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The Association Between Psychosocial Factors and Reported Injuries Among Youth Grassroot Soccer Players

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ABSTRACT

Regular participation in grassroot sports may benefit adolescents by developing movement skills, fostering peer relationships, and cultivating positive attitudes and behaviors. However, increased volume and intensity of sport participation raise the risk of injuries, which may lead adolescents to quit sport. Hence, sport injuries are a public health concern, yet knowledge about injury prevalence in grassroot settings remains limited. Therefore, the aim of this study was to investigate: (a) the prevalence of injury in youth grassroot football players and (b) the relationships between prevalence of injury and potential risk factors; namely, sex, age group, social support, coach and peer autonomy support, and training load. Adolescents (n = 568; M_{age} = 15.7 years; and SD = 1.4) playing for U14–U19 teams in Agder County in Norway provided information pertaining to their participation in grassroot football. Although no differences in the prevalence of injuries or substantial injuries were found between sex and age groups, the results indicated differences in injury anatomical areas based on sex and age. Moreover, the results revealed that a higher injury prevalence was associated with a combination of lower levels of peer autonomy support, higher weekly accumulated total football activity, and being female. For substantial injuries, the combination of higher amounts of match time or being a player who perceived lower levels of coach autonomy support in the group accumulating least match time was associated with a higher injury prevalence. Our results showed a surprisingly high prevalence of injury in youth grassroot football, highlighting the need for future intervention studies.

1 | Introduction

Sport takes many forms, one of which is youth grassroot sport. This form is characterized by its inclusive approach to participation, strong ties to local communities and social networks, emphasis on commitment and cooperation, reliance on the organizational skills of local sponsors and participants, and its integration into the daily lives of individuals within a larger community (Sanders and Coakley 2021). Around the world, 9.4 million children and adolescents under the age of 18 years are registered in football clubs and the overwhelming number of these individuals participate in grassroot settings (O'Gorman 2016). According to official statements in Norway, the overall aims for grassroot sport are mastery, inclusion, and positive experiences as well as creating safe and social environments (The Norwegian Olympic and Paralympic Committee and Confederation of Sports (NIF; Norges idrettsforbund 2019). Similarly, it has been suggested that grassroot sport settings should be easily accessible to everyone, with a strong focus on play and social interaction (Sanders and Coakley 2021; Solstad, Granerud, et al. 2022; Tuastad 2019).

Summary

- We investigated the prevalence of injuries among youth grassroot football players.
- We examined the associations between injury prevalence and multiple risk factors.
- The results revealed a surprisingly high prevalence of injury and substantial injury among youth grassroot football players.
- The findings indicated a complex nature of injury risk factors.
- The results underscore the need for targeted injury prevention interventions in youth grassroot football.

However, previous research has shown that in youth grassroot football, expectations and demands from clubs, coaches, and parents tend to rise as the level of competition and performance increases (Bakken 2019; Solstad, Søvik, et al. 2022), thereby increasing the risk of injury (DiFiori et al. 2014; Gould 2019). Indeed, previous research has shown that sport injuries among adolescents are related to several short-term and long-term negative health and behavioral consequences, including an increased risk of overweight and obesity (Whittaker et al. 2015), aggressive behavior in sport (Newman et al. 2021), mental health disorders (Haraldsdottir and Watson 2021), and sport dropout (Moulds et al. 2022).

Furthermore, injury prevalence research in large populations of youth grassroot football players is limited (Mandorino, Figueiredo, Gjaka, and Tessitore 2023; Robles-Palazón et al. 2022), with most studies being focused on elite youth male players (Jones et al. 2019; Robles-Palazón et al. 2022), whereas other team sports and cohorts of athletes have only sparse single-study investigations (Beech et al. 2024; Maniar et al. 2023; Raya-González et al. 2020; Zech et al. 2022). Of those few studies that have examined injuries in grassroot football, the majority have focused on injuries that occur during tournaments/competitions (Andreasen et al. 1993; Kolstrup et al. 2016; Soligard et al. 2012) or have integrated a range of standards regarding sample composition (e.g., not just grassroot players; Robles-Palazón et al. 2022). Consequently, there is currently limited insight pertaining to injury rates during a regular season or spanning the complete demographics of youth grassroot football. Without research explicitly focusing on this group of players, one cannot adequately identify possible injury risk factors that might have an impact on these individuals.

Injury etiology in youth football has been studied from multiple perspectives, leading to a wide range of risk factors (Hausken-Sutter et al. 2021; Mandorino, Figueiredo, Gjaka, and Tessitore 2023). From a biomedical perspective, factors, such as previous injuries (Steffen et al. 2008; Steffen et al. 2009), age, growth, and maturation (Colyer et al. 2021; D. M. Johnson et al. 2020; Read et al. 2018), and physical stress (e.g., training and match time the preceding week; Brink et al. 2010), have all been identified as risk factors for injuries. Moreover, psychosocial research on injury has identified personality traits (e.g., anxiety and ineffective coping; U. Johnson and Ivarsson 2011), history of stressors (e.g., negative life events; Ivarsson et al. 2014), and team climate (e.g., lack of support from teammates and coach; Steffen et al. 2009) as possible risk factors.

One of the most cited frameworks (the model of stress and athletic injury; J. M. Williams and Andersen 1998), developed to explain how psychosocial factors can be related to injury risk, proposes stress and stress response as strong predictors of injury (Ivarsson et al. 2017). However, stress is not restricted to psychosocial experiences but could also stem from physically demanding situations. The stress and injury model highlights demanding training or matches as a source of stress that could increase the likelihood of injury (Andersen and Williams 1988). Furthermore, to be able to respond to stress positively, the model emphasizes various coping resources. For instance, support from significant others (e.g., coaches, teammates, and parents) has been identified as a key resource for young athletes (Kontos 2016; Kristiansen and Stensrud 2020; Reverberi et al. 2020). Consequently, when examining factors related to injury risk, it is important to consider multiple factors that might interact together in a complex system contributing to the risk of injury rather than trying to determine single risk factors (Bittencourt et al. 2016; Tranaeus et al. 2022, 2024).

As complex systems can comprise a range of factors that interact and cause injury (Appaneal and Perna 2014; J. M. Williams and Andersen 1998), this might include different demographic factors. For instance, research on injury in youth elite football has shown that injury epidemiology partly differs across sexes, although there seems to be no significant difference in total injury prevalence/incidence (Robles-Palazón et al. 2022). However, ankle and thigh injuries are most common among male players, whereas knee and ankle are equivalent among female players (Mandorino, Figueiredo, Gjaka, and Tessitore 2023; Robles-Palazón et al. 2022; Sanchez-Sanchez et al. 2025; Quintana-Cepedal et al. 2024). Indeed, females are also significantly more prone to injuries to these locations than males (Leininger et al. 2007; Robles-Palazón et al. 2022). Furthermore, injury risk seems to increase with chronological age (Mandorino, Figueiredo, Gjaka, and Tessitore 2023). For instance, in a recent systematic review and meta-analysis, Robles-Palazón et al. (2022) reported an injury incidence of 5.3 injuries/1000 h in U13–U16 and 7.5 injuries/1000 h of football exposure in U17–U19-year-old male elite football players. Hence, it is important to investigate whether these injury patterns also apply in youth grassroot settings.

To overcome limitations in previous research related to prevalence of injuries among male and female football players and facilitate investigation of the complex risk factors in youth grassroot football, the aim of the present study was two-fold. First, to investigate the prevalence of injury in youth grassroot football players. Second, to investigate the relationships between prevalence of injury and potential multifactorial risk factors, including physical stress (i.e., number of training/match hours/week), psychosocial factors (i.e., peer and coach autonomy support and social support), and demographic factors (i.e., age and sex) using a complex system approach.

2 | Materials and Methods

2.1 | Participants

All grassroot football clubs in Agder County with U14–U19 teams registered for the season were invited to participate in this study. In total, 588 participants were recruited: 398 males and 190 females. However, 20 players were excluded from further analysis due to not completing the entire survey. Consequently, 568 male ($n = 386$) and female ($n = 182$) players (96.6%) were included in the final analyses (see Table 1).

2.2 | Procedure

Prior to commencing data collection, ethical approval was obtained from the Norwegian Agency for Shared Services in Education and Research (Ref.nr.: 923402) and the ethical committee at the Faculty of Health and Sport Science at the University of Agder. With the general manager's consent from each football club, the coaches of the respective teams were contacted and provided with consent forms to distribute to players and parents/legal guardians. The consent form outlined the details of the project, what participation entailed, and emphasized that consent was voluntarily and players could withdraw at any time. Data were collected via SurveyXact (Rambøll Management Consulting, 2022, Aarhus, Denmark). Data collection occurred mainly during September, although some continued into October and November to facilitate insights from a more representative sample of youth grassroot football players.

2.3 | Measures

The survey was based on previously validated versions of established scales, where available. Questionnaires not available in Norwegian were translated (Epstein et al. 2015). Some adaptations were also made to the context and timeframes used in some questions due to the ongoing COVID-19 pandemic, limiting certain aspects of training in the year preceding data collection.

2.3.1 | Injury

Traditionally, the magnitude and severity of injuries have been measured using a time-loss definition, defining an injury as more severe based on the time players are unable to participate in regular training (Bahr et al. 2018). Although this is an accepted approach, it is recognized that it can lead to an underestimation of injuries that are not associated with time-loss, particularly overuse injuries (Bahr 2009; Clarsen et al. 2013). To address these issues, the Oslo Sports Trauma Research Center (OSTRC) developed a questionnaire (OSTRC-O2; Clarsen et al. 2020) for recording all injury types and their severity (Clarsen et al. 2020; Clarsen et al. 2013), which was used in the current study.

The OSTRC-O2 (e.g., "To what extent have groin problems affected your performance during the past 7 days?") is made to be modified for specific anatomical areas (Clarsen et al. 2020), which led to five different scales being developed for the current study to account for common football injuries (i.e., back, knee, ankle, groin, and hamstring). Each scale consists of four questions regarding the anatomical area and the effect of the injury on participation and performance the past week. Responses are scored from 0 to 25 (0–8–17–25). Injury and substantial injury were defined in accordance with recommendations (Clarsen et al. 2013) and other prevalence studies (Leppänen et al. 2019; Moseid et al. 2018) conducted in youth sport. All players were defined as injured if they accumulated a severity score of more than 0, and further defined as substantially injured if they reported moderate or severe reductions in training volume or

TABLE 1 | Descriptive statistics of demographic variables of all participants.

	All athletes	Males	Females
Gender, *n* (%)	568 (100)	386 (68.0)	182 (32.0)
Age (year), mean (SD)	15.7 ± 1.4	16 ± 1.4	15.1 ± 1.2
Years playing football, mean (SD)	9 ± 2.7	9.7 ± 2.6	7.6 ± 2.3
Years with current coach, median (range)	2 (0–15)	2 (0–15)	3 (0–10)
Players with parent-coach, *n* (%)	299 (52.6)	175 (45.3)	124 (68.1)
Clubs, *n*	30	25	17
Geography, *n* (%)			
Kristiansand municipality	272 (47.9)	184 (47.7)	88 (48.4)
West of Kristiansand	94 (16.5)	57 (14.8)	37 (20.3)
East of Kristiansand	147 (25.9)	108 (28.0)	39 (21.4)
North of Kristiansand	55 (9.7%)	37 (9.6)	18 (9.9)
Ethnicity, *n* (%)			
Norwegian	504 (88.7)	335 (86.7)	170 (93.4)
Born with immigrant parents	35 (6.2)	26 (6.8)	8 (4.4)
Immigrant	29 (5.1)	25 (6.5)	4 (2.2)

performance (response 3 or 4 in either question 2 or 3). All five scales showed good internal reliability, with acceptable coefficient alpha values ($\alpha = 0.79–0.86$).

2.3.2 | Perceived Coach and Peer Autonomy Support

Perception of coach and peer autonomy support was assessed separately using the 6-item short version of the Health-Care Climate Questionnaire (HCCQ; G. C. Williams et al. 1996), modified for use within sports. This modified version of the HCCQ (e.g., "I feel that my coach provides me with choices and options") has previously shown good internal reliability (Adie et al. 2012; Bartholomew et al. 2011). The responses were rated on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The two 6-item scales showed good internal reliability, with a coefficient alpha value of $\alpha = 0.92$ for both scales.

2.3.3 | Perceived Social Support

Perception of social support was measured using the Brief Perceived Social Support Questionnaire (F-SozU K-6; Lin et al. 2019). This questionnaire maps a wide range of social resources incorporating various aspects of social support (e.g., "I know a very close person whose help I can always count on") and has shown good cross-cultural invariance (Lin et al. 2019). The scale consists of six items that are rated on a 5-point Likert scale ranging from 1 (*not true at all*) to 5 (*very true*). In the present study, the questionnaire showed a good internal reliability, with an acceptable coefficient alpha value ($\alpha = 0.87$).

2.3.4 | Number of Training and Match Hours/Week

The amount of practices was collected using a short form of a previously validated practice history questionnaire (Haugaasen et al. 2014). The questionnaire asked players to retrospectively report the average amount of time spent per week (and how many weeks) in different football activities over several years, from which one can calculate the total accumulated hours for each age-category (Haugaasen et al. 2014). However, in the present study, the questionnaire was modified, as we only were interested in the amount of recent practice. The questionnaire recorded weekly accumulated hours (preceding month average) spent in organized football practice, peer-led football play, peer-led football practice, matches, and other sports practices. The accumulated hours of activity were categorized into four variables prior to analyses (i.e., match, organized activity, football activity, and total activity). The validity of the questionnaire has previously been tested by comparing the players' and parents' responses, showing a good intraclass correlation of $r = 0.76$ (Ford et al. 2010).

2.4 | Statistical Analysis

Descriptive statistics of the demographic variables are presented in Table 1. We also calculated coefficient alpha values (Cronbach and Shavelson 2004) and correlation between independent and dependent variables (see Appendix 1). Exploratory factor analysis was used to explore the relationship and factor loadings between manifest variables within the same scales to evaluate the validity. The prevalence of injury and substantial injury are presented in Table 2, with Pearson's chi-squared tests used to check for differences between groups.

To test the potential relationships between the independent variables (sex, age group, perceived social support, perceived coach and peer autonomy support, and training load) and the dependent variables (prevalence of injury and substantial injury), a chi-squared automatic interaction detection (CHAID) analysis was applied (IBM SPSS Decision Trees 24; Milanović and Stamenković 2016). Decision tree methods allow nonlinear interactions among independent variables, which has made them successful in identifying subsets of risk factors explaining health outcomes (Bittencourt et al. 2012; Butchart et al. 2013; D'Alisa et al. 2006; Tranaeus et al. 2022). The CHAID algorithm is well suited for interpreting purposes and for use in large sample sizes (Momo 2013). Moreover, it uses a prepruning approach to prevent overfitting, which makes it more appropriate to generalize unseen data (Ying 2019). Tree pruning enables the tree to grow until the stopping rule is met, after which nonsignificant nodes are removed. This process reduces the tree's complexity while enhancing its accuracy. The following stopping rule was applied in accordance with suggestions made by previous studies (e.g., Linnér et al. 2024; Machuca et al. 2017); (a) number of cases in parent nodes to be minimum 10% (56 cases) of the total sample, (b) number of cases in child nodes to be minimum 5% (28 cases) of the total sample, or (c) no more statistically significant splits ($p < 0.0.05$) were possible. We calculated risk differences (with corresponding 95% confidence intervals) between the subgroups to illustrate the difference in proportion of injured players, and missing data were treated with surrogates splits. Additionally, no power calculation was performed, as our goal was to recruit nearly the entire population of youth grassroot football players in Agder County, Norway. All analyses were conducted using SPSS version 24.0 (IBM, Armonk, New York, USA). Of note, this study's design and analysis were not preregistered.

3 | Results

3.1 | Injury Prevalence

Of the total sample of youth grassroot football players, the prevalence of injured and substantially injured players was 54% and 23%, respectively (see Table 2). Regarding both total injuries and total substantial injuries, no sex differences were observed. The knee was the anatomical area, which displayed the highest injury prevalence comprising 29% and 12% for both injuries and substantial injuries, respectively. Female players reported a higher prevalence of knee injuries (X^2 (1, $N = 568$) = 8.2 and $p = 0.004$) and ankle injuries (X^2 (1, $N = 568$) = 5.1 and $p = 0.023$) than males, whereas male players reported a higher prevalence of groin injuries (X^2 (1, $N = 568$) = 15.3 and $p < 0.001$) than females. With respect to age groups, the oldest players (17-19 years) reported a higher prevalence of lower back

TABLE 2 | Prevalence of total injury problems and substantial injury problems as well as subcategories for location of the injury and prevalence for subgroups of athletes.

	Adolescent (13–19) grassroot football players (n = 568)				
	All (n = 568)	**Males (n = 386)**	**Females (n = 182)**	**13–16 years old (n = 393)**	**17–19 years old (n = 175)**
Total injury problems	308 (54.2%)	205 (53.1%)	103 (56.6%)	207 (52.7%)	101 (57.7%)
Lower back	83 (14.6%)	61 (15.8%)	22 (12.1%)	46 (11.7%)	37 (21.1%)
Knee	167 (29.4%)	99 (25.6%)	68 (37.4%)	126 (32.1%)	41 (23.4%)
Ankle	101 (17.8%)	59 (15.3%)	42 (23.1%)	64 (16.3%)	37 (21.1%)
Groin	82 (14.4%)	71 (18.4%)	11 (6.0%)	51 (13.0%)	31 (17.7%)
Hamstring	34 (6.0%)	28 (7.3%)	6 (3.3%)	19 (4.8%)	15 (8.6%)
Substantial injuries					
Total	129 (22.7%)	85 (22.0%)	44 (24.2%)	86 (21.9%)	43 (24.6%)
Lower back	34 (6.0%)	26 (6.7%)	8 (4.4%)	19 (4.7%)	15 (8.6%)
Knee	67 (11.8%)	40 (10.4%)	27 (14.8%)	45 (11.5%)	22 (12.6%)
Ankle	35 (6.2%)	22 (5.7%)	13 (7.1%)	22 (5.6%)	13 (7.4%)
Groin	33 (5.8%)	27 (7.0%)	6 (3.3%)	24 (6.1%)	9 (5.1%)
Hamstring	14 (2.5%)	12 (3.1%)	2 (1.1%)	8 (2.0%)	6 (3.4%)

Note: Data are shown as the number and percentage of players reporting at least one injury or substantial injury.

injuries (X^2 (1, N = 568) = 8.6 and p = 0.003), whereas the youngest players (14-16 years) reported a higher prevalence of knee injuries (X^2 (1, N = 568) = 4.3 and p = 0.037). Notably, no differences between age groups were found with respect to substantial injuries.

3.2 | Risk Factors of Injury and Substantial Injury

The results from the CHAID decision tree analysis for injuries (see Figure 1) showed a solution with three parent nodes and six child nodes. Peer autonomy support appeared to be the main risk factor for injuries, where the group with lower levels of perceived peer autonomy support (≤ 37.00) showed a higher prevalence of injuries (prevalence difference = 16.4% and 95% CI = [7.50, 25.30]). Among the players who perceived lower levels of autonomy support from their peers, football activity was a factor associated with injury prevalence. The group accumulating over 6.5 h of football activity per week displayed a higher prevalence of injury (prevalence difference = 15.1% and 95% CI = [4.54, 25.66]). In this group, sex was a factor that was associated with injury prevalence, where the female players experienced the highest injury prevalence (prevalence difference = 15.5% and 95% CI = [1.91, 29.09]).

For substantial injuries (see Figure 2), the CHAID decision tree presented a solution with two parent nodes and four child nodes. Match time was found to be the main grouping variable, with the group accumulating more than 3 h per week showing a higher prevalence of substantial injuries (prevalence difference = 21.6% and 95% CI = [9.66, 33.54]). In the group accumulating a match time of ≤ 3 h a week, perceived autonomy support from the coach appeared to be an important risk factor. Players who perceived higher levels of autonomy support from the coach (> 28.00) showed a lower prevalence of substantial injuries (prevalence difference = 15.4% and 95% CI = [6.41, 24.39]).

4 | Discussion

To our best knowledge, this is the first study of injury prevalence and possible risk factors in a large cohort of youth grassroot football players of both sexes during a regular season. A total of 54% of the players reported an injury, whereas 23% of the players reported a substantial injury. Additionally, the results showed that the combination of lower levels of perceived peer autonomy support, higher weekly amounts of total football activity, and being a female player were risk factors of injury. However, for substantial injuries, the combination of higher amounts of match time or being a player who perceived lower levels of coach autonomy support in the group accumulating least match time was associated with a higher injury prevalence.

Due to the measure utilized to obtain injury data, comparisons between the current findings and previous research are difficult. Nevertheless, Moseid et al. (2018) used the same measure in their study on Norwegian youth elite athletes, although, only providing separate injury data for team sport athletes. In our study, a higher prevalence of both injury and substantial injury was identified; specifically, Moseid et al. (2018) found a weekly average prevalence of 37% for injuries and 22% for substantial injuries among team sport athletes. Further, Dalen-Lorentsen et al. (2021) used the same measure to assess the prevalence of health problems (i.e., injury and illness) in a large cohort of youth elite football players. They found a weekly average prevalence of 63.8% and 35.3% for total health problems and substantial health problems, respectively. When considering

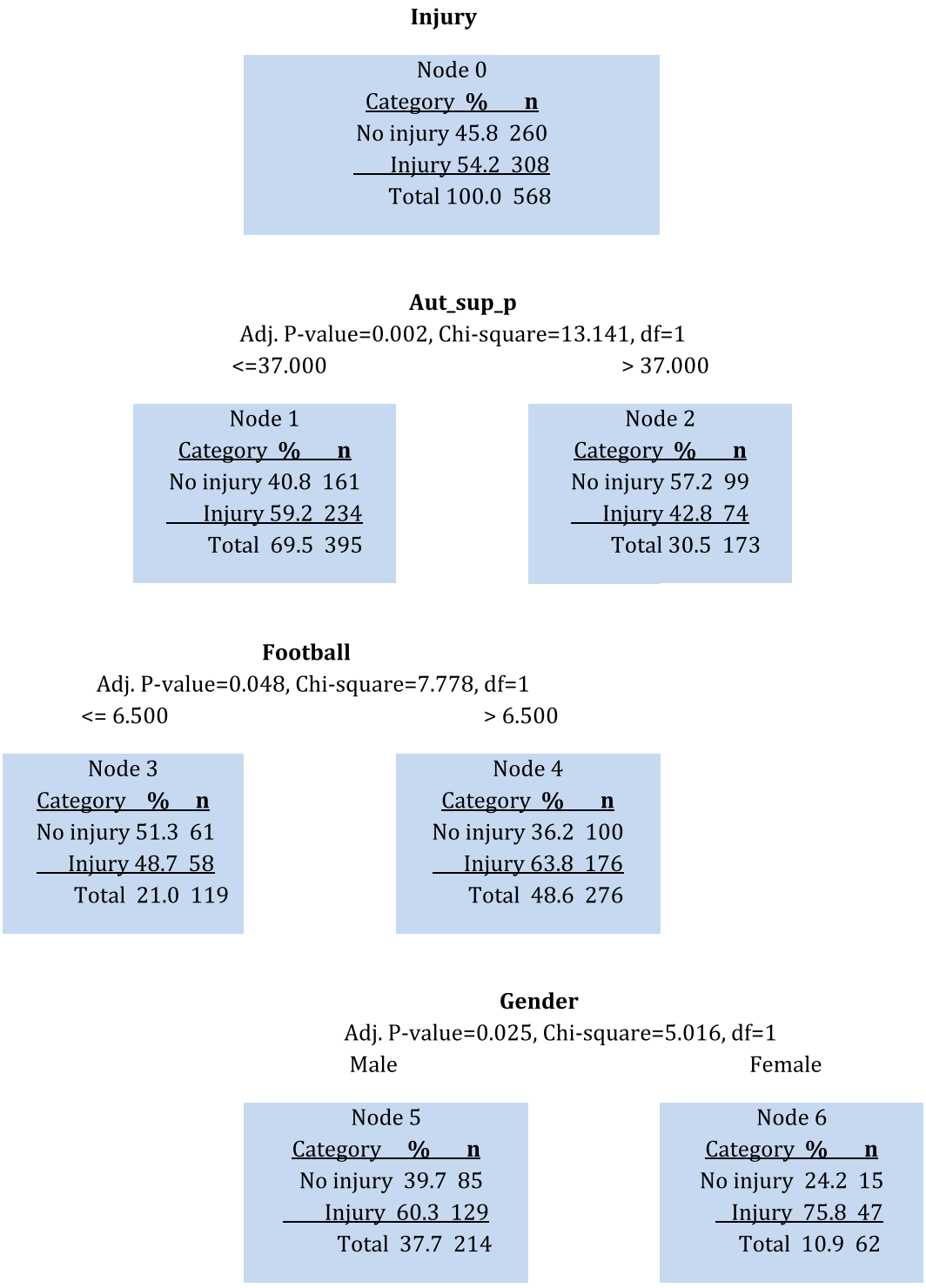

FIGURE 1 | The results of the CHAID decision tree analysis showing the 6 child nodes. Factors included in the analysis were as follows: match, organized football activity, football activity, all activity, perceived social support, perceived coach autonomy support, perceived peer autonomy support, age group, and gender.

that their prevalence study also included illness, it is reasonable to assume that our findings are in line with the injury prevalence data presented in this study. Previous studies (e.g., Emery et al. 2005; Robles-Palazón et al. 2022) have indicated that injury incidence is similar to or higher in elite players compared to grassroot players, as they accumulate higher amounts of practice hours. However, our findings dispute this suggesting that the prevalence of injury is similar in both samples. One possible explanation for the elevated prevalence rates within this sample of youth grassroot football players could be that our data were collected late in the competitive season using a cross-sectional design, and due to the COVID-19 pandemic limiting preseason training and preparation, it may be that participants were more susceptible to injury than they would have been at a different seasonal period. Indeed, previous studies have noted a peak in injury risk in the early parts of the competitive season

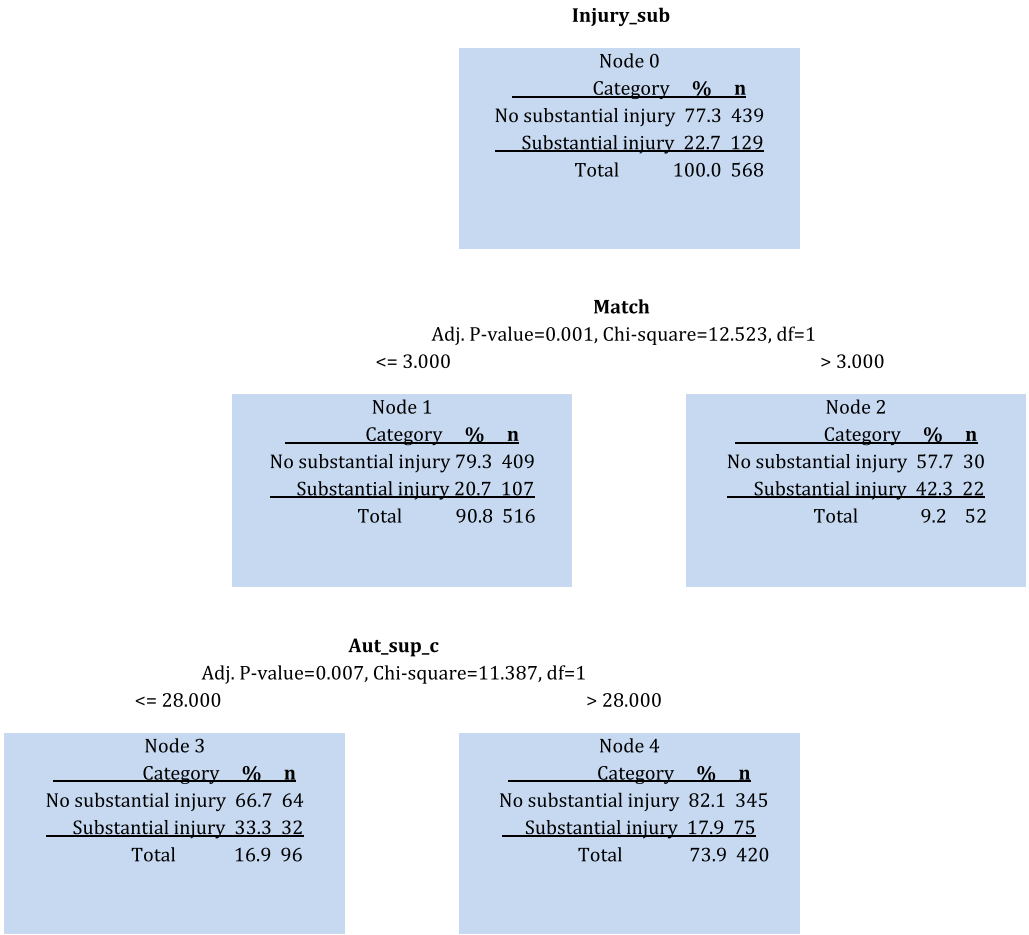

FIGURE 2 | The results of the CHAID decision tree analysis showing the 4 child nodes. Factors included in the analysis were as follows: match, organized football activity, football activity, all activity, perceived social support, perceived coach autonomy support, perceived peer autonomy support, age group, and gender.

(Le Gall et al. 2006; Price et al. 2004). Nevertheless, such high injury rates warrant further investigation.

Within the current study, there were no sex differences regarding total prevalence of injury or substantial injury; however, female players were more prone to ankle as well as knee injuries compared to male players, whereas male players were more prone to groin injuries. The injury patterns concerning sex found in our study are supported by previous studies (Mandorino, Figueiredo, Gjaka, and Tessitore 2023; Robles-Palazón et al. 2022; Sanchez-Sanchez et al. 2025; Quintana-Cepedal et al. 2024). A previous systematic review and meta-analysis found no significant sex differences regarding injuries but found that females were more prone to both ankle and knee injuries compared to males (Robles-Palazón et al. 2022). This could be due to females' higher susceptibility for sustaining joint and ligament injuries, possibly explained by sex-related differences in anatomy and body composition (joint laxity, neuromuscular control, and hormonal regulation; e.g., Hewett et al. 2004, 2006; Myer et al. 2004). Furthermore, as in our study, they also found males to report a higher amount of groin injuries, although their difference was not significant (Robles-Palazón et al. 2022). In addition, our findings showed no significant differences in total injury and substantial injury across different age groups. This is surprising because previous studies have suggested that injury risk increases with chronological age (Mandorino, Figueiredo, Gjaka, and Tessitore 2023; Robles-Palazón et al. 2022). However, our findings revealed that younger players were more prone to knee injuries. This finding is in line with Renshaw and Goodwin's (2016) study focusing on elite academy football players.

The decision tree for total injury problems showed that lower levels of perceived peer autonomy support in combination with higher weekly amounts of total football activity as well as being a female player were risk factors of being injured. The relationship between perceived peer autonomy support and increased injury prevalence may be explained through its potential relationship with athletes' stress responses (Ivarsson et al. 2017; Williams and Andersen, 1998). When experiencing support from significant others, this could serve as a coping resource decreasing the chance of maladaptive health outcomes (Kontos 2016; Li et al. 2019). Perceived autonomy support has shown positive associations with several indices of well-being (i.e., vitality and positive affect) as well as negative associations with ill-being (i.e., burnout, depression, disordered eating, and physical symptoms) in a variety of sports (Bartholomew et al. 2011) and in youth elite football (Adie et al. 2012). These

previous studies investigated coach autonomy support; however, recent research suggests that peer motivational climate also could be of great importance (Bruner et al. 2014; Kontos 2016; Reverberi et al. 2020). More specifically, Reverberi et al. (2020) found young football players' interest in improvement and effort within the team to be more important than relational elements of coaches and parents regarding their psychological well-being. Our findings thereby suggest that perceived peer autonomy support could be a contributing factor in illuminating the process regarding sport injuries.

Our findings are in line with the suggestions within the multifactorial model that include multiple extrinsic factors (e.g., psychosocial factors and physical stress; J. M. Williams and Andersen 1998). For instance, previous research (e.g., Andersen and Williams 1988) suggests that demanding practice or competition could be appraised as more stressful without appropriate coping resources (e.g., perceived autonomy support). Furthermore, the combination of lower levels of perceived peer autonomy support and higher amounts of football activity was associated with a higher prevalence of injury among female players than male players. The importance of psychosocial experiences regarding injury in female players has recently been documented (Edwards et al. 2024). More specifically, perceived autonomy support and peer pressure has been described by athletes as major influences, both leading up to injury and during injury rehabilitation (Hildingsson et al. 2018; Ivarsson et al. 2019; Tranaeus et al. 2024). This could be a contributing factor in explaining the higher female injury prevalence in our study and further supports the assumption of a complex system of risk factors associated with injury prevalence.

Furthermore, the findings showed that the group with higher amounts of match time showed the highest prevalence of substantial injuries. Thus, match time as opposed to total football activity appeared to be a risk factor for substantial injuries. This aligns with findings from adult professional football players, which have also shown that severe injuries occur more often during matches than training (Pfirrmann et al. 2016). The reason for this has been attributed to enhanced physical demands, fatigue, and number of collisions during matches compared to training (Robles-Palazón et al. 2022). Additionally, in our study, lower levels of perceived coach autonomy support appeared as a further risk factor for substantial injury in the group accumulating the least amount of match hours per week. This finding shows that lower levels of perceived coach autonomy support could be a risk factor for substantial injuries even without the presence of physical stress. Perceived coach autonomy support, as a risk factor for substantial injuries, aligns with previous research in elite male and female football, which has investigated the association between the coach and sport injuries. More specifically, high levels of transformational leadership has been positively associated with smaller numbers of severe injuries (Ekstrand et al. 2018), whereas perceived stress from the coach has been associated with increased overuse injuries (Pensgaard et al. 2018). Consequently, we identified perceived autonomy support as an important risk factor in the coach–athlete relationship concerning injury prevalence. This highlights the various ways in which coaches influence their players' physical well-being (Ekstrand et al. 2018; Pensgaard et al. 2018).

4.1 | Practical Implications

Based on our findings, we suggest the following applied implications: (1) *Injury prevention strategies:* Given the relatively high prevalence of injuries and substantial injuries among youth grassroot football players in this study, clubs and coaches should prioritize injury prevention programs*;* (2) *Load management:* The association between increased weekly football activities and injury prevalence suggests the need for monitoring training and match loads among youth grassroot football players, including activities outside of football; (3) *Match time optimization:* Since increased match time was a primary risk factor for substantial injuries, coaches should monitor playing time, particularly for the high-exposure group of players; (4) *Promote autonomy supportive environments:* The findings suggest that lower perceived autonomy support from peers and coaches is associated with injury risk. Clubs and coaches should create environments that encourage players' sense of autonomy, as this might mitigate injury risk; and (5) *Coach education programs:* Since perceived coach autonomy support is associated with injury risk, sport federations and clubs should provide training for coaches on effective communication and coach–athlete-centered relationships to foster a supportive team environment that promotes health and well-being among youth grassroot football players. These suggested strategies might support clubs and coaches in their efforts to reduce injury risk among youth grassroot football players while promoting safe, supportive, and development-oriented environments.

4.2 | Strengths and Limitations

The main strength of this study is the relatively large sample size that strongly contributed to our aim of representing youth grassroot football players in Agder County, Norway. Another key strength of this study is the use of the OSTRC-O2 questionnaire (Clarsen et al. 2020). Unlike traditional time-loss definitions, which primarily categorizes injury severity based on the duration of training absence, the OSTRC-O2 questionnaire allows for a more comprehensive assessment by capturing injuries that do not necessarily result in time-loss such as overuse injuries. This approach enhances the accuracy of injury prevalence research, reducing the risk of underestimating the true burden of injuries. By incorporating a broader definition of injury severity, this study provides a more holistic understanding of injury patterns in youth grassroot football. Additionally, the study investigated multiple injury risk factors, allowing for investigation of possible complex systems of injury mechanisms.

However, a limitation of this study is the cross-sectional design, which limited the investigation of factors associated with risk factors rather than focusing on predictors of injury and substantial injury. Moreover, most previous studies conducted in youth football investigating prevalence of injuries have used a time-loss injury/illness definition, whereas we used an 'any physical complaint' definition (Clarsen et al. 2020). This, in turn, complicated direct comparisons with similar studies in youth football. Furthermore, our sample was drawn exclusively from one county (Agder), which may limit the generalizability of our findings to other regions of grassroot football in Norway

(Tuastad 2019). Differences in sample characteristics (e.g., socioeconomic status and ethnicity), playing conditions (e.g., weather conditions and quality of the football pitch), and available training facilities (e.g., facility availability and travel distance) across counties could affect the applicability of our results beyond this specific sample of grassroot football players.

4.3 | Future Directions

Future studies should focus on investigating the prevalence of injury in youth grassroot football both over time and replicating our findings in other sport types and settings (Evans et al. 2017). To further explore the nuances of our findings, we encourage researchers to investigate the influence of different types of psychosocial resources while at the same time taking training load into account, as these factors together may both directly and indirectly influence the prevalence of injury in youth grassroot football (U. Johnson and Ivarsson 2017; Sniffen et al. 2022; Tranaeus et al. 2024). Moreover, although injury prevention has primarily been emphasized in youth elite sports, the high participation rates in grassroot sports (Obërtinca et al. 2023; Sanders and Coakley 2021) underscore the need for targeted injury prevention interventions at this level. Future research should prioritize grassroot sports, as they engage a larger portion of the youth population. Such efforts could contribute to the sustainable development of grassroot sports by reducing injury-related health risks, preventing social exclusion, and minimizing dropout from sport participation.

5 | Conclusion

Our results showed a surprisingly high prevalence of injury and substantial injury in this sample of youth grassroot football players as well as indicating the complex nature of injury risk factors. Indeed, our findings revealed that perceived autonomy supportive behaviors from both coaches and peers, along with training and match load management, to be important risk factors to consider when working to prevent injuries in youth grassroot football.

Conflicts of Interest

The authors declare no conflicts of interest.

References

Adie, J. W., J. L. Duda, and N. Ntoumanis. 2012. "Perceived Coach-Autonomy Support, Basic Need Satisfaction and the Well- and Ill-Being of Elite Youth Soccer Players: A Longitudinal Investigation." *Psychology of Sport and Exercise* 13, no. 1: 51–59. https://doi.org/10.1016/j.psychsport.2011.07.008.

Andersen, M. B., and J. M. Williams. 1988. "A Model of Stress and Athletic Injury: Prediction and Prevention." *Journal of Sport & Exercise Psychology* 10, no. 3: 294–306. https://doi.org/10.1123/jsep.10.3.294.

Andreasen, I., P. Faunø, B. Lund, P. Lemche, and H. Knudsen. 1993. "Soccer Injuries Among Youth." *Scandinavian Journal of Medicine & Science in Sports* 3, no. 1: 62–66. https://doi.org/10.1111/j.1600-0838.1993.tb00363.x.

Appaneal, R. N., and F. M. Perna. 2014. "Biopsychosocial Model of Injury." In *Encyclopedia of Sport and Exercise Psychology*, edited by R. C. Eklund and G. Tenenbaum, 74–77. SAGE Publications, Inc. https://doi.org/10.4135/9781483332222.n30.

Bahr, R. 2009. "No Injuries, but Plenty of Pain? on the Methodology for Recording Overuse Symptoms in Sports." *British Journal of Sports Medicine* 43, no. 13: 966–972. https://doi.org/10.1136/bjsm.2009.066936.

Bahr, R., B. Clarsen, and J. Ekstrand. 2018. "Why We Should Focus on the Burden of Injuries and Illnesses, Not Just Their Incidence." *British Journal of Sports Medicine* 52, no. 16: 1018–1021. https://doi.org/10.1136/bjsports-2017-098160.

Bakken, A. 2019. *Idrettens posisjon i ungdomstida: Hvem deltar og hvem slutter i ungdomsidretten? [Who Participates and Who Drops Out of Youth Sports?*. NOVA.

Bartholomew, K. J., N. Ntoumanis, R. M. Ryan, J. A. Bosch, and C. Thøgersen-Ntoumani. 2011. "Self-determination Theory and Diminished Functioning: The Role of Interpersonal Control and Psychological Need Thwarting." *Personality and Social Psychology Bulletin* 37, no. 11: 1459–1473. https://doi.org/10.1177/0146167211413125.

Beech, J., B. Jones, T. Hughes, and S. Emmonds. 2024. "Injury Profile in Youth Female Athletes: A Systematic Review and Meta-Analysis." *Sports Medicine* 54, no. 5: 1207–1230. https://doi.org/10.1007/s40279-023-01988-w.

Bittencourt, N. F. N., W. H. Meeuwisse, L. D. Mendonça, A. Nettel-Aguirre, J. M. Ocarino, and S. T. Fonseca. 2016. "Complex Systems Approach for Sports Injuries: Moving From Risk Factor Identification to Injury Pattern Recognition—Narrative Review and New Concept." *British Journal of Sports Medicine* 50, no. 21: 1309–1314. https://doi.org/10.1136/bjsports-2015-095850.

Bittencourt, N. F. N., J. M. Ocarino, L. D. Mendonça, T. E. Hewett, and S. T. Fonseca. 2012. "Foot and Hip Contributions to High Frontal Plane Knee Projection Angle in Athletes: A Classification and Regression Tree Approach." *Journal of Orthopaedic & Sports Physical Therapy* 42, no. 12: 996–1004. https://doi.org/10.2519/jospt.2012.4041.

Brink, M. S., C. Visscher, S. Arends, J. Zwerver, W. J. Post, and K. A. P. M. Lemmink. 2010. "Monitoring Stress and Recovery: New Insights for the Prevention of Injuries and Illnesses in Elite Youth Soccer Players." *British Journal of Sports Medicine* 44, no. 11: 809–815. https://doi.org/10.1136/bjsm.2009.069476.

Bruner, M. W., M. A. Eys, K. S. Wilson, and J. Côté. 2014. "Group Cohesion and Positive Youth Development in Team Sport Athletes." *Sport, Exercise, and Performance Psychology* 3, no. 4: 219–227. https://doi.org/10.1037/spy0000017.

Butchart, C., F. Ismailoglu, P. K. Myint, et al. 2013. "Identification of Possible Determinants of Inpatient Mortality Using Classification and Regression Tree (CART) Analysis in Hospitalized Oldest Old Patients." *Archives of Gerontology and Geriatrics* 56, no. 1: 188–191. https://doi.org/10.1016/j.archger.2012.07.005.

Clarsen, B., R. Bahr, G. Myklebust, et al. 2020. "Improved Reporting of Overuse Injuries and Health Problems in Sport: An Update of the Oslo Sport Trauma Research Center Questionnaires." *British Journal of Sports Medicine* 54, no. 7: 390–396. https://doi.org/10.1136/bjsports-2019-101337.

Clarsen, B., G. Myklebust, and R. Bahr. 2013. "Development and Validation of a New Method for the Registration of Overuse Injuries in Sports Injury Epidemiology: The Oslo Sports Trauma Research Centre (OSTRC) Overuse Injury Questionnaire." *British Journal of Sports Medicine* 47, no. 8: 495–502. https://doi.org/10.1136/bjsports-2012-091524.

Colyer, S. L., J. J. Miles, F. J. Crump, et al. 2021. "Association Between Biological Maturation and Anterior Cruciate Ligament Injury Risk Factors During Cutting." *Journal of Sports Medicine and Physical Fitness* 62, no. 8. https://doi.org/10.23736/s0022-4707.21.12590-3.

Cronbach, L. J., and R. J. Shavelson. 2004. "My Current Thoughts on Coefficient Alpha and Successor Procedures." *Educational and Psychological Measurement* 64, no. 3: 391–418. https://doi.org/10.1177/0013164404266386.

Dalen-Lorentsen, T., J. Bjørneboe, B. Clarsen, M. Vagle, M. W. Fagerland, and T. E. Andersen. 2021. "Does Load Management Using the Acute: Chronic Workload Ratio Prevent Health Problems? A Cluster Randomised Trial of 482 Elite Youth Footballers of Both Sexes." *British Journal of Sports Medicine* 55, no. 2: 108–114. https://doi.org/10.1136/bjsports-2020-103003.

D'Alisa, S., G. Miscio, S. Baudo, A. Simone, L. Tesio, and A. Mauro. 2006. "Depression Is the Main Determinant of Quality of Life in Multiple Sclerosis: A Classification-Regression (CART) Study." *Disability & Rehabilitation* 28, no. 5: 307–314. https://doi.org/10.1080/09638280500191753.

DiFiori, J. P., H. J. Benjamin, J. S. Brenner, et al. 2014. "Overuse Injuries and Burnout in Youth Sports: A Position Statement From the American Medical Society for Sports Medicine." *British Journal of Sports Medicine* 48, no. 4: 287–288. https://doi.org/10.1136/bjsports-2013-093299.

Edwards, C. D., P. Weatherbee, and C. M. Aron. 2024. "Unique Considerations for Female Athletes: A Psychiatric Perspective." *Psychiatric Annals* 54, no. 11: e295–e300. https://doi.org/10.3928/00485713-20241107-01.

Ekstrand, J., D. Lundqvist, L. Lagerbäck, M. Vouillamoz, N. Papadimitiou, and J. Karlsson. 2018. "Is There a Correlation Between Coaches' Leadership Styles and Injuries in Elite Football Teams? A Study of 36 Elite Teams in 17 Countries." *British Journal of Sports Medicine* 52, no. 8: 527–531. https://doi.org/10.1136/bjsports-2017-098001.

Emery, C. A., W. H. Meeuwisse, and S. E. Hartmann. 2005. "Evaluation of Risk Factors for Injury in Adolescent Soccer: Implementation and Validation of an Injury Surveillance System." *American Journal of Sports Medicine* 33, no. 12: 1882–1891. https://doi.org/10.1177/0363546505279576.

Epstein, J., R. M. Santo, and F. Guillemin. 2015. "A Review of Guidelines for Cross-Cultural Adaptation of Questionnaires Could Not Bring Out a Consensus." *Journal of Clinical Epidemiology* 68, no. 4: 435–441. https://doi.org/10.1016/j.jclinepi.2014.11.021.

Evans, M. B., V. Allan, K. Erickson, L. J. Martin, R. Budziszewski, and J. Côté. 2017. "Are All Sport Activities Equal? A Systematic Review of How Youth Psychosocial Experiences Vary Across Differing Sport Activities." *British Journal of Sports Medicine* 51, no. 3: 169–176. https://doi.org/10.1136/bjsports-2016-096725.

Ford, P. R., J. Low, A. P. McRobert, and A. M. Williams. 2010. "Developmental Activities That Contribute to High or Low Performance by Elite Cricket Batters When Recognizing Type of Delivery From Bowlers' Advanced Postural Cues." *Journal of Sport & Exercise Psychology* 32, no. 5: 638–654. https://doi.org/10.1123/jsep.32.5.638.

Gould, D. 2019. "The Current Youth Sport Landscape: Identifying Critical Research Issues." *Kinesiology Review* 8, no. 3: 150–161. https://doi.org/10.1123/kr.2019-0034.

Haraldsdottir, K., and A. M. Watson. 2021. "Psychosocial Impacts of Sports-Related Injuries in Adolescent Athletes." *Current Sports Medicine Reports* 20, no. 2: 104–108. https://doi.org/10.1249/JSR.0000000000000809.

Haugaasen, M., T. Toering, and G. Jordet. 2014. "From Childhood to Senior Professional Football: A Multi-Level Approach to Elite Youth Football Players' Engagement in Football-specific Activities." *Psychology of Sport and Exercise* 15, no. 4: 336–344. https://doi.org/10.1016/j.psychsport.2014.02.007.

Hausken-Sutter, S. E., R. Pringle, A. Schubring, S. Grau, and N. Barker-Ruchti. 2021. "Youth Sport Injury Research: A Narrative Review and the Potential of Interdisciplinarity." *BMJ Open Sport & Exercise Medicine* 7, no. 1: e000933. https://doi.org/10.1136/bmjsem-2020-000933.

Hewett, T. E., G. D. Myer, and K. R. Ford. 2004. "Decrease in Neuromuscular Control About the Knee With Maturation in Female Athletes." *Journal of Bone and Joint Surgery* 86, no. 8: 1601–1608. https://doi.org/10.2106/00004623-200408000-00001.

Hewett, T. E., G. D. Myer, and K. R. Ford. 2006. "Anterior Cruciate Ligament Injuries in Female Athletes: Part 1, Mechanisms and Risk Factors." *American Journal of Sports Medicine* 34, no. 2: 299–311. https://doi.org/10.1177/0363546505284183.

Hildingsson, M., U. T. Fitzgerald, and M. Alricsson. 2018. "Perceived Motivational Factors for Female Football Players During Rehabilitation After Sports Injury - A Qualitative Interview Study." *Journal of exercise rehabilitation* 14, no. 2: 199–206. https://doi.org/10.12965/jer.1836030.015.

Ivarsson, A., U. Johnson, M. B. Andersen, U. Tranaeus, A. Stenling, and M. Lindwall. 2017. "Psychosocial Factors and Sport Injuries: Meta-Analyses for Prediction and Prevention." *Sports Medicine* 47, no. 2: 353–365. https://doi.org/10.1007/s40279-016-0578-x.

Ivarsson, A., U. Johnson, J. Karlsson, et al. 2019. "Elite Female Footballers' Stories of Sociocultural Factors, Emotions, and Behaviours Prior to Anterior Cruciate Ligament Injury." *International Journal of Sport and Exercise Psychology* 17, no. 6: 630–646. https://doi.org/10.1080/1612197X.2018.1462227.

Ivarsson, A., U. Johnson, M. Lindwall, H. Gustafsson, and M. Altemyr. 2014. "Psychosocial Stress as a Predictor of Injury in Elite Junior Soccer: A Latent Growth Curve Analysis." *Journal of Science and Medicine in Sport* 17, no. 4: 366–370. https://doi.org/10.1016/j.jsams.2013.10.242.

Johnson, D. M., S. Williams, B. Bradley, S. Sayer, J. Murray Fisher, and S. Cumming. 2020. "Growing Pains: Maturity Associated Variation in Injury Risk in Academy Football." *European Journal of Sport Science* 20, no. 4: 544–552. https://doi.org/10.1080/17461391.2019.1633416.

Johnson, U., and A. Ivarsson. 2011. "Psychological Predictors of Sport Injuries Among Junior Soccer Players." *Scandinavian Journal of Medicine & Science in Sports* 21, no. 1: 129–136. https://doi.org/10.1111/j.1600-0838.2009.01057.x.

Johnson, U., and A. Ivarsson. 2017. "Psychosocial Factors and Sport Injuries: Prediction, Prevention and Future Research Directions." *Current opinion in psychology* 16: 89–92. https://doi.org/10.1016/j.copsyc.2017.04.023.

Jones, S., S. Almousa, A. Gibb, et al. 2019. "Injury Incidence, Prevalence and Severity in High-Level Male Youth Football: A Systematic Review." *Sports Medicine* 49, no. 12: 1879–1899. https://doi.org/10.1007/s40279-019-01169-8.

Kolstrup, L. A., K. U. Koopmann, U. H. Nygaard, R. H. Nygaard, and P. Agger. 2016. "Injuries During Football Tournaments in 45,000 Children and Adolescents." *European Journal of Sport Science* 16, no. 8: 1167–1175. https://doi.org/10.1080/17461391.2016.1205145.

Kontos, A. P. 2016. "Risk of Injury in Youth Sports - Role of Psychological Factors." In *Youth Sports: Participation, Trainability and Readiness*, M. J. Coelho, E. Silva, A. J. Figueiredo, M. T. Elferink-Gemser, and R. M. Malina, 2. a Edição, 205–219. Coimbra University Press. https://doi.org/10.14195/978-989-26-1171-6_14.

Kristiansen, E., and T. Stensrud. 2020. "Talent Development in a Longitudinal Perspective: Elite Female Handball Players Within a Sport School System." *Translational Sports Medicine* 3, no. 4: 364–373. https://doi.org/10.1002/tsm2.143.

Le Gall, F., C. Carling, T. Reilly, H. Vandewalle, J. Church, and P. Rochcongar. 2006. "Incidence of Injuries in Elite French Youth Soccer Players: A 10-season Study." *American Journal of Sports Medicine* 34, no. 6: 928–938. https://doi.org/10.1177/0363546505283271.

Leininger, R. E., C. L. Knox, and R. D. Comstock. 2007. "Epidemiology of 1.6 Million Pediatric Soccer-Related Injuries Presenting to US Emergency Departments From 1990 to 2003." *American Journal of*

Sports Medicine 35, no. 2: 288–293. https://doi.org/10.1177/0363546506294060.

Leppänen, M., K. Pasanen, B. Clarsen, et al. 2019. "Overuse Injuries Are Prevalent in Children's Competitive Football: A Prospective Study Using the OSTRC Overuse Injury Questionnaire." *British Journal of Sports Medicine* 53, no. 3: 165–171. https://doi.org/10.1136/bjsports-2018-099218.

Li, C., A. Ivarsson, L. T. Lam, and J. Sun. 2019. "Basic Psychological Needs Satisfaction and Frustration, Stress, and Sports Injury Among University Athletes: A Four-Wave Prospective Survey." *Frontiers in Psychology* 10. https://doi.org/10.3389/fpsyg.2019.00665.

Lin, M., G. Hirschfeld, and J. Margraf. 2019. "Brief Form of the Perceived Social Support Questionnaire (F-SozU K-6): Validation, Norms, and Cross-Cultural Measurement Invariance in the USA, Germany, Russia, and China." *Psychological Assessment* 31, no. 5: 609–621. https://doi.org/10.1037/pas0000686.

Linnér, L., N. Stambulova, A. Ivarsson, A. Franck, and K. Lindahl. 2024. "In Pursuit of Dual Career Excellence: Factors Associated to Satisfaction of Swedish University Student-Athletes." *International Journal of Sport and Exercise Psychology*. https://doi.org/10.1080/1612197X.2024.2437516.

Machuca, C., M. V. Vettore, M. Krasuska, S. R. Baker, and P. G. Robinson. 2017. "Using Classification and Regression Tree Modelling to Investigate Response Shift Patterns in Dentine Hypersensitivity." *BMC Medical Research Methodology* 17, no. 1: 120. https://doi.org/10.1186/s12874-017-0396-3.

Mandorino, M., A.J. Figueiredo, M. Gjaka, and A. Tessitore. 2023. "Injury Incidence and Risk Factors in Youth Soccer Players: A Systematic Literature Review. Part I: Epidemiological Analysis." *Biology of Sport* 40, no. 1: 3–25. https://doi.org/10.5114/biolsport.2023.109961.

Mandorino, M., A.J. Figueiredo, M. Gjaka, and A. Tessitore. 2023. "Injury Incidence and Risk Factors in Youth Soccer Players: A Systematic Literature Review. Part II: Intrinsic and Extrinsic Risk Factors." *Biology of Sport* 40, no. 1: 27–49. https://doi.org/10.5114/biolsport.2023.109962.

Maniar, N., D. S. Carmichael, J. T. Hickey, et al. 2023. "Incidence and Prevalence of Hamstring Injuries in Field-Based Team Sports: A Systematic Review and Meta-Analysis of 5952 Injuries From over 7 Million Exposure Hours." *British Journal of Sports Medicine* 57, no. 2: 109–116. https://doi.org/10.1136/bjsports-2021-104936.

Milanović, M., and M. Stamenković. 2016. "CHAID Decision Tree: Methodological Frame and Application." *Economic Themes* 54, no. 4: 563–586. https://doi.org/10.1515/ethemes-2016-0029.

Momo. 2013. "I Will List Some Properties and Later Give You My Appraisal for what its Worth." [Comment on the online forum post CHAID vs CRT (or CART)]. https://stats.stackexchange.com/questions/61230/chaid-vs-crt-or-cart.

Moseid, C. H., G. Myklebust, M. W. Fagerland, B. Clarsen, and R. Bahr. 2018. "The Prevalence and Severity of Health Problems in Youth Elite Sports: A 6-month Prospective Cohort Study of 320 Athletes." *Scandinavian Journal of Medicine & Science in Sports* 28, no. 4: 1412–1423. https://doi.org/10.1111/sms.13047.

Moulds, K., S. Galloway, S. Abbott, and S. P. Cobley. 2022. "Youth Sport Dropout According to the Process-Person-Context-Time Model: A Systematic Review." *International Review of Sport and Exercise Psychology* 17, no. 1: 440–481. https://doi.org/10.1080/1750984X.2021.2012817.

Myer, G. D., K. R. Ford, and T. E. Hewett. 2004. "Rationale and Clinical Techniques for Anterior Cruciate Ligament Injury Prevention Among Female Athletes." *Journal of Athletic Training* 39, no. 4: 352–364.

Newman T. J., E. Magier, C. Kimiecik, and M. Burns. 2021. "The Relationship Between Youth Sport Participation and Aggressive and Violent Behaviors: A Scoping Review of the Literature." *Journal of the Society for Social Work and Research* 12, no. 2: 371-389. https://doi.org/10.1086/714421.

Norges idrettsforbund. 2019. "Nøkkeltall - Rapport 2019." www.idrettsforbundet.no.

Obërtinca, R., I. Hoxha, R. Meha, et al. 2023. "Efficacy of Multi-Component Exercise-Based Injury Prevention Programs on Injury Risk Among Footballers of All Age Groups: A Systematic Review and Meta-Analysis." *Sports Medicine* 53, no. 4: 837–848. https://doi.org/10.1007/s40279-022-01797-7.

O'Gorman, J. 2016. "Introduction: Developing the Research Agenda in Junior and Youth Grassroot Football Culture." *Soccer and Society* 17, no. 6: 793–799. https://doi.org/10.1080/14660970.2015.1100895.

Pensgaard, A. M., A. Ivarsson, A. Nilstad, B. E. Solstad, and K. Steffen. 2018. "Psychosocial Stress Factors, Including the Relationship With the Coach, and Their Influence on Acute and Overuse Injury Risk in Elite Female Football Players." *BMJ Open Sport & Exercise Medicine* 4, no. 1: e000317. https://doi.org/10.1136/bmjsem-2017-000317.

Pfirrmann, D., M. Herbst, P. Ingelfinger, P. Simon, and S. Tug. 2016. "Analysis of Injury Incidences in Male Professional Adult and Elite Youth Soccer Players: A Systematic Review." *Journal of Athletic Training* 51, no. 5: 410–424. https://doi.org/10.4085/1062-6050-51.6.03.

Price, R. J., R. D. Hawkins, M. A. Hulse, and A. Hodson. 2004. "The Football Association Medical Research Programme: An Audit of Injuries in Academy Youth Football." *British Journal of Sports Medicine* 38, no. 4: 466–471. https://doi.org/10.1136/bjsm.2003.005165.

Quintana-Cepedal, M., I. López-Aguado, A. Fernández-Somoano, M. Á. Rodríguez, M. del Valle, and H. Olmedillas. 2024. "Injury Incidence and Characteristics in Adolescent Female Football Players: A Systematic Review With Meta-Analysis of Prospective Studies." *Biology of Sport* 41, no. 3: 137–151. https://doi.org/10.5114/biolsport.2024.132996.

Raya-González, J., F. M. Clemente, M. Beato, and D. Castillo. 2020. "Injury Profile of Male and Female Senior and Youth Handball Players: A Systematic Review." *International Journal of Environmental Research and Public Health* 17, no. 11: 3925. https://doi.org/10.3390/ijerph17113925.

Read, P. J., J. L. Oliver, M. B. A. De Ste Croix, G. D. Myer, and R. S. Lloyd. 2018. "A Prospective Investigation to Evaluate Risk Factors for Lower Extremity Injury Risk in Male Youth Soccer Players." *Scandinavian Journal of Medicine & Science in Sports* 28, no. 3: 1244–1251. https://doi.org/10.1111/sms.13013.

Renshaw, A., and P. C. Goodwin. 2016. "Injury Incidence in a Premier League Youth Soccer Academy Using the Consensus Statement: A Prospective Cohort Study." *BMJ open sport & exercise medicine* 2, no. 1: e000132. https://doi.org/10.1136/bmjsem-2016-000132.

Reverberi, E., C. D'Angelo, M. A. Littlewood, and C. F. Gozzoli. 2020. "Youth Football Players' Psychological Well-Being: The Key Role of Relationships." *Frontiers in Psychology* 11. https://doi.org/10.3389/fpsyg.2020.567776.

Robles-Palazón, F. J., A. López-Valenciano, M. De Ste Croix, et al. 2022. "Epidemiology of Injuries in Male and Female Youth Football Players: A Systematic Review and Meta-Analysis." *Journal of Sport and Health Science*. https://doi.org/10.1016/j.jshs.2021.10.002.

Sanchez-Sanchez, J., J. Raya-González, V. Martín, and A. Rodríguez Fernández. 2025. "Understanding Injuries in Young Female Soccer Players: A Narrative Review on Incidence, Mechanism, Location Risk Factors, and Preventive Strategies." *Applied Sciences* 15, no. 3: 1612. https://doi.org/10.3390/app15031612.

Sanders, B., and J. Coakley. 2021. "Leveling the Playing Field: Investing in Grassroots Sports as the Best Bet for Sustainable Development." In edited by J. Maguire, K. Liston, and M. Falcous, *The Palgrave Handbook of Globalization and Sport*, 529–555. Palgrave Macmillan. https://doi.org/10.1057/978-1-137-56854-0_24.

Sniffen, K., K. Noel-London, M. Schaeffer, and O. Owoeye. 2022. "Is Cumulative Load Associated With Injuries in Youth Team Sport? A Systematic Review." *Sports Medicine-Open* 8, no. 1: 1–13. https://doi.org/10.1186/s40798-022-00516-w.

Soligard, T., R. Bahr, and T. E. Andersen. 2012. "Injury Risk on Artificial Turf and Grass in Youth Tournament Football." *Scandinavian Journal of Medicine & Science in Sports* 22, no. 3: 356–361. https://doi.org/10.1111/j.1600-0838.2010.01174.x.

Solstad, B. E., M. Granerud, H. M. Haraldsen, H. Gustafsson, and C. J. Knight. 2022. "An Exploration of Reciprocity Between Female Athletes and Their Coach in Elite Junior Swimming: A Shared Reality Theory Perspective." *Qualitative Research in Sport, Exercise and Health* 22, no. 4: 545–563. https://doi.org/10.1080/2159676X.2021.1941211.

Solstad, B. E., M. L. Søvik, T. M. Larsen, and Y. Ommundsen. 2022. "A Coach Education Initiative in the Context of Norwegian Grassroots Football: Implementation and Lessons Learned." In *Coach Education in Football: Contemporary Issues and Global Perspectives*, edited by T. M. Leeder, 181–192. Routledge. https://doi.org/10.4324/9781003148784.

Steffen, K., G. Myklebust, T. E. Andersen, I. Holme, and R. Bahr. 2008. "Self-reported Injury History and Lower Limb Function as Risk Factors for Injuries in Female Youth Soccer." *American Journal of Sports Medicine* 36, no. 4: 700–708. https://doi.org/10.1177/0363546507311598.

Steffen, K., A. M. Pensgaard, and R. Bahr. 2009. "Self-reported Psychological Characteristics as Risk Factors for Injuries in Female Youth Football." *Scandinavian Journal of Medicine & Science in Sports* 19, no. 3: 442–451. https://doi.org/10.1111/j.1600-0838.2008.00797.x.

Tranaeus, U., A. Gledhill, U. Johnson, et al. 2024. "50 Years of Research on the Psychology of Sport Injury: A Consensus Statement." *Sports Medicine* 54, no. 7: 1733–1748. https://doi.org/10.1007/s40279-024-02045-w.

Tranaeus, U., A. Ivarsson, U. Johnson, N. Weiss, M. Samuelsson, and E. Skillgate. 2022. "The Role of the Results of Functional Tests and Psychological Factors on Prediction of Injuries in Adolescent Female Football Players." *International Journal of Environmental Research and Public Health* 19, no. 1: 143. https://doi.org/10.3390/ijerph19010143.

Tuastad, S. 2019. "The Scandinavian Sport Model: Myths and Realities. Norwegian Football as a Case Study." *Soccer and Society* 20, no. 2: 341–359. https://doi.org/10.1080/14660970.2017.1323738.

Whittaker, J. L., L. J. Woodhouse, A. Nettel-Aguirre, and C. A. Emery. 2015. "Outcomes Associated With Early Post-traumatic Osteoarthritis and Other Negative Health Consequences 3-10 Years Following Knee Joint Injury in Youth Sport." *Osteoarthritis and Cartilage* 23, no. 7: 1122–1129. https://doi.org/10.1016/j.joca.2015.02.021.

Williams, G. C., V. M. Grow, Z. R. Freedman, R. M. Ryan, and E. L. Deci. 1996. "Motivational Predictors of Weight Loss and Weight-Loss Maintenance." *Journal of Personality and Social Psychology* 70, no. 1: 115–126. https://doi.org/10.1037/0022-3514.70.1.115.

Williams, J. M., and M. B. Andersen. 1998. "Psychosocial Antecedents of Sport Injury: Review and Critique of the Stress and Injury Model." *Journal of Applied Sport Psychology* 10, no. 1: 5–25. https://doi.org/10.1080/10413209808406375.

Ying, X. 2019. "An Overview of Overfitting and its Solutions." *Journal of Physics: Conference Series* 1168: 022022. https://doi.org/10.1088/1742-6596/1168/2/022022.

Zech, A., K. Hollander, A. Junge, et al. 2022. "Sex Differences in Injury Rates in Team-Sport Athletes: A Systematic Review and Meta-Regression Analysis." *Journal of Sport and Health Science* 11, no. 1: 104–114. https://doi.org/10.1016/j.jshs.2021.04.003.

Supporting Information

Additional supporting information can be found online in the Supporting Information section.