Journal of Athletic Training 2016;51(5):410–424
doi: 10.4085/1062-6050-51.6.03

www.natajournals.org

Analysis of Injury Incidences in Male Professional Adult and Elite Youth Soccer Players: A Systematic Review

Daniel Pfirrmann, MSS*; Mark Herbst, MSS*; Patrick Ingelfinger, MD†; Perikles Simon, MD, PhD*; Suzan Tug, PhD*

*Department of Sport Medicine, Johannes Gutenberg University of Mainz, Germany; †University Hospital, Center for Musculoskeletal Surgery and Orthopedic Hospital, Mainz, Germany

Context: The incidence of injury for elite youth and professional adult soccer players is an important concern, but the risk factors for these groups are different.

Objective: To summarize and compare the injury incidences and injury characteristics of male professional adult and elite youth soccer players.

Data Sources: We searched MEDLINE and Web of Science using the search terms *elite*, *international*, *European*, *soccer*, *football*, *injury*, *injuries*, *epidemiology*, *incidence*, *prevalence*, *not female*, *not American football*, and *not rugby*. We also used the search terms *professional* for studies on professional adult soccer players and *high-level*, *soccer academy*, *youth*, *adolescent*, and *young* for studies on elite youth soccer players.

Study Selection: Eligible studies were published in English, had a prospective cohort design, and had a minimum study period of 6 months. To ensure that injury data were assessed in relationship to the athlete's individual exposure, we included only studies that reported on injuries and documented exposure volume.

Data Extraction: Two independent reviewers applied the selection criteria and assessed the quality of the studies.

Data Synthesis: A total of 676 studies were retrieved from the literature search. Eighteen articles met the inclusion criteria: 6 for elite youth and 12 for professional adult soccer players.

Conclusions: Injury rates were higher for matches than for training for both youth and adult players. Youth players had a higher incidence of training injuries than professionals. Efforts must be made to reduce the overall injury rate in matches. Therefore, preventive interventions, such as adequately enforcing rules and focusing on fair play, must be analyzed and developed to reduce match-related injury incidences. Reducing training injuries should be a particular focus for youth soccer players.

Key Words: risk factors, injury characteristics, muscles

Key Points

- Injury rates in matches were higher than in training for both elite youth and professional adult soccer players.
- The incidence of training injuries was higher in elite youth than in professional adult soccer players.
- The rates of the most common injury types did not differ between groups.
- Existing studies addressing the quality and intensity of training need to be analyzed more precisely to provide reliable comparisons between these groups.
- An assessment model of training intensities might protect these players from overload and subsequent injuries.

Soccer is a complex contact sport that involves relatively high risks and rates of injury in professional,[1,2] amateur,[3,4] and youth[5–9] players during practices and matches. Athletes are playing the game faster and, depending on the importance of the game, more aggressively than in the past,[10] requiring elevated physical fitness levels and more intensive training predominantly at the professional level.[10] International soccer bodies are concerned about the pressure on elite and professional soccer players and the increased mental and physical demands leading to injuries.[11] Soccer injuries are associated with player age, exercise load, level of play, and standard of training.[11] Most investigators studying exposure-related injuries have focused on adult male professional soccer players.[12–17]

To develop athletes with the potential to be resilient professional soccer players, increasing emphasis has been placed on skill development in young players.[18,19] To achieve excellence, young athletes undertake elevated training volumes and intensities and face greater expectations from coaches or parents (or both).[20] To ensure young soccer players reach their maximum potential and simultaneously avoid exposure-related injuries, medical staff continuously look for the safest and most successful methods to help young players compete at the highest level.[21] Adolescent soccer players who are approaching the professional-league level of play are more susceptible to sustaining injuries.[6,20] However, only a few prospective injury studies in youth soccer have been conducted.[22,23] In addition, the definitions, diagnoses, and categorizations of injuries differ among studies, making comparison of results difficult.[6] This complex of problems appears in both youth and adult soccer player studies. As a part of the First World

Table 1. Methodologic Quality of the Included Studies for Elite Youth Soccer Players[a]

Question	Brink et al[20] (2010)	Ergün et al[23] (2013)	Deehan et al[9] (2007)	Le Gall et al[5] (2006)	Junge et al[25] (2000)	Peterson et al[29] (2000)
Time period given?	Yes	Yes	Yes	Yes	Yes	Yes
Groups given?	Yes	Yes	Yes	Yes	Yes	Yes
Dropouts given?	No	No	No	No	Yes	Yes
Consent given?	Yes	Yes	Yes	Yes	Don't know	Don't know
Type of survey described?	Yes	Yes	Yes	Yes	Yes	Yes
Injured body parts given?	Yes	Yes	Yes	Yes	Yes	Yes
Injury mechanism or situation given? (overuse or traumatic, contact or noncontact)	Yes	Yes	Yes	No	Yes	Yes
Definition of *injury* given?	Yes	Yes	Yes	Yes	Yes	Yes
Definition of *reinjury* given?	No	Yes	No	Yes	No	No
Age given?	Yes	Yes	Yes	Yes	Yes	Yes
Participants given?	Yes	Yes	Yes	Yes	Yes	Yes
No. of injuries given?	Yes	Yes	Yes	Yes	Yes	Yes
Study design given?	Yes	Yes	Yes	Yes	Yes	Yes
Proficiency level given?	Yes	Yes	Yes	Yes	Yes	Yes
Injury severity given?	Yes	Yes	Yes	Yes	Yes	Yes
Points, No. (%) (30 maximum)	26 (86.7)	28 (93.3)	26 (86.7)	26 (86.7)	27 (90.0)	27 (90.0)

[a] Two points were awarded for *yes*; 1 point for *don't know*; and 0 points for *no*.

Congress on Sports Injury Prevention in 2005, the Fédération Internationale de Football Association Medical Assessment and Research Centre (F-MARC) defined *injury*, *medical attention injury*, *time-loss injury*, and *recurrent injury*.[24] In studies completed before the implementation of the F-MARC guidelines, investigators defined *injury* and *time loss from activity*. These definitions ranged from missing 48 hours[9] to more than 72 hours,[13] at least 1 week,[25] the next match or training session,[26] and at least 1 day[1] of activity. Accordingly, little knowledge exists about injury incidence and its related risk factors in elite youth soccer players.[23,27] To analyze exposure-related injuries, the development and skill acquisition of each player should be considered.[6] An elite player who is frequently injured during his career may struggle to achieve maximum skill levels because of lack of training and competition. Sensitivity to injury may affect the potential of players to acquire excellent skills and reach the professional-league level in modern soccer.[5]

Precise conclusions regarding the nature and incidence of injuries in youth soccer players are difficult to draw from the available literature.[5] Therefore, researchers need to focus more specifically on sport injuries in elite youth athletes and follow their long-term development[23]; identify high-risk groups, particularly at elite levels of soccer[5]; and use the injury definitions of the F-MARC to ensure maximum comparability. Another important area of this research field is the prevention of soccer-related injuries to ensure the health and safety of young players during matches and practice.[6] To prevent soccer-related injuries, we need to determine the main factors that contribute to them.[28] Few investigators have analyzed the conditions and physiologic and psychological demands placed on young soccer players in high-pressure settings.[5,20,23,25] However, whereas the occurrences vary, the influences that lead to injuries in young athletes are nearly similar to those for adults, so a systematic comparison of soccer injuries in young and adult players may offer relevant insights for improving injury prevention. Therefore, the purpose of our systematic review was to summarize the incidences and characteristics of injury during training and matches for elite youth and professional adult soccer players. Comparing the main injury characteristics, including the severity and cause of injury, between youth and adults will allow us to draw comprehensive conclusions for practical considerations and future research.

METHODS

Data Sources

We searched the MEDLINE and Web of Science databases for key terms and their variations to identify appropriate studies on professional adult and elite youth soccer players. The search terms were *elite*, *international*, *European*, *soccer*, *football*, *injury*, *injuries*, *epidemiology*, *incidence*, *prevalence*, *not female*, *not American football*, and *not rugby* in the title or abstract. We also used the search terms *professional* for studies on professional adult soccer players and *high-level* OR *soccer academy* AND *youth* OR *adolescent* OR *young* for studies on elite youth soccer players. We limited our search to originally published English-language research articles with a prospective cohort design.

Selection Criteria

Relevant data were extracted to obtain the necessary information about study characteristics and findings from the included studies and were cross checked for accuracy. We included studies (1) with data collected prospectively to minimize the occurrence of errors associated with recall[24] and therefore ensure the quality of the data collected, (2) with a minimum 6-month study period to ensure that an ongoing competitive period was analyzed, (3) that were limited to outdoor soccer, and (4) that reported on injuries and documented exposure volume to ensure that injury data were assessed in relation to an athlete's individual exposure.[11,24] Additional inclusion criteria specific to the elite youth soccer players were defined as follows: youth or

adolescent male elite youth soccer players between 8 and 19 years of age[5,9,20,23,25,29] whose performance status was described as *soccer academy*, *high level*, or *elite*. For professional adult players, we searched for performance status that was described as *professional*, *elite*, *international*, or *European*. We excluded studies that focused exclusively on 1 specific type of injury; that examined school sport, amateur athletes, or recreational athletes; and in which the results could not be differentiated into age groups. We excluded *female* from the search terms.

Data Extraction and Methodologic Design

Two independent reviewers applied the selection criteria and assessed the quality of the studies. Data were extracted by an author (D.P. or M.H.) and independently verified by another author (S.T.). Controversy was resolved through detailed discussion by the reviewers or consultation with a third reviewer (P.S.).

Answers were scored with 2 points for *yes*, 1 point for *don't know*, and 0 points for *no*. The total possible score was 30. A summary of the methodologic quality of the included studies is shown in Tables 1 and 2.

RESULTS

Study Selection

Of the 676 studies retrieved from the literature search, only 18 articles were considered appropriate for our review: 6 studies of elite youth soccer players and 12 studies of professional adult soccer players (Figure 1). The studies of elite youth soccer players had quality scores ranging from 26 points[5,9,20] (86.7%) to 28 points[23] (93.3%; Table 1). The proficiency level for youth players was described in all 6 studies. Junge et al[25] and Peterson et al[29] distinguished between high-level and low-level players and showed a greater amount of time spent in training and matches in the high-level groups. Le Gall et al[5] reported that players at the National Institute of Football trained at least 2 hours each day. Deehan et al,[9] Brink et al,[20] and Ergün et al[23] specified the proficiency level of the players with the status or league place of the investigated club. The 12 studies of professional adult soccer players had quality scores ranging from 21 (70%)[26] to 30 (100%)[16,17,32] points (Table 2). The study dropouts were described clearly in 7 studies,[16,17,25,26,29,32,34] and participant consent was obtained in 14 studies.* The term *injury* was clearly defined in all studies. Six studies used the consensus definition of F-MARC,[20,23,30–32,34] some investigators provided their own definitions of *injury*[5,9,33] or partially modified the F-MARC definition,[13,14] and authors conducting studies before the F-MARC publication provided their own definitions.[1,15–17,25,26,29] The researchers in 9 studies[5,13,16,17,23,30–32,34] explained the term *reinjury*. In 17 studies, the injury numbers were reported,† and injury severity was characterized in most.‡ Summaries of the characteristics and methodologic quality of the included studies are provided in Tables 1 through 4.

* *References 5,9,13,14,16,17,20,23,26,30–34.*

† *References 1,5,9,13–17,20,23,25,29,30–34.*

‡ *References 1,5,9,13–17,20,23,25,29,30–32,34.*

Table 2. Methodologic Quality of the Included Studies for Professional Adult Soccer Players[a]

Question	Bjørneboe et al[30] (2014)	Dauty and Collon[13] (2011)	Ekstrand et al[14] (2011)	Ekstrand et al[31] (2011)	Ekstrand et al[26] (2004)	Eirale et al[32] (2013)	Eirale et al[33] (2012)	Hawkins and Fuller[1] (1999)	Morgan and Oberlander[15] (2001)	Parry and Drust[34] (2006)	Waldén et al[16] (2005)	Waldén et al[17] (2005)
Time period given?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Groups given?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dropouts given?	No	No	No	No	Yes	Yes	No	No	No	Yes	Yes	Yes
Consent given?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Don't know	Don't know	Yes	Yes	Yes
Type of survey described?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Injured body parts given?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Injury mechanism or situation given? (overuse or traumatic, contact or noncontact)	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes
Definition of *injury* given?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Definition of *reinjury* given?	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No	Yes	Yes
Age given?	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Participants given?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of injuries given?	Yes	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Study design given?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Proficiency level given?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Injury severity given?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Points, No. (%) (30 maximum)	26 (86.7)	26 (86.7)	26 (86.7)	28 (93.3)	21 (70.0)	30 (100)	28 (93.3)	23 (76.7)	23 (76.7)	22 (73.3)	30 (100)	30 (100)

[a] Two points were awarded for *yes*; 1 point for *don't know*, and 0 points for *no*.

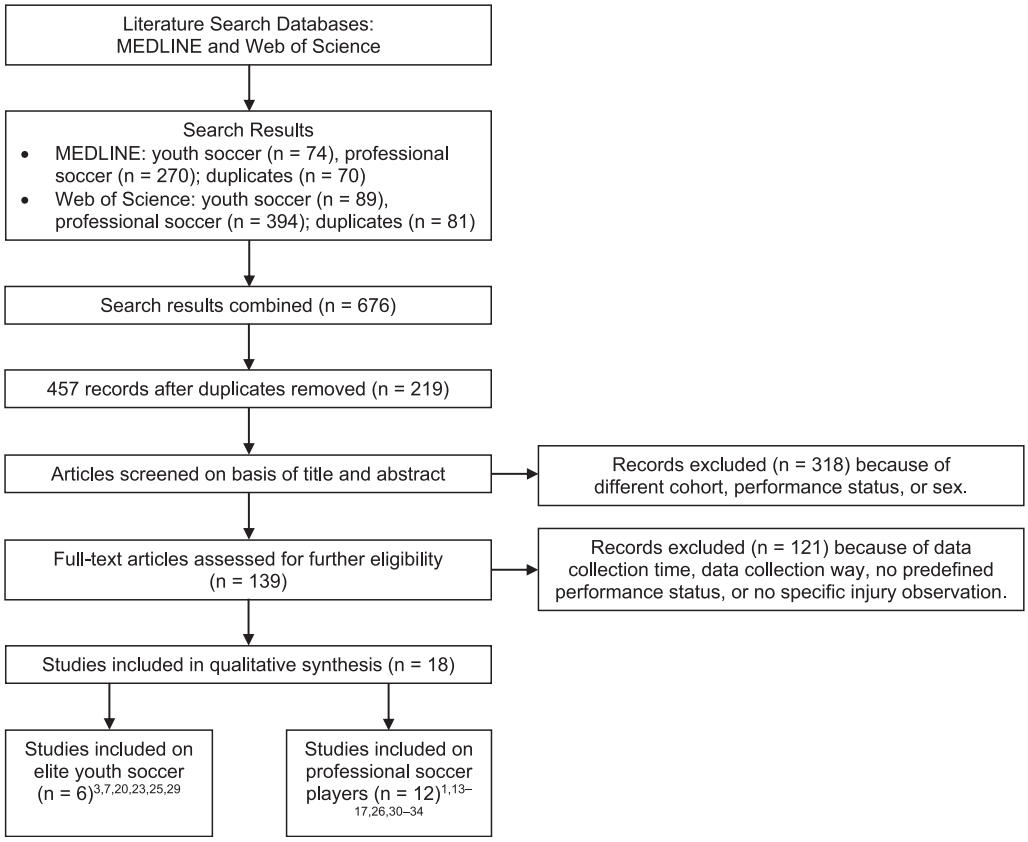

Figure 1. Flow chart of study-selection process.

Injuries in Youth Soccer Players

The total injury incidence in the elite youth players ranged from 2.0 injuries[25] to 19.4 injuries[23] per 1000 hours of exposure. The injury rate ranged from 9.5 injuries[5] to 48.7 injuries[23] per 1000 hours of exposure during matches and 3.7 injuries[5] to 11.14 injuries[20] per 1000 hours of exposure during training sessions (Table 5).

Strains, sprains, and contusions were the most common injury types (Table 6).[5,9,23] Le Gall et al[5] reported the most frequently injured body part was the upper leg, whereas others further subdivided the most commonly injured location into the ankle, knee,[25,29] and groin or lower limb.[9,23] Fractures represented only a small percentage of all injuries.[5,9,20] The risk for injury was higher during matches than during training time ($P = .002$).[5] Ergün et al[23] described an injury rate that was 5 times higher in matches than in training. Four groups[5,20,23,29] examined the severity of injuries. Le Gall et al[5] noted that, whereas the youngest age group sustained more major injuries, no differences in injury frequency existed among age groups, and authors of 2 studies[20,23] observed that most of the injuries across all age groups were slight or minimal (Table 6). Le Gall et al[5] and Peterson et al[29] found that most injuries were minor and mild, but they did not identify slight or minimal injuries in their surveys. Le Gall et al[5] reported 35 reinjuries. Across all groups, sprains and strains composed 42.9% and 22.9%, respectively, of all reinjuries. Forty percent of the reinjuries resulted in a longer absence from participation than the initial injury.[5] Ergün et al[23] demonstrated that reinjuries were more common during training than during matches ($P = .08$), and all the documented reinjuries were overuse injuries. All outcome measurements and injury classifications in elite youth soccer players are summarized in Tables 5 and 6.

Injuries in Professional Soccer Players

The total injury incidence in professional soccer players ranged from 2.48 injuries[14] to 9.4 injuries[16] per 1000 hours of exposure. The injury rate during competition ranged from 8.7 injuries[14] to 65.9 injuries[33] per 1000 hours of exposure, whereas the injury incidence during training ranged from 1.37 injuries[14] to 5.8 injuries[16] per 1000 hours of exposure (Table 7). Ekstrand et al[14] noted 2908 muscle injuries, with 53% occurring during competition and 47% during training. Dauty and Collon[13] reported a total of 903 injuries in 173 professional French soccer players. Morgan and Oberlander[15] evaluated 399 injuries; 256 (64%) fit their operational definition of *injury* (resulting in time missed from participation). The most common injury types were strains, sprains, and contusions.[1,15–17,31,32] The thigh was the most frequently injured body part,[1,13,16,17,30–32] and in 2 studies, the hamstrings were the most affected location.[13,16] Most thigh injuries were strains, with a higher incidence in the posterior portion ($P < .05$).[31] However, quadriceps strains led to a longer absence from activity than hamstrings injuries ($P = .009$).[14] Other common injury locations were the groin, knee, and ankle (Table 8).[1,15–17,30,32] Fractures represented only a small percentage of all injuries.[1,16,17,31] However, most fractures were classified as major injuries.[16,17,32,34] The risk for

Table 3. Group and Intervention Characteristics in Youth Elite Soccer Players

Study	Article Title	Region	Study Design	Status	No.	Age Range	Duration
Ergün et al[23] (2013)	"Injuries in elite youth football players: a prospective three-year study"	Turkey	Prospective cohort study	National soccer team	52	U17–U19	3 y
Brink et al[20] (2010)	"Monitoring stress and recovery: new insights for the prevention of injuries and illnesses in elite youth soccer players"	The Netherlands	Prospective longitudinal cohort study	Elite	53	15–18 y	2 Competitive seasons (2006–2008)
Deehan et al[9] (2007)	"Adolescent musculoskeletal injuries in a football academy"	England	Prospective cohort study	Soccer academy	210	9–18 y	August 1999–July 2004
Le Gall et al[5] (2006)	"Incidence of injuries in elite French youth soccer players: a 10-season study"	France	Cohort study	Elite	528	U14–U16	10 Seasons (1993–2003)
Junge et al[25] (2000)	"Incidence of football injuries in youth players: comparison of players from two European regions"	Alsace region of France and Germany and Czech Republic	Cohort study	High level	193	14–16 y and 16–18 y	1 y
Peterson et al[29] (2000)	"Incidence of football injuries and complaints in different age groups and skill-level groups"	Not provided	Prospective cohort study	High level	135 Total (70 age 14–16 y and 65 age 16–18 y)	14–16 y and 16–18 y	1 y

Abbreviation: U, under.

Table 4. Group and Intervention Characteristics in Professional Adult Soccer Players

Study	Article Title	Region	Study Design	Status	No.	Age, mean ± SD, y[a]	Duration
Bjørneboe et al[30] (2014)	"Gradual increase in the risk of match injury in Norwegian male professional football: a 6-year prospective study"	Europe	Prospective cohort study	Professional	Not provided	Not provided	2002–2007 (January–October/November)
Eirale et al[32] (2013)	"Epidemiology of football injuries in Asia: a prospective study in Qatar"	Asia	Prospective cohort study	Professional	230	28.4 ± 4.4	August 2008–April 2009
Eirale et al[33] (2012)	"Injury epidemiology in a national football team of the Middle East"	Asia	Prospective cohort study	Professional	36	23.8	17 mo (June 2007–October 2008)
Dauty and Collon[13] (2011)	"Incidence of injuries in French professional soccer players"	France	Prospective cohort study	Professional	173	24.1 ± 4	15 seasons
Ekstrand et al[14] (2011)	"Epidemiology of muscle injuries in professional football (soccer)"	Europe	Prospective cohort study	Professional	2299	25.3 ± 4.6	9 y
Ekstrand et al[31] (2011)	"Injury incidence and injury patterns in professional football: the UEFA injury study"	Europe	Prospective cohort study	Professional	2226	25.7 ± 4.4	2001–2008
Ekstrand et al[26] (2004)	"A congested football calendar and the wellbeing of players: correlation between match exposure of European footballers before the World Cup 2002 and their injuries and performances during that World Cup"	Europe	Prospective cohort study	Professional	266	26	10 mo
Waldén et al[16] (2005)	"UEFA Champions League study: a prospective study of injuries in professional football during the 2001–2002 season"	Europe	Prospective cohort study	Professional	266	26 ± 4	9 mo (July 2001–May 2002)
Waldén et al[17] (2005)	"Injuries in Swedish elite football: a prospective study on injury definitions, risk for injury and injury pattern during 2001"	Europe	Prospective cohort study	Professional	310	25	2001 (January–October)
Morgan and Oberlander[15] (2001)	"An examination of injuries in Major League Soccer: the inaugural season"	United States	Prospective cohort study	Professional	237	27	7 mo (1 season)
Hawkins and Fuller[1] (1999)	"A prospective epidemiological study of injuries in four English professional football clubs"	England	Prospective cohort study	Professional	108	Not provided	November 1994–May 1997
Parry and Drust[34] (2006)	"Is injury the major cause of elite soccer players being unavailable to train and play during the competitive season?"	Europe	Prospective cohort study	Professional	55	24 ± 5	2003–2005

Abbreviation: UEFA, Union of European Football Associations.

[a] Some authors did not provide the SD.

Table 5. Outcome Measurements for Elite Youth Soccer Players Extended on Next Page

Study	No. of Injuries per 1000 h			Ratio of Injuries per 1000 h of Matches to Injuries per 1000 h of Training
	Training	Match	Total	
Ergün et al[23] (2013)	10.5	48.7	U17: 19.4 U18: 15.2 U19: 18.1	4.6
Brink et al[20] (2010)	11.14	37.55	Not provided	3.4
Deehan et al[9] (2007)	Not provided	Not provided	0.6 Per player per season	Not provided
Le Gall et al[5] (2006)	U14: 4.1 U15: 3.7 U16: 3.8 All age groups: 3.9	U14: 9.5 U15: 10.4 U16: 14.2 All age groups: 11.2	U14: 4.9 U15: 4.6 U16: 5.2 All age groups: 4.8	U14: 2.3 U14: 2.8 U16: 3.7 All age groups: 2.9
Junge et al[25] (2000)	Not provided by age group	Not provided	Alsace 14–16 y: 2.2 16–18 y: 2.5 Czech Republic 14–16 y: 2.5 16–18 y: 2.0	Not provided
Peterson et al[29] (2000)	14–16 y: 7.2 16–18 y: 7.9	14–16 y: 35.0 16–18 y: 38.4	14–16 y: Not provided 16–18 y: Not provided	14–16 y: 4.9 16–18 y: 4.9

Abbreviation: U, under.

injury was higher during matches ($P = .001$)[17] than during training ($P < .001$).[14] Morgan and Oberlander[15] observed that more severe injuries occurred during matches ($P < .001$). The authors of 6 studies showed that a majority of injuries were moderate,[1,13,14,16,31,32] and in 4 studies,[15,17,30,33] most injuries lasted up to 1 week ($P < .001$; Table 8). Investigators in 7 studies reported on reinjuries or recurrence.[1,14,16,17,30–33] Waldén et al[16] found that 15.3% (101 of 658) of all injuries were reinjuries, and nearly two-thirds (63%) of those were overuse injuries. Ekstrand et al[14] noted that the most frequently reinjured body part was the hamstrings, and 16% of the muscle injuries were reinjuries. According to Ekstrand et al,[31] reinjuries required more rest than new injuries ($P < .001$). All outcome measurements and injury classifications in professional adult soccer players are summarized in Tables 7 and 8.

DISCUSSION

The presentation of epidemiologic information provides a composite picture of injury prevalences and incidences and can enable researchers to detect possible susceptibilities to injury in different age groups and across different performance levels. Our systematic review represents injury incidences in elite youth and professional adult soccer players with a subsequent comparison of the age groups. The aim of this review was to discuss the current understanding of injury incidences in elite youth soccer players. Moreover, we intended to gain novel insights into the susceptibility of elite youth soccer players to injury given the increasing physiologic and psychosocial demands on adolescent athletes.[20]

Characteristics in Youth and Adult Soccer Players

In our study cohorts, the incidence of injury was higher during matches than during training. In professional adult soccer players, the incidence was 3.3 to 15.3 times higher during matches than during training (Table 7); in youth soccer players, it was 2.3 to 4.9 times higher during matches than during training (Table 5). Similar results were presented in other studies, regardless of the definition of *injury* or level of play.[35] Elite youth players had higher incidences of injury during training than did professional adult soccer players (highest [mean] value = 11.1 [6.9] and 5.8 [3.7], respectively). Professional adult soccer players had a higher rate ratio (1000 hours of match per 1000 hours of training exposure) than elite youth soccer players (highest [mean] value = 4.9 [3.8] and 15.3 [8.1], respectively). Therefore, we conclude that the injury ratio is more balanced in elite youth participants. Matches created greater potential for injury than training did in professional adult soccer players.

The upper leg was the most frequently reported injury for both groups, followed by the ankle and the knee,[5,16] which was consistent with other studies.[36,37] The pattern of injury location was unaffected by age, suggesting a common and constant feature of injury. The lack of difference in the risk of injury was consistent with previously published results.[36]

Overuse injuries accounted for 27% to 33% of the injury incidences.[14,16,32,34] Inklaar et al[36] stated that two-thirds of the injuries in youth soccer players were traumatic, whereas one-third were overuse injuries. This finding could reflect a crucial role in injury prevention because different risk factors and mechanisms lead to traumatic and overuse injuries.[38] Overuse injuries are caused by repetitive stress without sufficient time to undergo the natural regenerative process.[39] Based on the framework of Kenttä and Hassmén,[40] physical stress and recovery are assumed to be the most important factors in relation to overuse injuries. Therefore, investigating variations in the intensities of training and competition[41] and differentiating between overuse and traumatic injuries is essential in surveys of soccer injuries.[5]

We did not note differences among the most common injury types (ie, strains, sprains, and contusions) in elite youth and professional adult soccer players, which is consistent with previously published results.[12,23,25,42] Le Gall et al[5] observed that disorders such as tendinopathies peaked during the first few months of the season in youth soccer players. These results may indicate that professional

Table 5. Extended From Previous Page

Injury Prevalence	Exposure, h		
	Training	Match	Total
44	1897.0	493.2	2390.2
320	Not provided	Not provided	Not provided
685	Not provided	Not provided	Not provided
U14: 420	All age groups: 205 920	All age groups: 31 680	All age groups: 237 600
U15: 361			
U16: 371			
All age groups: 1152			
Alsace	Alsace	Alsace	Alsace
14–16 y: 17	14–16 y: 252.2	14–16 y: 39.8	14–16 y: 292.0
16–18 y: 19	16–18 y: 198.0	16–18 y: 35.1	16–18 y: 233.1
Czech Republic	Czech Republic	Czech Republic	Czech Republic
14–16 y: 53	14–16 y: 249.9	14–16 y: 51.4	14–16 y: 301.3
16–18 y: 42	16–18 y: 267.7	16–18 y: 55.4	16–18 y: 323.1
14–16 y: 126	14–16 y: 249.9	14–16 y: 51.4	14–16 y: 301.3
16–18 y: 136	16–18 y: 267.7	16–18 y: 55.4	16–18 y: 323.1

soccer players do not acquire the necessary levels of fitness during preseason conditioning to resist the stress associated with playing competitive soccer.[1] In 3 studies,[30,31,34] researchers analyzing the severity of injury in matches and training separately showed that severe injuries, which accompany longer return-to-play intervals, occurred more often during matches than during training. Fractures represent only a small percentage of all injuries in adult and youth soccer players.[2,5,9,16,20,31] However, most fractures were classified as major injuries.[17,32,34] Peterson et al[29] demonstrated that more severe injuries occurred in youth soccer players aged 14 to 16 years than in older adolescents. Otherwise, the severity of injuries was relatively constant across all age groups, and no differences were evident among any of the severity classes among age groups within the elite youth and professional adult soccer players.

Influences on Injury Incidences for Youth and Adult Soccer Players

Junge and Dvorak[12] found that, on average, all professional soccer players experienced 1 activity-limiting injury per season. Soccer players with previous injuries had a 4 to 7 times greater risk for subsequent injury.[43] Therefore, the probability of injury occurrence continues to rise throughout a player's career, which could also lead to an increased injury rate in professional adults.

Several researchers reported on recurrent injuries in youth[5,23] and adult[14,16,17,30–32,34] soccer players. Prior injury and inadequate rehabilitation were commonly suggested as risk factors for soccer players.[11,16,22] Reinjury incidences ranged between 9% and 30% in professional adult soccer players[11,16,27] and caused longer absences than new injuries, which was in accordance with previous findings.[14,17] Hawkins and Fuller[1] stated that 76% of all reinjuries were either strains (predominantly to the lower leg, thigh, and groin) and sprains or injuries to the ankle and knee. These types of injuries have been reported to result in the highest risk of reinjury.[7,44] Youth soccer players had a lower rate of reinjury.[5,6] Cloke et al[27] concluded that reinjury was most likely to occur in 16-year-old soccer players, and Le Gall et al[5] commented that the rate of reinjury was generally low (3%), noting that most injuries were strains and sprains. Ergün et al[23] reported a higher percentage of reinjuries (25%) in youth soccer players. However, this finding could be due to the lower number of total injuries (44 total injuries and 11 reinjuries) in contrast to 1152 injuries (35 reinjuries) in the study of Le Gall et al.[5] The reinjuries were more general during training than during competition, and all the documented reinjuries were overuse injuries.[23] Ergün et al[23] suggested that the considerably higher percentage of reinjuries during training may reflect the high demands of intensive training and matches at the youth level or may result from eager players not providing accurate reports to their team physicians and athletic trainers during selection. This conclusion indicates relatively high levels of pressure on young players while they are participating in selection processes for national soccer teams. Therefore, improvements in controlled rehabilitation and using functional tests before return to participation in team training and competition could be instituted. Furthermore, education of coaches and education that increases player compliance might reduce the risk of reinjury in both soccer groups.[23,45]

In contrast, low incidences of recurrence in elite youth soccer players signify that the pressure to return these young soccer players to participation in matches is not a major factor contributing to high injury incidences. In addition, coach education and player compliance are higher at the elite level.[6] To gain more precise information about recurrence, subcategories of reinjury and exacerbation of injury must be recorded in greater detail.[45] Less severe injuries should not be disregarded in injury-control systems because they may predispose soccer players to new, and perhaps more severe, injuries.[1] In future studies, researchers need to investigate risk factors for reinjury and exacerbation of injury separately and to observe how players have been rehabilitated before returning to full training and participation in competitions.[45]

Dupont et al[46] concluded that decreased recovery time between matches leads to an increase in injury incidences. A recovery time of 72 to 96 hours between 2 matches was

Table 6. Injury Classifications for Elite Youth Soccer Players **Continued on Next Page**

Study	Most Common Injury: Type, No. (%)	Most Common Injury: Locations, No. (%)	Total Exposure: Circumstances/ Mechanism, No. (%)	Total Exposure: Severity, No. (%)[a]	Reinjuries, No. (%)
Ergün et al[23] (2013)	Muscle: 27 (61.4) (Strains: 22 [81.5]) Contusions: 9 (20.5)	Thigh: 14 (31.8) Hip/groin: 11 (25.0) Lower back: 6 (13.6) Ankle: 4 (9.1) Knee: 3 (6.8) Head and neck: 3 (6.8) Lower leg: 2 (4.6) Thorax: 1 (2.3) Foot: 1 (2.3)	Traumatic: 23 (52.3) Overuse: 21 (47.7)	Match Slight: 9 (60.0) Minimal: 8 (50.0) Mild: 1 (20.0) Moderate: 5 (71.4) Severe: 1 (100) Training Slight: 6 (40.0) Minimal: 8 (50.0) Mild: 4 (80.0) Moderate: 2 (28.6) Severe: 0 (0)	11 (25.0)
Brink et al[20] (2010)	Muscle and tendon: 138 (43.1) Contusions, hematoma: 84 (26.2) Joint and ligament: 80 (25)	Lower limb: 271 (84.7) Trunk: 25 (7.8) Upper limb: 13 (4.1) Head and neck: 11 (3.4)	Not provided	Slight: 114 (35.6) Minimal: 88 (27.5) Mild: 43 (13.4) Moderate: 43 (13.4) Severe: 32 (10)	Not provided
Deehan et al[9] (2007)	Strains: 252 (37) Sprains: 121 (18) Acute tendinopathy: 41 (5.9) Muscular contusions: 40 (5.8)	Lower limb: 542 (79) Groin: 44 (6.5) Spine: 42 (6) Upper limb: 27 (4) Other parts of the body: 30 (4.5)	Competition: 351 (51) Training: 334 (49) Tackling: 62 (9) Being tackled: 70 (10) Contact injuries: 210 (31) Noncontact injuries: 475 (69)	Not provided	Not provided
Le Gall et al[5] (2006)	U14 Contusion: 109 (26.0) Sprain: 76 (18.1) Tendinopathy: 55 (13.1) Muscle strain: 53 (12.6)	U14 Upper leg: 89 (21.2) Ankle: 76 (18.1) Knee: 74 (17.6) Foot: 40 (9.5)	Not provided	U14 Minor: 119 (28.3) Mild: 123 (29.3) Moderate: 128 (30.5) Major: 50 (11.9)	35 (3)
	U15 Contusion: 132 (36.6) Muscle strain: 61 (16.9) Sprain: 58 (16.1) Vertebral lesions: 26 (7.2)	U15 Upper leg: 107 (29.6) Ankle: 56 (15.5) Knee: 49 (13.6) Back: 35 (9.7)		U15 Minor: 118 (32.7) Mild: 106 (29.4) Moderate: 105 (29.1) Major: 32 (8.9)	

Table 7. Outcome Measurements for Professional Adult Soccer Players **Extended on Next Page**

Study	Injuries per 1000 h: Training	Injuries per 1000 h: Match	Injuries per 1000 h: Total	Ratio of Injuries per 1000 h of Matches to Injuries per 1000 h of Training
Bjørneboe et al[30] (2014)	1.9	15.9	4.8	8.4
Eirale et al[32] (2013)	4.4	14.5	6.0	3.3
Eirale et al[33] (2012)	4.3	65.9	7.8	15.3
Dauty and Collon[13] (2011)	Not provided	Not provided	4.7	Not provided
Ekstrand et al[14] (2011)	1.37	8.70	2.48	6.4
Ekstrand et al[31] (2011)	4.1	27.5	8.0	6.7
Ekstrand et al[26] (2004)	World Cup players: 3.2 Non–World Cup players: 5.5	World Cup players: 26.7 Non–World Cup players: 30.3	World Cup players: 7.9 Non–World Cup players: 9.5	World Cup players: 8.3 Non–World Cup players: 5.5
Waldén et al[16] (2005)	5.8	30.5	9.4	5.3
Waldén et al[17] (2005)	5.2	25.9	7.8	5.0
Morgan and Oberlander[15] (2001)	2.9	35.3	6.2	12.2
Hawkins and Fuller[1] (1999)	3.4	25.9	Not provided	7.6
Parry and Drust[34] (2006)	1.8	24.6	6.2	13.7

Table 6. Continued From Previous Page

Study	Most Common Injury: Type, No. (%)	Most Common Injury: Locations, No. (%)	Total Exposure: Circumstances/ Mechanism, No. (%)	Total Exposure: Severity, No. (%)[a]	Reinjuries, No. (%)
	U16 Contusion: 111 (29.9) Muscle strain: 62 (16.7) Sprain: 58 (15.6) Vertebral lesions: 30 (8.1)	U16 Upper leg: 86 (23.2) Ankle: 73 (19.7) Knee: 53 (14.3) Back: 44 (11.9)		U16 Minor: 120 (32.3) Mild: 108 (29.1) Moderate: 111 (29.9) Major: 32 (8.6)	
	All age groups Contusion: 352 (30.6) Sprain: 192 (16.7) Muscle strain: 176 (15.3) Tendinopathy: 108 (9.4)	All age groups Upper leg: 282 (24.5) Ankle: 205 (17.8) Knee: 176 (15.3) Back: 108 (9.4)		All age groups Minor: 357 (31.0) Mild: 337 (29.3) Moderate: 344 (29.9) Major: 114 (9.9)	
Junge et al[25] (2000)	Not provided	Not provided	Not provided	Not provided	Not provided
Peterson et al[29] (2000)	Not provided	Not provided	Not provided	14–16 y (per person per y) Mild: 1.03 Moderate: 0.53 Severe: 0.24 16–18 y (per person per y) Mild: 1.23 Moderate: 0.78 Severe: 0.22	Not provided

Abbreviation: U, under.

[a] Some studies did not provide percentages.

sufficient to maintain the level of physical performance but was not enough time to maintain a low injury rate. Hence, with a short recovery time between matches, the risk of injury increases. In addition, Ekstrand et al[26] discussed how too many matches (eg, taking part in national and international competitions and athletes playing for their countries) can lead to a lack of motivation and mental burnout and, therefore, to a greater risk of injury. Bjørneboe et al[30] showed that Norwegian professional soccer league teams had an average of 3.7 matches per month, whereas English professional soccer teams had an average of 4.2 matches per month. Consequently, the pressure that is placed on professional soccer players and the effects of physical and mental demands on injury incidence vary among countries and their sports cultures.[47] In addition, elite young soccer players who strive to be professional players may be exposed to high levels of pressure. Match and training sessions and school education need to be supported adequately and independent-

Table 7. Extended From Previous Page

Injury Prevalence	Exposure, h: Training	Exposure, h: Match	Exposure, h: Total
2365	433 024	61 133	494 157
217	142.8 (per person)	27.2 (per person)	170 (per person)
78	9482	561	10 043
903	Not provided	Not provided	Not provided
2908	998 000	177 000	1 175 000
4483	475 000	91 000	566 000
Not provided	World Cup players: 234 Non–World Cup players: 214	World Cup players: 59 Non–World Cup players: 38	World Cup players: 293 Non–World Cup players: 252
658	58 149	11 558	69 707
715	81 801	11 552	93 353
256	57 117	6567	63 684
578	Not provided	Not provided	Not provided
83	10 742	2604	13 346

Table 8. Injury Classifications of Professional Adult Soccer Players

Study	Most Common Injury		Circumstances/Mechanism Total Exposure, No. (%)	Severity Total Exposure, No. (%)	Reinjuries, No. (%)
	Type, No. (%)	Injury Location, No. (%)			
Bjørneboe et al[30] (2014)	Muscle injuries: 1057 (46) Joint injuries: 631 (27) Contusions: 325 (14)	Thigh: 506 (22) Ankle: 412 (18) Knee: 379 (16) Groin: 255 (11) Lower leg: 221 (10)	Acute injuries: 1664 (70.4) Overuse injuries: 701 (29.6)	Mild: 1191 (50.4) Moderate: 650 (27.5) Severe: 484 (20.5)	Approximately 20%[a]
Eirale et al[32] (2013)	Strain: 79 (36.4)	Thigh: 85 (39.2) Knee: 33 (15.2) Ankle: 26 (12.0)	Not provided	Not provided	32 (15)
Eirale et al[33] (2012)	Strain: 24 (30.8) Contusion: 12 (15.4) Sprain: 10 (12.8) Tendon injury: 10 (12.8) Fracture: 4 (5.1) Dislocation: 3 (3.8) Other: 15 (19.2)	Thigh: 26 (33.3) Knee: 13 (16.7) Leg: 8 (10.3) Ankle: 7 (9.0) Pelvis: 5 (6.4) Hand: 4 (5.1) Calf: 3 (3.8)	Traumatic: 68 (87.2) Overuse: 10 (12.8)	Minimal: 26 (33.3) Mild: 24 (30.8) Moderate: 23 (39.5) Severe: 5 (6.4)	19 (24.4)
Dauty and Collon[13] (2011)	Not provided	Hamstrings: most frequent[a,b]	Not provided	Minor: 1.36/1000 h Moderate: 3.5/1000 h Major: 0.25/1000 h	Not provided
Ekstrand et al[14] (2011)	Muscle injury: 2908 (31)	Hamstrings: 1084 (37) Quadriceps: 485 (19) Adductors: 672 (23) Calf muscles: 368 (13)	Overuse: one-third Traumatic: two-thirds	Minimal: 432 (15) Mild: 786 (27) Moderate: 1366 (47) Severe: 324 (11)	Reinjuries of the 4 most common muscle injuries: Hamstrings: 174 (6) Quadriceps: 81 (3) Adductors: 124 (4) Calf muscles: 48 (2)
Ekstrand et al[31] (2011)	Strain: 1581 (35) Sprain: 828 (18) Contusion: 744 (17) Tendon injury: 327 (7)	Thigh: 1064 (23) Knee: 818 (18) Ankle: 625 (14) Hip/groin: 616 (14)	Overuse: 28%[a]	Minimal: 971[b] Mild: 1164[b] Moderate: 1651[b] Severe: 697[b]	12%[a]
Ekstrand et al[26] (2004)	Not provided	Not provided	Not provided	Not provided	Not provided
Waldén et al[16] (2005)	Strain: 169 (26) Sprain: 141 (21) Contusion: 105 (16) Fracture: 16 (2) Dislocation: 6 (1) Other: 31 (5)	Thigh: 152 (23) Knee: 131 (20) Ankle: 89 (14) Hip/groin: 79 (12)	Overuse: 179 (27)	Slight: 182 (28) Minor: 186 (28) Moderate: 193 (29) Major: 97 (15)	101 (15.3)
Waldén et al[17] (2005)	Strain: 158 (22) Contusion: 122 (17) Sprain: 99 (14)	Thigh: 165 (23) Hip/groin: 114 (16) Knee: 111 (16) Lower leg: 109 (15)	Overuse: 261 (36.5) Traumatic: 454 (63.5)	Slight: 232 (32.5) Minor: 196 (27.5) Moderate: 220 (30.5) Major: 67 (9.5)	22%[a]
Morgan and Oberlander[15] (2001)	Not provided	Lower extremity: 197/256 (77.0) Knee: 54/256 (21) Ankle: 46/256 (18)	Not provided	Minor: 154 (60) Moderate: 67 (26) Major: 35 (14)	Not provided
Hawkins and Fuller[1] (1999)	Strain: 245 (42.4) Sprain: 116 (20.1) Contusion: 104 (18.0) Other: 113 (19.6)	Thigh: 132 (22.8) Ankle: 97 (16.8) Knee: 86 (14.9) Lower leg: 80 (13.8)	Tackled: 128 (22.1) Running: 126 (21.8) Tackling: 78 (13.5) Shooting: 53 (9.2)	Slight: 95 (16.4) Minor: 208 (36.0) Moderate: 214 (37.0) Major: 61 (10.6)	139 (24.0)
Parry and Drust[34] (2006)	Not provided	Not provided	Not provided	Not provided	Not provided

[a] Number was not provided.
[b] Percentage was not provided.

ly. Consequently, the lack of time that younger soccer players have to participate in training sessions places greater demands on the coach. He or she must compensate for the limited training exposure in these players, whereas professional soccer players can focus exclusively all day on improving and optimizing their abilities.[48] Not every youth soccer player can permanently persevere with this pressure, which can lead to overload and injuries during the player's career.[48]

Another aspect for analysis is a possible discrepancy between the coach-intended intensity and the actual training intensity perceived by the player. Brink et al[49] showed that under 17 and under 19 players reported a higher intensity and training load than the coach intended. The reason, therefore, could be a mismatch between the external pressure (coach plans the intensity for the players) and the internal effort (players perceive the intensity). The internal effort depends largely on individual factors of the players and should be considered by the coach when planning the training sessions. A lack of balance between internal and external efforts could result in either a constant underload (no performance gain) or a permanent overload (power stagnation, performance regression, or injuries and consequently mental health problems) of the players. This limits advancement for stronger players and increases the risk for overuse injury in weaker players. Consequently, only a small group of players achieve an optimal benefit.

The influence of the season on the injury incidence has frequently been analyzed, and the consensus is that seasonal variations exist for elite youth[9] and professional adult soccer players.[15,17,32,50] Explanations could include different training designs and match exposures during the preseason and competitive season.[17] More intense match series, such as the World Cup or Champions League, also replace the usual rest period of the players.[26]

The injury incidence during matches is influenced by the playing position. According to Deehan et al,[9] the risk for injury was greatest for the midfield position. Cloke et al[27] supported this result, reporting that midfield players and defenders were the most at-risk groups. However, Dauty and Collon[13] found no difference in injury incidence or injury severity according to playing position.

Eirale et al[32] concluded that soccer players do not stop playing during matches after sustaining injuries, so their injuries may become worse and make it difficult to predict injury severity. In addition to the severity of injury, the injury incidences increased toward the end of each half of play ($P < .01$).[1] This could be due to increased fatigue during the game.[32]

Influence of Certain Variables on Youth Soccer Players

As noted, elite youth players have higher injury incidences in training than professional adult soccer players. We speculate that different standards of training quality may be a reason for the discrepancy. To provide an overall comparison between elite youth and professional adult soccer players, a more detailed classification focused on the intensity of training is needed. In addition, youth soccer players are clearly not as physically mature as professional adult soccer players,[41] and researchers[5,51] have suggested that increased exposure to training may be linked to higher injury incidences. Hence, observing stress and recovery in youth soccer players may enable the identification of athletes who are at risk for injuries and illnesses.[20] Ergün et al[23] determined that the higher incidence of overuse injury in youth soccer players during training requires the adoption of a cautious approach to training intensity and developing technical and tactical abilities. They also emphasized the importance of developing muscle strength, endurance, and coordination. Ergün et al[23] showed that the increasing incidence of match injuries and decreasing incidence of training injuries with age suggest that the age of the soccer players affects injury incidences for both match and training exposures.[23]

Elite youth soccer players aged 16 to 18 years have a higher susceptibility to injury.[29] This observation is supported by a survey of injuries during 12 international tournaments involving athletes of different ages and skill levels.[52] In older adolescents, the increased injury incidences could be due to a higher level of competitiveness, a rapid shift in training loads as soccer players start exercising and training full time at their clubs,[41] or simply an increase in exposure.[6] These findings tend to be consistent with other research in which the injury incidences among adolescent players has been reported to increase with age, which may be because of the increased subjective intensity of competition as players age.[6,53] Therefore, investigators should also investigate the relationship among injuries in different age groups, considering the subjective intensity of training and competition by controlling for physical, technical, or psychological factors.[5]

In summary, different factors, such as age, playing position, season, concealment of injury, double burden, mismatch between external pressure and internal effort, training (training intensity and reinjuries higher during training), playing schedule (recovery time), reinjuries, and maturity status can lead to higher injury incidences and have varied effects on elite youth and professional adult soccer players (Figure 2).

To reduce the overall high injury rate in matches, preventive interventions, such as adequate rule enforcement and focusing on fair play, must be analyzed and developed.[54] According to Dupont et al,[46] another step to reduce the match-related injury incidence is to reconsider the number of matches played each week.

Our results indicated that a focus should be placed on reducing injuries during training in elite youth soccer players. Therefore, a first step in injury prevention is to assess the extent of the injury problem, incidence and severity of injury, and injury profile of the sport. Sport injuries in elite youth athletes need to be studied and followed up to verify long-term development.[23]

CONCLUSIONS

To our knowledge, we are the first to summarize injury incidences and characteristics of elite youth and professional adult soccer players separately. The rate of match injuries was higher than that of training injuries for both youth and adult players. The incidence of training injuries was higher in youth players than in adult players. No differences were noted among the most common injury types in elite youth and professional adult soccer players. To provide a reliable comparison between these groups of

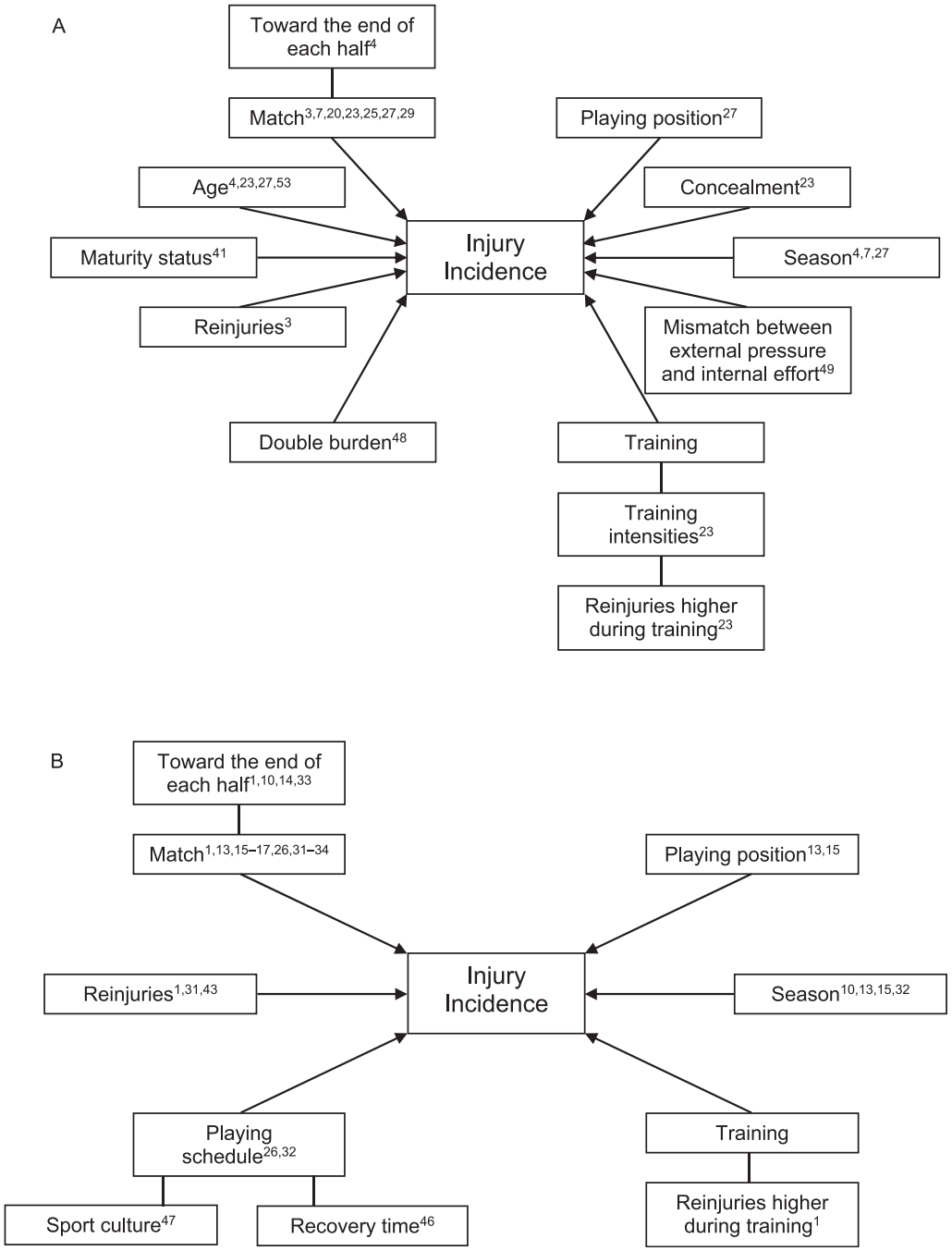

Figure 2. Risk factors for injury incidences in A, Elite youth and, B, Professional adult soccer players. A and B, Different risk factors have varied effects on the injury incidences in elite youth and professional adult soccer players.

players, the existing studies concerning the quality and intensity of training need to be analyzed more precisely. In addition, more detailed information about training content and preventive measures in different skill-level cohorts is necessary. Thus, an assessment model of training intensities might be a promising tool to protect these youth and adult elite players from overload and subsequent injuries.

REFERENCES

1. Hawkins RD, Fuller CW. A prospective epidemiological study of injuries in four English professional football clubs. *Br J Sports Med*. 1999;33(3):196–203.
2. Hawkins RD, Hulse MA, Wilkinson C, Hodson A, Gibson M. The association football medical research programme: an audit of injuries in professional football. *Br J Sports Med*. 2001;35(1):43–47.
3. Kofotolis ND, Kellis E, Vlachopoulos SP. Ankle sprain injuries and risk factors in amateur soccer players during a 2-year period. *Am J Sports Med*. 2007;35(3):458–466.
4. Junge A, Cheung K, Edwards T, Dvorak J. Injuries in youth amateur soccer and rugby players: comparison of incidence and characteristics. *Br J Sports Med*. 2004;38(2):168–172.
5. Le Gall F, Carling C, Reilly T, Vandewalle H, Church J, Rochcongar P. Incidence of injuries in elite French youth soccer players: a 10-season study. *Am J Sports Med*. 2006;34(6):928–938.

6. Price RJ, Hawkins RD, Hulse MA, Hodson A. The Football Association medical research programme: an audit of injuries in academy youth football. *Br J Sports Med*. 2004;38(4):466–471.
7. Nielsen AB, Yde J. Epidemiology and traumatology of injuries in soccer. *Am J Sports Med*. 1989;17(6):803–807.
8. Schmidt-Olsen S, Jørgensen U, Kaalund S, Sørensen J. Injuries among young soccer players. *Am J Sports Med*. 1991;19(3):273–275.
9. Deehan DJ, Bell K, McCaskie AW. Adolescent musculoskeletal injuries in a football academy. *J Bone Joint Surg Br*. 2007;89(1):5–8.
10. Andersen TE, Tenga A, Engebretsen L, Bahr R. Video analysis of injuries and incidents in Norwegian professional football. *Br J Sports Med*. 2004;38(5):626–631.
11. Hägglund M, Waldén M, Ekstrand J. Injury incidence and distribution in elite football: a prospective study of the Danish and the Swedish top divisions. *Scand J Med Sci Sports*. 2005;15(1):21–28.
12. Junge A, Dvorak J. Soccer injuries: a review on incidence and prevention. *Sports Med*. 2004;34(13):929–938.
13. Dauty M, Collon S. Incidence of injuries in French professional soccer players. *Int J Sports Med*. 2011;32(12):965–969.
14. Ekstrand J, Hägglund M, Waldén M. Epidemiology of muscle injuries in professional football (soccer). *Am J Sports Med*. 2011; 39(6):1226–1232.
15. Morgan BE, Oberlander MA. An examination of injuries in Major League Soccer: the inaugural season. *Am J Sports Med*. 2001;29(4): 426–430.
16. Waldén M, Hägglund M, Ekstrand J. UEFA Champions League study: a prospective study of injuries in professional football during the 2001–2002 season. *Br J Sports Med*. 2005;39(8):542–546.
17. Waldén M, Hägglund M, Ekstrand J. Injuries in Swedish elite football: a prospective study on injury definitions, risk for injury and injury pattern during 2001. *Scand J Med Sci Sports*. 2005;15(2):118–125.
18. Vaeyens R, Coutts A, Philippaerts RM. Evaluation of the "under-21 rule": do young adult soccer players benefit? *J Sports Sci*. 2005; 23(10):1003–1012.
19. Gonçalves CEB, Rama LML, Figueiredo AB. Talent identification and specialization in sport: an overview of some unanswered questions. *Int J Sports Physiol Perform*. 2012;7(4):390–393.
20. Brink MS, Visscher C, Arends S, Zwerver J, Post WJ, Lemmink KA. Monitoring stress and recovery: new insights for the prevention of injuries and illnesses in elite youth soccer players. *Br J Sports Med*. 2010;44(11):809–815.
21. Johnson A, Doherty PJ, Freemont A. Investigation of growth, development, and factors associated with injury in elite schoolboy footballers: prospective study. *BMJ*. 2009;338:b490.
22. Dvorak J, Junge A, Chomiak J, et al. Risk factor analysis for injuries in football players: possibilities for a prevention program. *Am J Sports Med*. 2000;28(suppl 5):S69–S74.
23. Ergün M, Denerel HN, Binnet MS, Ertat KA. Injuries in elite youth football players: a prospective three-year study. *Acta Orthop Traumatol Turc*. 2013;47(5):339–346.
24. Fuller CW, Ekstrand J, Junge A, et al. Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Scand J Med Sci Sports*. 2006;16(2):83–92.
25. Junge A, Chomiak J, Dvorak J. Incidence of football injuries in youth players: comparison of players from two European regions. *Am J Sports Med*. 2000;28(suppl 5):S47–S50.
26. Ekstrand J, Waldén M, Hägglund M. A congested football calendar and the wellbeing of players: correlation between match exposure of European footballers before the World Cup 2002 and their injuries and performances during that World Cup. *Br J Sports Med*. 2004; 38(4):493–497.
27. Cloke D, Moore O, Shah T, Rushton S, Shirley MD, Deehan DJ. Thigh muscle injuries in youth soccer: predictors of recovery. *Am J Sports Med*. 2012;40(2):433–439.
28. Olsen L, Scanlan A, MacKay M, et al. Strategies for prevention of soccer related injuries: a systematic review. *Br J Sports Med*. 2004; 38(1):89–94.
29. Peterson L, Junge A, Chomiak J, Graf-Baumann T, Dvorak J. Incidence of football injuries and complaints in different age groups and skill-level groups. *Am J Sports Med*. 2000;28(suppl 5):S51–S57.
30. Bjørneboe J, Bahr R, Andersen TE. Gradual increase in the risk of match injury in Norwegian male professional football: a 6-year prospective study. *Scand J Med Sci Sports*. 2014;24(1):189–196.
31. Ekstrand J, Hägglund M, Waldén M. Injury incidence and injury patterns in professional football: the UEFA injury study. *Br J Sports Med*. 2011;45(7):553–558.
32. Eirale C, Farooq A, Smiley FA, Tol JL, Chalabi H. Epidemiology of football injuries in Asia: a prospective study in Qatar. *J Sci Med Sport*. 2013;16(2):113–117.
33. Eirale C, Hamilton B, Bisciotti G, Grantham J, Chalabi H. Injury epidemiology in a national football team of the Middle East. *Scand J Med Sci Sports*. 2012;22(3):323–329.
34. Parry L, Drust B. Is injury the major cause of elite soccer players being unavailable to train and play during the competitive season? *Phys Ther Sport*. 2006;7(2):58–64.
35. Bjørneboe J, Flørenes TW, Bahr R, Andersen TE. Injury surveillance in male professional football: is medical staff reporting complete and accurate? *Scand J Med Sci Sports*. 2011;21(5):713–720.
36. Inklaar H, Bol E, Schmikli SL, Mosterd WL. Injuries in male soccer players: team risk analysis. *Int J Sports Med*. 1996;17(3):229–234.
37. Tucker AM. Common soccer injuries: diagnosis, treatment and rehabilitation. *Sports Med*. 1997;23(1):21–32.
38. Van Mechelen W, Hlobil H, Kemper HC. Incidence, severity, aetiology and prevention of sports injuries: a review of concepts. *Sports Med*. 1992;14(2):82–99.
39. Brenner JS. Overuse injuries, overtraining, and burnout in child and adolescent athletes. *Pediatrics*. 2007;119(6):1242–1245.
40. Kenttä G, Hassmén P. Overtraining and recovery: a conceptual model. *Sports Med*. 1998;26(1):1–16.
41. Le Gall F, Carling C, Reilly T. Biological maturity and injury in elite youth football. *Scand J Med Sci Sports*. 2007;17(5):564–572.
42. Wong P, Hong Y. Soccer injury in the lower extremities. *Br J Sports Med*. 2005;39(8):473–482.
43. Arnason A, Sigurdsson SB, Gudmundsson A, Holme I, Engebretsen L, Bahr R. Risk factors for injuries in football. *Am J Sports Med*. 2004;32(suppl 1):S5–S16.
44. Ekstrand J, Tropp H. The incidence of ankle sprains in soccer. *Foot Ankle*. 1990;11(1):41–44.
45. Fuller CW, Bahr R, Dick RW, Meeuwisse WH. A framework for recording recurrences, reinjuries, and exacerbations in injury surveillance. *Clin J Sport Med*. 2007;17(3):197–200.
46. Dupont G, Nedelec M, McCall A, McCormack D, Berthoin S, Wisløff U. Effect of 2 soccer matches in a week on physical performance and injury rate. *Am J Sports Med*. 2010;38(9):1752–1758.
47. Høy K, Lindblad BE, Terkelsen CJ, Helleland HE, Terkelsen CJ. European soccer injuries: a prospective epidemiologic and socioeconomic study. *Am J Sports Med*. 1992;20(3):318–322.
48. Wrigley R, Drust B, Stratton G, Scott M, Gregson W. Quantification of the typical weekly in-season training load in elite junior soccer players. *J Sports Sci*. 2012;30(15):1573–1580.
49. Brink MS, Frencken W, Jordet G, Lemmink KA. Coaches' and players' perceptions of training dose: not a perfect match. *Int J Sports Physiol Perform*. 2014;9(3):497–502.

50. Chomiak J, Junge A, Peterson L, Dvorak J. Severe injuries in football players: influencing factors. *Am J Sports Med*. 2000;28(suppl 5):S58–S68.
51. Gabbett TJ, Whyte DG, Hartwig TB, Wescombe H, Naughton GA. The relationship between workloads, physical performance, injury and illness in adolescent male football players. *Sports Med*. 2014; 44(7):989–1003.
52. Junge A, Dvorak J, Graf-Baumann T, Peterson L. Football injuries during FIFA tournaments and the Olympic Games, 1998–2001: development and implementation of an injury-reporting system. *Am J Sports Med*. 2004;32(suppl 1):S80–S89.
53. Hoff GL, Martin TA. Outdoor and indoor soccer: injuries among youth players. *Am J Sports Med*. 1986;14(3):231–233.
54. Koutures CG, Gregory AJ. Injuries in youth soccer. *Pediatrics*. 2010; 125(2):410–414.

Address correspondence to Suzan Tug, PhD, Department of Sport Medicine, Johannes Gutenberg University of Mainz, Albert-Schweitzer Strasse 22, Mainz, Germany 55128. Address e-mail to tug@uni-mainz.de.