined)				
Backous et al. [55]	47			
Brito et al. [34]		43	57	4
Emery et al. [11]	46	10	90	
Froholdt et al. [44]	62	24	77	
Inklaar et al. [40]		35	65	
Junge et al. [35]	52	15	85	
Junge et al. [26]	38	37	63	
Junge et al. [59]	46	17	83	
Kakavelakis et al. [36]	63	20	80	
Le Gall et al. [31]		13	86	4
Le Gall et al. [30]				3
Müller-Rath et al. [48]		35	65	
Söderman et al. [37]		34	66	
Soligard et al. [25]	35	24	76	
Steffen et al. [29]	58	13	87	19
Timpka et al. [65]	68			18
Yde and Nielsen [60]	51			
All studies, median (range)	51 (35–68)	24 (10–43)	77 (57–90)	4 (3–19)
Studies analyzing injuries during a tournament (match injuries only)				
Kibler [61]	56			
Rosenbaum et al. [63]		10	90	26
Schmidt-Olsen et al. [42]		5	95	

children's football are urgently warranted to arrive at more homogenous and conclusive results in this regard. This is particularly relevant because players with a history of injuries showed an increased risk for new injuries (but not necessarily the same one) [11, 66].

5 Location and Type of Injury

Most injuries (60 to 90 %) were located at the lower extremities with the ankle, knee, and thigh being mostly affected (Table 5). The proportion of injuries in these locations varied considerably between studies, possibly due to inconsistencies in definition and documentation as well as low sample sizes. Injuries to the lower leg and foot/toe were less frequent (about 10 % each). Approximately 10 % of all injuries were related to the trunk including back complaints and 10 % to the upper extremity. About 5 % of all injuries affected the head/face. Interestingly, the frequency of upper body injuries was higher in those studies that analyzed match injuries only. This was mainly due to a higher proportion of upper extremity and head/face injuries (Table 5). Head and back injuries can have serious consequences, particularly in children, and, thus, they should be considered when planning preventive measures.

The proportion of upper body injuries was higher in children under the age of 15 years (20–29 %) [32, 36, 67] than in players older than 14 years (11–21 %) [29, 31, 35, 37, 48]. This difference was mainly due to a higher proportion of upper extremity injuries (9–13 % [32, 36, 67] and 3–8 % [31, 35, 37, 48], respectively), and fractures of the arm, wrist, or hand (6–8 % [32, 36] and 1–3 % [31, 35, 37], respectively). A decrease in the proportion of fractures with age has also been reported in other investigations [8, 9, 58]. Possible explanations for this observation are skeletal immaturity and/or less developed skills and coordination of younger players together with less playing experience leading to a higher likelihood of falls, and, consecutively, to more fractures [8].

The most common injury types were strains (muscle–tendon injuries), sprains (joint–ligament injuries), and contusions (Table 6). The proportion of these injury types varied from 10 % up to 40 % between studies. Studies on boys [32, 34–36, 40] reported a similar percentage of strains (5–32 %) and sprains (17–33 %), while in girls [25, 29, 31, 37] more sprains (27–47 %) than strains (15–25 %)

Table 5 Distribution of injuries in different body parts

Reference	Body part affected (%)										
	Lower extremities	Thigh/upper leg	Ankle	Knee	Lower leg	Foot/toe	Hip/groin	Upper body	Trunk/ spine	Upper extremities	Head/face
Studies analyzing injuries over a season (match and training injuries combined)											
Backous et al. [55]	71	8	19	13		10					8
Brito et al. [34]	86	30	18	12	7	13	7	14	5	7	2
Emery et al. [11]	79	6	28	19	8	8	10	21	8	4	9
Froholdt et al. [44]	76	14	20	13	9	12	8	24	12[a]		12
Inklaar et al. [40]		26	19	26	16						
Junge et al. [35]	80	17	17	15	16	6	9	20	11	5	4
Junge et al. [26]	79	22	16	16	5	12	8	21	14	6	1
Junge et al. [59]		16	24	22	6		7[b]				
Kakavelakis et al. [36]	80	9	29	36	6			20	5	12	3[c]
Le Gall et al. [31]	84	21	25	17	5	6	10	16	11	5	0.3
Le Gall et al. [32]	73	25	18	15	5	8	2[b]	27	17	9	1
Müller-Rath et al. [48]	83	21	27	8	8	10	8	17	6	8	2
Nielsen and Yde [39]		15[d]	37	22		7					
Schmidt-Olsen et al. [68]	70		23	26	11	0.3	9		14	10	4
Söderman et al. [37]	89	19	23	19	13	9	6	11	9	3	
Soligard et al. [25]		8	24	27			4				
Steffen et al. [29]	82	13	38	16			3[b]	18			
Timpka et al. [65]	58	7	15	10	10	17	7	42	9	12	12
Yde and Nielsen [60]		24	27	19		19				4	
All studies, median (range)	79.5 (58–89)	16.5 (6–30)	23 (15–38)	17 (8–36)	8 (5–16)	9.5 (0.3–19)	7.5 (2–10)	20 (11–42)	10 (5–17)	6.5 (3–12)	3.5 (0.3–12)

Table 5 continued

Reference	Body part affected (%)										
	Lower extremities	Thigh/upper leg	Ankle	Knee	Lower leg	Foot/toe	Hip/groin	Upper body	Trunk/spine	Upper extremities	Head/face
Studies analyzing injuries during a tournament (match injuries only)											
Elias [41]	66	12	20	17	9	8		33	8	12	13
Kibler [61]		21	13	16		13			11		8[c]
Maehlum et al. [43]	61								8	14	17
Nilsson and Roaas [47]	68	12[d]	16	14	13	13		32	7	15	10
Rosenbaum et al. [63]	65	1	22	18	6	10	4	35	7	15	13
Schmidt-Olsen et al. [42]	81	15	16	10	10	28	2	19	4	10	5
All studies, median (range)	66 (61–81)	12 (1–21)	16 (13–22)	16 (10–18)	9.5 (6–13)	13 (8–28)		32.5 (19–35)	7.5 (4–11)	14 (10–15)	11.5 (5–17)

[a] Includes upper extremities
[b] Groin or hip only
[c] Includes neck
[d] Includes groin or hip

were observed. Some studies found an increase in the proportion of sprains and strains with age [8, 34, 44, 58]. Froholdt et al. [44] observed that sprains increased with age in girls, while strains increased with age in boys.

Fractures (1–15 %), dislocations (0.3–3 %), and concussions (1–7 %) were less frequent. In two studies the percentage of concussions was 6 and 7 % [11, 63], respectively, whereas in several other studies it was 2 % or less [35, 36, 41, 42, 61, 65, 68]. One of the studies with a high frequency of concussion was conducted during a tournament [63]. There is some evidence, that the risk of traumatic injuries, and, particularly, of sustaining a fracture, contusion, or concussion as well as head, face, or neck injuries was higher during match play than in practice sessions [62, 69]. Because of the serious consequences, a more detailed analysis of the mechanisms resulting in fractures and concussions in children seems warranted, in particular for the development of injury-prevention programs for this population.

In studies on football injuries presented to an emergency department or hospital, lower extremity injuries were fewer (40 and 50 % of all injuries) and upper extremity injuries were more frequent (30–40 % of all injuries) [8–10]. The number of fractures and dislocations in these studies was particularly high (23–31 %). Injuries to high school players that resulted in absence from sport of more than 3 weeks were mainly fractures or sprains [70]. In this study boys incurred more fractures (42 vs 22 %) and fewer sprains (24 vs 46 %) than girls, and girls had twice as many knee injuries as boys (50 vs 23 %) [70].

A relevant problem in young football players is also growth-related conditions, such as osteochondral disorders like Osgood-Schlatter or Sever's disease [30, 32, 57]. Le Gall et al. [30, 32] found that Osgood-Schlatter disease was (together with fractures) the most common major injury in 14-year-old elite football players. The incidence of Osgood-Schlatter syndrome peaked in the under-13 and under-14 age groups [32, 57]. Sever's disease has been reported to be most frequent in the under-11 age group [57]. On average, this corresponds to growth spurts at the beginning and the end of puberty. Thus, growth-related injury characteristics and maturation status should be considered when designing training and/or prevention programs in pubescent and adolescent players. Growth-related conditions, however, are often self-limiting and disappear with skeletal maturation [71].

6 Severity of Injury and Return to Play

Fourteen studies reported data on the time players were not able to fully take part in training and/or match play, or were absent from football as a result of an injury (see

Table 6 Distribution of different injury types

Reference	Type of injury (%)					
	Strain	Sprain	Contusion	Fracture	Dislocation	Concussion
Studies analyzing injuries over a season (match and training injuries combined)						
Backous et al. [55]	28	16	32	1		
Brito et al. [34]	31	25	23	3	3	
Emery et al. [11]	24	35				6
Froholdt et al. [44]	17	24	41	5		
Inklaar et al. [40]	16	33	28	2	2	
Junge et al. [35]	32	21	28	1	1	1
Kakavelakis et al. [36]	23	33	21[a]	8		1
Le Gall et al. [31]	25	27	16	3	0.3	
Le Gall et al. [32]	15	17	31[b]	6	1	
Schmidt-Olsen et al. [68]				5		1
Söderman et al. [37]	19	32	8	3	3	
Soligard et al. [25]	17	47	20	4		
Steffen et al. [29]	15	43	31			
Timpka et al. [65]	5	27	29	15		2
All studies, median (range)	19 (5–32)	27 (16–47)	28 (8–41)	3.5 (1–15)	1.5 (0.3–3)	1 (1–6)
Studies analyzing injuries during a tournament (match injuries only)						
Elias [41]						2
Kibler [61]	25	22	32	9		2
Maehlum et al. [43]		22	47	6	1	
Nilsson and Roaas [47]			36	4		
Rosenbaum et al. [63]	9	32	29[b]	6		7
Schmidt-Olsen et al. [42]	10	20	33	4	1	1
All studies, median (range)	10 (9–25)	22 (20–32)	33 (29–47)	6 (4–9)		2 (1–7)

[a] Includes abrasion

[b] Includes hematoma

Table 7). For injury severity, the established consensus was used, which defines a mild injury if the time of absence is between 1 and 7 or 8 days, a moderate injury if the time missed is between 7–8 and 28–30 days, and a severe injury if the time missed is longer than 28 or 30 days. About half of all time-loss injuries led to an absence of less than 1 week, one third resulted in an absence of between 1 and 4 weeks, and 10 to 15 % of all injuries were severe. It should be considered that in youth football training and match schedules are not as tight and consistent, and medical care is not as comprehensive as in professional football. Thus, the proportion of mild injuries might be underestimated, and, consequently, the proportion of severe injuries overestimated. Seven studies reported the average number of days absent due to an injury as an indicator of injury severity (Table 7) [30–34, 48, 65]. The average duration varied, with one exception [65], between 12 and 18 days. A conclusive statement with regard to possible differences between sexes, age groups, or level of play is not possible from the available data.

About 1–5 % of the injuries presented to emergency departments resulted in hospitalization and/or surgery [8–10, 69, 72]. The risk for hospitalization and/or surgery was higher in boys than in girls [8, 10], and higher for match injuries than for training injuries [8, 69]. Injuries that resulted in hospital admission mostly concerned the head, face, or neck as well as the trunk [8]. Fatal accidents in football are fortunately very scarce. Leininger et al. [10] estimated the number of fatalities being about 5 per 100,000 football accidents presented to emergency departments.

7 Summary and Potential for Injury Prevention

The incidence of injury in children's and youth football increased with age, and in players of both sexes aged 17–19 years the incidence approached the values observed in adult players [16, 17, 21, 73]. For prepubertal children very few data existed. The available studies found low

Table 7 Distribution of football injury severity as measured by inability to play or train, or length of absence from playing football

Reference	Days unable to play or train (%)			Days absent (mean)
	Mild (<7–8 days)	Moderate (7–8 to 28–30 days)	Severe (>28–30 days)	
Brito et al. [34]				14.6
Froholdt et al. [44]	53	NA	NA	
Johnson et al. [33]				12.5
Junge et al. [35]	67	NA	NA	
Junge et al. [26]	66	20	14	
Kakavelakis et al. [36]	30	38	32	
Le Gall et al. [31]	52	36	12	18
Le Gall et al. [30]	59	31	10	17.4
Le Gall et al. [32]	60	30	10	15
Müller-Rath et al. [48]				14.2
Söderman et al. [37]	34	52	14	
Soligard et al. [25]	31	32	37	
Steffen et al. [29]	44	NA	NA	
Timpka et al. [65]	27	NA	NA	26.3
All studies, median (range)	52 (27–67)	32 (20–52)	14 (10–37)	15 (12.5–26.3)

No completely uniform definition of injury severity exists across studies

NA data not available or not applicable because a different definition of injury severity was used

overall (0.1 to 1.6 injuries per 1,000 h of football) [44, 74, 75] and match (about 3 or 4 injuries per 1,000 match hours) [51] incidences for children younger than 12 years. These data were based on low sample sizes and separate training data were completely missing. Further research on injury risks and patterns in the youngest children playing football are needed to arrive at valid conclusions for injury prevention in this age group.

Above the age of about 14 years, injury characteristics tended to be similar to adult players [21, 76]. Younger players had more fractures, fewer strains and sprains, and the upper body was more frequently affected as compared to their older counterparts. Skeletal and coordinative immaturity together with growth-related diseases seem to be more frequent, leading to specific injury characteristics. In addition, growth-related conditions are of particular relevance because they result in long absence from sport.

One of the pillars of prevention research is establishing the mechanism of injury and possible risk factors [14, 15]. Most studies simply distinguished between contact and noncontact or traumatic and overuse injuries. More detailed information on injury mechanisms was scarcely available. Detailed risk factor analyses and more in-depth description of injury mechanics [77] are valuable topics for future studies.

From the available data, it can be concluded that different age groups need different preventive approaches. Adolescents showed similar injury characteristics to adult players, and, thus, similar preventive measures might be beneficial in this age group. Twelve studies on injury prevention in youth and adolescent football players (13–19 years old) were found in the literature, of which six were designed to reduce the overall rate of injury [24–27, 78, 79] while the others focused on specific injuries [80–85]. In most studies, there was evidence that injury-prevention programs were effective [24–26, 79–83, 85]. When an injury-prevention program failed [27, 84], poor compliance was considered to be the main reason. No study investigated the prevention of football injuries in children under the age of 13 years.

Based on the presented data, three main areas are particularly relevant for future injury-prevention research focusing on young football players. First, the relevant number of severe contact injuries occurring during match play needs to be addressed. Injuries resulting from dangerous play or foul play can potentially be reduced by applying the laws of the game and promoting fair play. Fair play is part of the FIFA 11+ prevention program, which has been shown to be effective in reducing severe and overall injury incidence in female youth football players [25]. Moreover, fair play programs have been shown to be promising approaches for reducing injuries in junior ice hockey players [86, 87]. Nevertheless, more research on the effectiveness of fair play in injury-prevention programs is needed to arrive at evidence-based recommendations. Systematic promotion of fair play by coaches, parents, and officials should start at latest when playing organized football. The laws of the game should be comprehensible for young players and should be enforced on the pitch (during match play by the referees as well as in practice

sessions by the coaches). Creating a safe environment (secure goals and clearing of all debris and unneeded obstacles) is a further step to reduce severe injuries [23].

Another relevant issue is the high number of fractures observed in younger players. One approach might be to reduce the risk of falling by implementing particular preventive training, focusing either on the improvement of coordination, balance, or neuromuscular performance. Similar approaches have been proven beneficial in adolescent players [24, 80, 82, 83], but it is questionable whether these results can be easily transferred to pubescent or even younger children. Another promising approach might be to teach fall techniques like those used in martial arts. Martial arts techniques decrease the impact forces when falling, and, thus, can reduce the consequences of falls [88, 89]. Interestingly, Scase et al. [90] reported that teaching sport-specific landing skills during eight 30-min sessions during the preseason significantly reduced the injury rate, particularly of fall-related injuries, compared to a control group in under-18 competitive Australian rules football players.

A third focus should be on the influence of physical maturation status and growth spurts. In youth football, players of a similar age but of different biological maturation levels usually play together. Thus, some players are physically less developed than their early matured teammates and opponents. The relative age effect (referring to the asymmetry of birth date distribution in squads favoring players born early in the selection year) has frequently been described for the talent selection process [91, 92]. Although known for a long time, no solution for this problem has been established yet [92]. It can be assumed that the relative age effect does not only affect talent selection and performance but also injury risk and characteristics. However, to date scientific evidence in this regard is lacking. Future injury surveillance studies should provide relevant information to address the relative age effect in relation to injury risk in more detail. Training methods adapted to the developmental status might help to reduce injuries and growth-related overuse conditions. Governing bodies of football should consider categories for youth players of similar physical maturity instead of chronological age.

With regard to the development of injury-prevention programs, data on specific risk factors should be considered [14, 15]. In youth football, however, scientific information on risk factors is limited to date [11]. Playing in adult teams has been shown to increase the risk for anterior cruciate ligament injury in adolescent female football players [93]. Emery [94] summarized the literature on injury risk factors with respect to children and adolescent sport and concluded that evidence exists that shows poor endurance, lack of preseason training, and psychosocial factors being important modifiable risk factors, whereas age, sex-specific factors, and previous injury are relevant nonmodifiable risk factors. The author, however, raised concerns on the internal and external validity of these results in children and adolescents. Particularly regarding football injuries, previous injury within the past year and left-leg dominance were found to be significant risk factors in players aged 12–18 years [11]. Interestingly, Inklaar et al. [40] observed that injury risk may be more specific to the team than to the individual player, and, thus, preventive measures may also target the teams and their environments. Future research on injury risk factors in youth football is warranted to arrive at comprehensive conclusions with regard to the development of prevention programs.

8 Methodological Issues

The studies included in present review vary considerably in injury definitions and data collection procedures, which has made comparisons between studies difficult or impossible. For instance, some authors combined sprains and strains, others injuries of thigh and lower leg, injuries in boys and girls, or match and training injuries, and some pooled injuries of all age groups. Such limitations are inherent when comparing projects across a 35-year period [95].

In contrast to professional football players who often have team physicians and/or physiotherapists, the injury surveillance of children is more difficult due to the lack of medical coverage. Thus, critical evaluation of injury monitoring is necessary and uniform methodological standards need to be established. Many minor injuries do not lead to time loss (missing organized football sessions or physical education lessons in school) and might not be presented to a physician; thus, exact medical diagnoses are not always available. Because the injury incidence in children is among the lowest reported in football, large numbers of teams need to be followed carefully to obtain reliable data on injury risk. Frequent recording and reporting of injury by a specifically identified individual (e.g., a coach or research team member) is recommended [22], and has been successfully conducted in this age group [44]. In addition, more information on specific injury circumstances as well as more precise information on population characteristics (e.g., exact age of players, level of play, fitness level, anthropometric data), and, in particular, more detailed analyses of injury characteristics, mechanisms, and risk factors within specific age groups seem to be warranted in future research.

9 Conclusions and Recommendations for Future Research

While many studies on the incidence, characteristics, mechanisms, and prevention of football injuries in adult

and adolescent players have been published in recent decades, there is a remarkable lack of information on football injuries and their prevention for players younger than 13 years. The widely accepted consensus for epidemiological studies on football injuries [22] should serve as the methodological foundation for future projects, but needs to be partly adapted to the specific conditions in children's and youth football. Future studies should pay attention to injury mechanisms, risk factors, and overuse injuries [64]. Due to the different injury profile and maturation status of children, preventive programs that have proven effective in late adolescent or adult players need to be adapted and their effects evaluated in younger age groups. Injury rates in young children may be the lowest within the sport, but due to the high number of participants injury-prevention programs can result in a substantial public health impact with outcomes similar to a recent successful national implementation of a football prevention program [96].

All epidemiological studies on football injuries of children and youth players (Tables 1, 2) were conducted in developed countries, mostly in North America and Europe. Investigations on risk and prevention of football injuries in developing and emerging countries where organizational structures and environmental conditions can be very different are completely missing. An expansion of campaigns to prevent communicable and noncommunicable diseases in selected African countries [97] might be a promising foundation for future projects on injury risk and prevention in these regions of the world.

Emery and colleagues [98] pointed out that the child should be at the center of all efforts to reduce injuries. Parents, coaches, and professional players should be role models with regard to injury prevention and fair play. Parents should provide their children with safe protective equipment and coaches should include injury-prevention strategies into training and provide a safe environment. The governing bodies of football should promote injury prevention and enforce the strict application of the laws of the game. Prevention strategies should be properly integrated throughout this spectrum to reduce the injury risk in football, and thereby reduce risk compensation behavior by athletes [99]. Froholdt and colleagues [44] emphasized that "it is important to develop good habits, for example, by using appropriate warm-up programs, correct playing technique, and focusing on fair play attitudes from an early age," (p. 1159). Also, Verhagen et al. [100] pointed out the relevance of behavioral approaches for sports injury prevention in a real-life setting. Future injury-prevention strategies, thus, need a broader research focus. Children usually are regarded as the future of our society, and, therefore, their health should be of particular importance.

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