

Concussion Nondisclosure in Youth Sports

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Context: Researchers conducting studies about sport-related concussion (SRC) reporting behaviors and reasons for nondisclosure primarily focus on older athletic populations. Youth athletes participating in contact sports are also at risk for SRC; however, little is known about their SRC disclosure patterns and reasons for nondisclosure.

Objective: To examine the self-reported SRC history and reasons for SRC nondisclosure of youth athletes aged 8–14 years.

Design: Cross-sectional study.

Setting: Youth athletes in organized football, ice hockey, lacrosse, or soccer.

Patients or Other Participants: A total of 411 youth athletes (boys = 70.0% [$n = 287/410$]; median age = 11 [interquartile range = 10–13] years).

Main Outcome Measure(s): A 15-minute survey including self-reported demographics, diagnosed and nondisclosed SRC history, and reasons for nondisclosure of suspected SRCs.

Results: Ten percent of respondents ($n = 41/411$) recounted ≥ 1 diagnosed SRC, 12.7% ($n = 52/411$) did not report a suspected SRC, 13.1% ($n = 53/404$) indicated they continued to practice, and 12.3% ($n = 50/406$) reported they continued to play

in a game after a suspected SRC. Significant associations between sport and nondisclosure existed (P values $< .001$) but not with self-reported concussion history ($P = .14$). In sex-comparable analyses, boys' lacrosse players had a higher frequency of nondisclosure than girls ($P = .05$). The most common reasons for nondisclosure were not wanting to lose playing time (66.7%, $n = 32/48$), miss a game (56.3%, $n = 27/48$), and let the team down (43.8%, $n = 21/48$) and uncertainty over injury severity and the presence of SRC (43.8%, $n = 21/48$).

Conclusions: Ten percent of youth athletes self-reported at least 1 diagnosed SRC. However, they also described continuing to practice or play in a game after a suspected SRC. Reasons for nondisclosure at this age were similar to those reported in high school and collegiate athletes. Recent researchers suggested negative consequences of continued play with SRC, especially in the acute stages. Anyone conducting future educational initiatives should emphasize these risks and focus on reasons why athletes of both sexes withhold reporting.

Key Words: brain injuries, children, football

Key Points

- Approximately 13% ($n = 52/411$) of youth contact-sport athletes indicated nondisclosure of a suspected sport-related concussion.
- A significant association was found between the current sport played and nondisclosure: the greatest percentage of nondisclosure was in football athletes (25.3%, $n = 23/91$).

Millions of youth athletes participate in sport each year, affording opportunities for positive long-term health outcomes.¹ However, athletic participation also poses the risk for injury. For example, 1.1 to 1.9 million sport- and recreation-related concussions occur annually in children ≤ 18 years of age in the United States.² Despite the many youth athletes participating in sport, most concussion researchers have focused on high school, collegiate, and professional athletes. Therefore, we have a limited understanding of concussion culture in younger athlete populations. Based on descriptive studies, investigators suggested that 30% of collegiate athletes^{3,4} and 30% to 46.3% of high school athletes^{5,6} reported a history of ≥ 1 concussions, yet little is known about the frequency of concussions in youth athletes participating in athletics below the high school level. Assessing and diagnosing concussions in youth athletes may be challenging for health care professionals, possibly due to various levels of

developmental ability and comprehension of health concepts.⁷ Additionally, consistent on-site sports medicine services in the youth sport setting are lacking, prompting parents and coaches to play a significant role in concussion recognition and immediate management. In fact, Wicklund and Coatsworth⁸ identified that youth athletes participating in middle school and high school sports most often reported a concussion to their mothers, fathers, and peers; however, less is known about youth athletes younger than middle school.

Since the enactment of the first law promoting early detection and immediate removal from play after a suspected head injury, each state has passed its own law requiring immediate removal from participation if a concussion is suspected, clearance to return to participation from a licensed health care professional, and concussion education for athletes, parents, and coaches.⁹ Still, most of these laws are limited to interscholastic athletics, with few

addressing youth athletes participating in club or recreational sport teams.¹⁰ To provide resources for this sport population, the Centers for Disease Control and Prevention developed the “Heads Up Concussion in Youth Sport” initiative, a free online course designed to increase awareness of preventing, recognizing, and responding to concussions in youth sports.¹¹ This national awareness initiative has had a positive influence on concussion knowledge in parents, coaches, and youth athletes,^{12,13} but it is unclear whether this increased knowledge translates to more favorable identification and disclosure practices. Furthermore, investigators¹⁴ highlighted a disconnect between health literacy and care-seeking behaviors such that an intervention aimed at increasing concussion knowledge did not yield improvements in concussion disclosure.

Although concussion nondisclosure and continuing to play with a head injury may increase the risk for prolonged recovery,¹⁵ 16% to 33% of collegiate athletes^{4,16} and 50% to 77% of high school athletes^{6,17,18} indicated not disclosing a suspected concussion to anyone. Moreover, approximately 31% of high school athletes stated they had knowledge of a teammate who did not report a possible concussion.¹⁹ Furthermore, differences in disclosure behaviors exist between sports and between older male and female athlete athletes,^{4,5,16} yet few researchers²⁰ have examined these differences in the disclosure behaviors of youth athletes. Collegiate¹⁶ and high school^{5,6,17,18} athletes continuously identify reasons for suspected concussion nondisclosure, with top motivations often relating to the perceived seriousness of the injury and their desire to remain in sport. Despite the existing literature regarding the frequency of and reasons for concussion nondisclosure in older athletes, a gap remains in our understanding of the magnitude of youth athlete concussion nondisclosure and their motivations for continuing to play with a concussion at this level. Accordingly, we aimed to describe the self-reported concussion history and nondisclosure in a sample of youth contact-sport athletes, including the common reasons youth athletes have not reported or would not report a suspected concussion. In addition, we compared sexes and sports in the frequency of self-reported concussion history and nondisclosure in youth athletes.

METHODS

Participants

We recruited a convenience sample of youth contact-sport athletes aged 8 to 14 years participating in youth football, ice hockey, lacrosse, and soccer organizations in Pennsylvania and Michigan. We obtained institutional review board approval from Duquesne University before data collection and acquired child assent and parental consent before survey administration.

Instrumentation

As part of a larger survey, participants disclosed demographic information, including age, sex, race, geographic location (ie, Pennsylvania, Michigan), and current sport participation.²¹ To gain an understanding of concussion history in this sample, we asked youth athletes if a doctor had ever told them they had a concussion from

playing sports (*yes* or *no*) and how many times that happened. Participants also responded to the following 3 questions regarding concussion nondisclosure behaviors: (1) “Do you think you have ever had a concussion and did not report it to anyone?” (*yes* or *no*), (2) “Have you ever thought you had a concussion but you still practiced?” (*yes*, *no*, or *I don’t know*), and (3) “Have you ever thought you had a concussion but you still played in a game?” (*yes*, *no*, or *I don’t know*). We did not provide a formal definition of *concussion*, as a major aim of the larger study was to determine the knowledge of concussion in youth athletes. We also assessed motivations for concussion nondisclosure by presenting a list of items, prompting youth athletes to select all that applied. For participants who indicated *yes* to not disclosing a previous concussion, we asked them to select from a list of reasons why they did not report their suspected concussion(s) to anyone. For those who did not indicate a history of concussion nondisclosure, we asked them to select why they thought they would not report a suspected concussion to anyone. These methods were originally developed by Register-Mihalik et al,¹⁷ and to ensure reading comprehension, one author (A.J.S.), a youth reading disability expert and psychologist, adapted the language of the youth athlete survey from a recent study of disclosure behaviors in collegiate athletes.⁴

Procedures

We distributed a survey to examine concussion knowledge, attitudes, and reporting behaviors as part of a larger investigation of youth athletes, and we focused on nondisclosure in youth athletes. The research team coordinated meetings with local youth sport league administrators and team coaches to describe the study aims and gain approval for survey distribution. We provided educational interventions to interested organizations after survey administration. On-site survey administration occurred between October 2017 and January 2019 at team meetings, practices, and competitions. Participants completed paper-and-pencil surveys under the direction of a trained research team member to ensure that their responses were supplied independently and to clarify any questions regarding the survey. The survey took approximately 15 to 20 minutes to complete. Members of the research team recorded all participant survey responses in Qualtrics.

Statistical Analysis

We used descriptive statistics, including frequencies and percentages or medians and interquartile ranges (IQRs), to describe our sample’s age, sex, race and ethnicity, geographic location, and current sport participation. Similarly, we calculated frequencies and percentages to describe youth athletes’ concussion history and nondisclosure behaviors. We also inquired about concussion nondisclosure history for those with and those without a self-reported concussion history. We separately determined the association between the current sport and each self-reported concussion outcome (eg, self-reported diagnosed concussion history and concussion nondisclosure history) using the Fisher exact test, as expected cell counts were <5. Furthermore, we determined the association between sex and each self-reported concussion outcome within each sport (eg, boys’ soccer versus girls’ soccer) using the Fisher

Table 1. Participant Characteristics

Characteristic	Values
Age, median (interquartile range), y (n = 401)	11 (10, 13)
Sex, male (n = 410)	287 (70.0)
Sport, No. (%) (n = 408)	
Football	91 (22.3)
Boys' soccer	73 (17.9)
Girls' soccer	37 (9.1)
Boys' ice hockey	77 (18.9)
Girls' ice hockey	30 (7.3)
Boys' lacrosse	52 (12.7)
Girls' lacrosse	48 (11.8)
Race or ethnicity, No. (%) (n = 409)	
White, non-Hispanic	370 (90.5)
Black, non-Hispanic	8 (2.0)
Hispanic or Latino	10 (2.4)
Asian	5 (1.2)
American Indian or Alaskan Native	2 (0.5)
Other	14 (3.4)
State, No. (%) (n = 411)	
Pennsylvania	255 (62.0)
Michigan	156 (38.0)

exact test. Finally, we computed the frequencies and percentages of reasons for not reporting a concussion separately among athletes with and those without a history of nondisclosure. The statistical analysis was completed with Stata (version 16.0; StataCorp), and significance was set a priori at $P \leq .05$.

RESULTS

A total of 411 youth sport athletes, with a median age of 11 years (IQR = 10–13 years), completed the study survey. Most participants were boys (70.0%), from Pennsylvania (62.0%), and self-identified as White, non-Hispanic (90.5%). We present additional demographic information in Table 1.

Concussion History and Reporting Behaviors

Overall, most youth sport athletes (90.0%) self-reported no previously diagnosed concussion, and 10% self-reported a history of ≥ 1 previous concussions. For concussion nondisclosure, 12.7% of youth athletes indicated they thought they had a concussion that they did not report to anyone. In Table 2, we outline complete information related to the self-reported diagnosed concussion history and concussion nondisclosure overall and for practices and games. We show the self-reported diagnosed concussion history stratified by nondisclosure history in Table 3. The proportion of youth athletes' self-reported concussion history and concussion nondisclosure in each sport is displayed in Figure 1. We found no significant association between sport and self-reported diagnosed concussion history ($P = .14$). However, significant associations between sport and concussion nondisclosure existed (P values $< .001$): football athletes had the highest frequency of nondisclosure and girls' lacrosse athletes had the lowest frequency. When considering sex-comparable sports, we observed that a greater proportion of boys' lacrosse athletes (17.3%) than girls' lacrosse athletes (4.2%) acknowledged concussion nondisclosure ($P = .05$). No other significant within-sport associations were present between sex and

Table 2. Youth Athlete Self-Reported Diagnosed and Nondisclosed Concussion History

Reporting Behavior	No. (%)
Diagnosed concussion history (n = 411)	
0	370 (90.0)
1	28 (6.8)
2+	13 (3.2)
Do you think you have ever had a concussion and did not report it to anyone? (n = 411)	
Yes	52 (12.7)
No	359 (87.3)
Have you ever thought you had a concussion but you still practiced? (n = 404)	
Yes	53 (13.1)
No	251 (62.1)
I don't know	100 (24.8)
Have you ever thought you had a concussion but you still played in a game? (n = 406)	
Yes	50 (12.3)
No	260 (64.0)
I don't know	96 (23.7)

self-reported concussion history or nondisclosure (P values $> .05$).

Reasons for Nondisclosure

Of the youth athletes who indicated nondisclosure (n = 48), the most common reasons for not reporting a suspected concussion were the following: "I did not want to lose playing time" (n = 32, 66.7%), "I did not want to miss a game" (n = 27, 56.3%), and "At the time I did not think it was a concussion" (n = 26, 54.2%; Figure 2). Youth athletes who did not report nondisclosure (n = 330) had similar responses, with the following most common reasons why they would not report: "I did not want to lose playing time" (n = 184, 55.8%), "I did not think it was a concussion" (n = 178, 53.9%), and "I did not want to miss a game" (n = 152, 46.1%; Figure 3).

DISCUSSION

We evaluated self-reported diagnosed concussion history in a sample of youth sport athletes and were the first to assess concussion nondisclosure in this population. We identified that 10.0% of youth sport athletes aged 8 to 14 years old had a history of diagnosed sport-related concussion (SRC) and 12.7% reported (a) previous instance(s) of concussion nondisclosure during sport participation. Furthermore, we found a significant association between concussion nondisclosure and the youth athletes' current sport participation: football athletes indicated the greatest percentage of nondisclosure, but no association occurred between sport and diagnosed concus-

Table 3. Concussion Nondisclosure History for Youth Athletes Without and Those With a Self-Reported Concussion History

History of Diagnosed Concussion(s)?	History of Concussion Nondisclosure(s)?	No. (%)
No	No	334 (81.2)
No	Yes	36 (8.8)
Yes	No	25 (6.1)
Yes	Yes	16 (3.9)

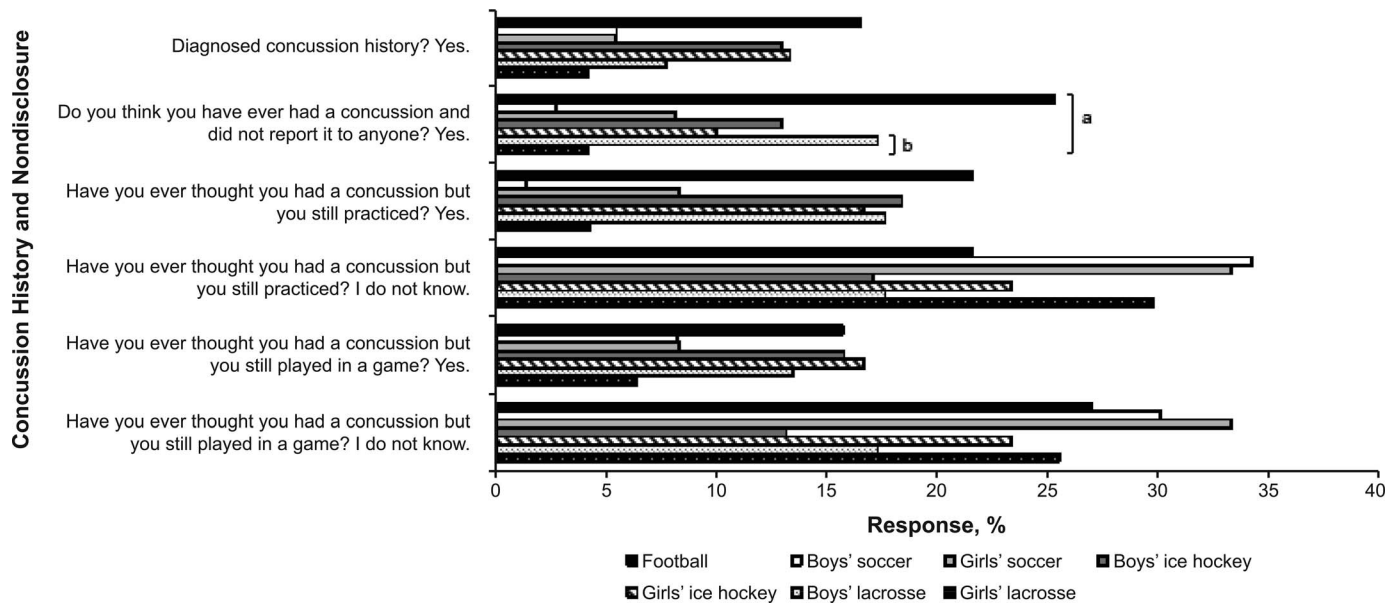


Figure 1. Self-reported concussion history and concussion nondisclosure among youth athletes by sport. ^a $P < .001$. ^b $P = .05$.

sion history. Additionally, the top reasons for concussion nondisclosure in our sample were related to removal from participation and athletes not understanding that their injury was a possible concussion. These foundational results may be useful for directing the development of future population-specific awareness and management initiatives geared toward promoting a supportive concussion reporting culture at the youth sport level.

It is unsurprising that a small proportion of youth athletes participating in contact sports reported a history of concussion. Previous researchers suggested that 30.0% of

collegiate athletes self-reported an SRC history,³ and in high school, the percentage of athletes with a self-reported concussion history was lower, as 23.7% noted a history of ≥ 1 diagnosed concussions.⁵ Compared with those studies, our frequency of youth athletes self-reporting previous concussion(s) was considerably lower, namely, 10%. Potential explanations for this lower percentage at the youth level include exposure, as youth athletes have had less time to participate in a given sport than older athletes. In addition, youth sport athletes may spend more time practicing and emphasizing fundamental skill development

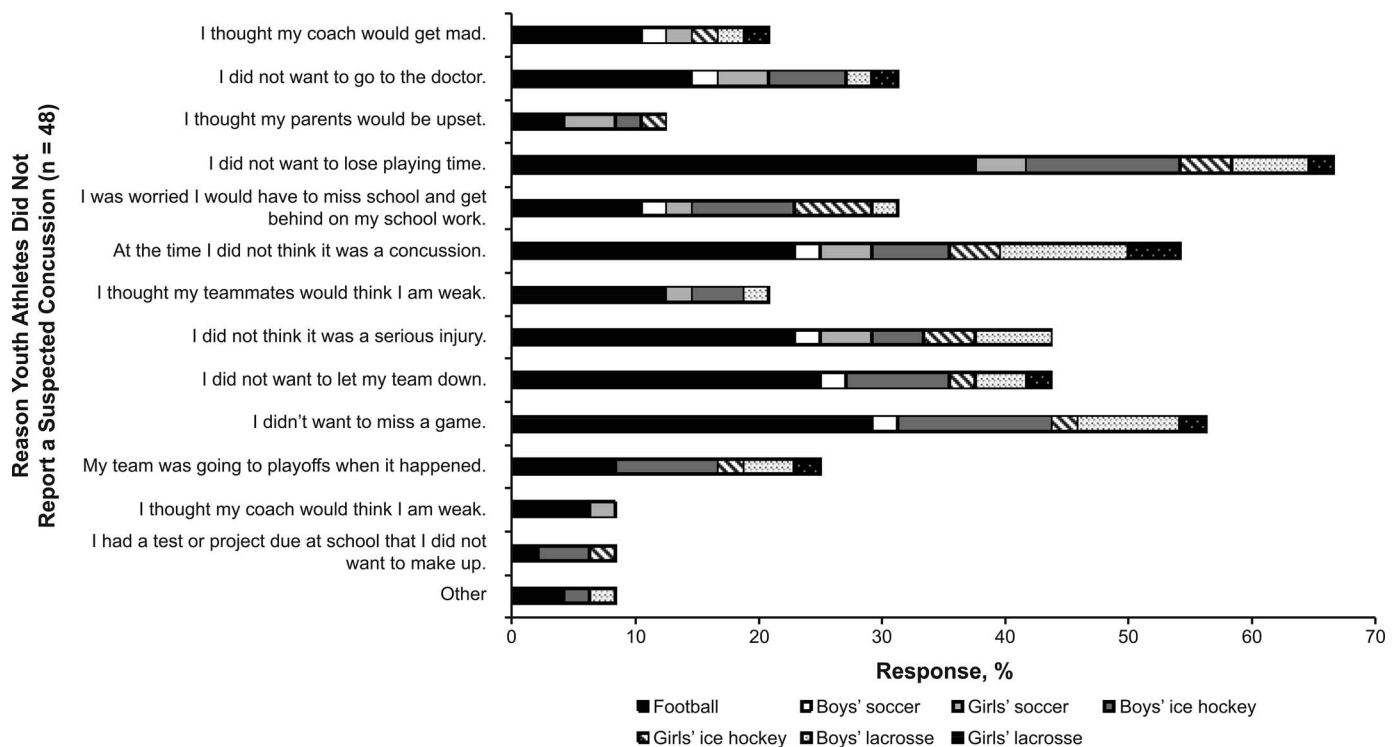


Figure 2. Reasons for concussion nondisclosure reported overall and by sport among athletes indicating a history of nondisclosure.

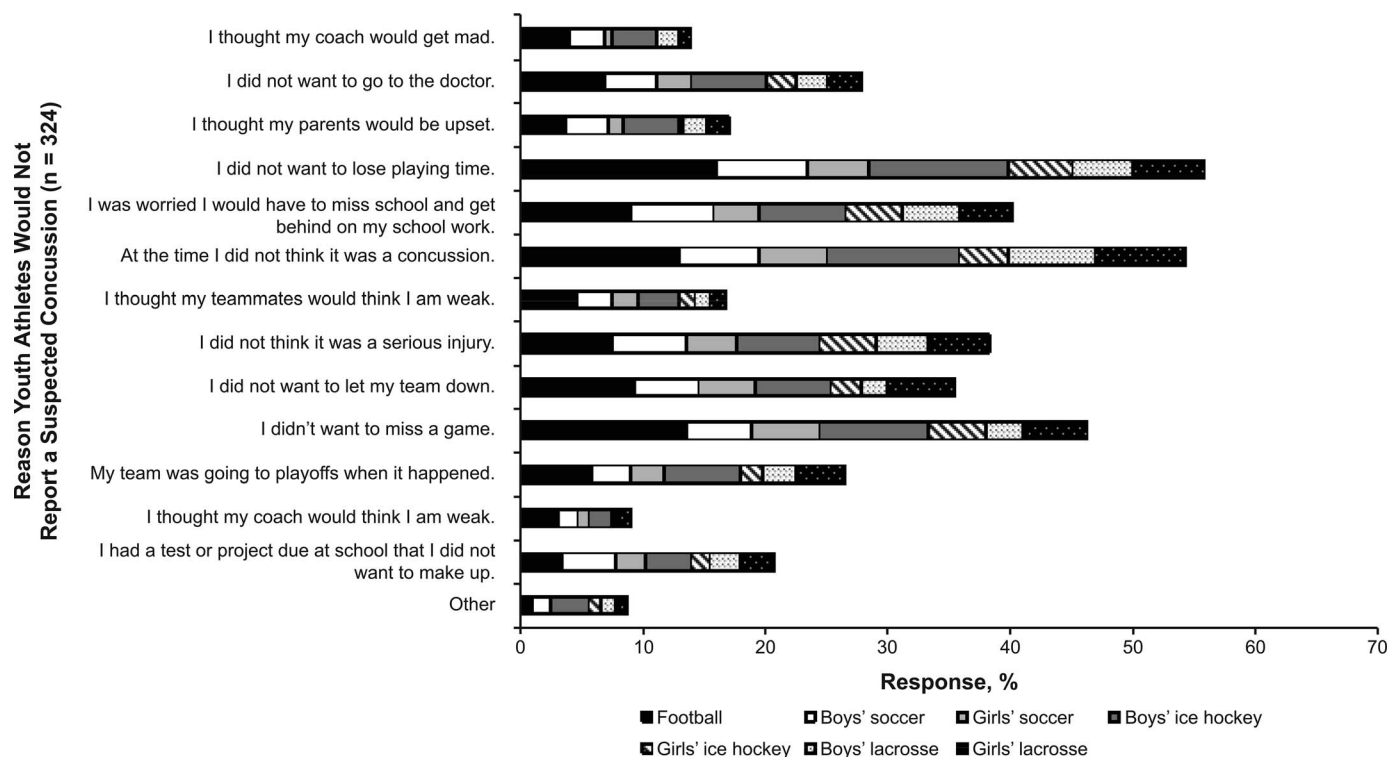


Figure 3. Reasons for concussion nondisclosure reported overall and by sport among athletes without a history of nondisclosure.

versus older athletes participating in activities at higher risk for concussion. Furthermore, youth athletes may have different concussion knowledge and attitudes than older athletes^{20,22} because youth athletes may not have had equal educational opportunities and may not fully understand the injury. Also, younger athletes more often report their suspected concussion to their parents, who receive less concussion-specific training, whereas older high school athletes more often report to coaches and athletic trainers.⁸ Therefore, the recipients of disclosure may also influence the concussion diagnosis, especially in younger athletes. Importantly, despite initial investigations of athletic injury at the youth level,²³ more investigations of the epidemiology of injury in youth sports would add to our understanding of the burden of concussion in youth athletes and direct preventive efforts in this setting.

Beyond self-reported concussion history, with the results of this study, we suggest that approximately 13% of youth contact-sport athletes had a history of concussion nondisclosure. More specifically, 13.1% described still participating in a practice and 12.3% acknowledged still participating in a game with a suspected concussion. In the collegiate setting, these percentages were reported as 23.8% and 24.7% for nondisclosure in practices and games, respectively.³ These findings are clinically meaningful, as athletes who continue to participate in their sport with a suspected concussion may demonstrate worse outcomes.²⁴ For example, researchers determined^{15,25} that athletes exhibited shorter symptom durations and more rapid recoveries from concussion if they did not delay reporting their symptoms and were immediately removed from participation. Thus, our findings of concussion nondisclosure behaviors among young athletes should motivate the development of awareness initiatives that specifically highlight the impor-

tance of immediate recognition and removal from play. Furthermore, on-site sports medicine health care resources can critically influence the recognition of suspected concussions. For instance, McGuine et al²⁶ observed a higher rate of concussion identification and diagnosis in high schools that employed athletic trainers, who are allied health professionals trained to properly recognize and manage concussion. Wallace et al¹⁸ demonstrated that athletes at schools with access to athletic trainers had greater concussion knowledge than those without. Therefore, a mechanism to improve concussion recognition may be to increase the presence of sports medicine personnel at this level of participation, as some researchers²⁷ suggested that concussions remain underreported or missed in the absence of trained health care professionals at sporting events. Disparities in access to athletic training and medical services are being studied in secondary schools²⁸; however, a critical knowledge gap exists regarding appropriate medical coverage in youth sports to aid in the recognition, management, and prevention of athletic injuries.

In our study, the greatest percentage of nondisclosure occurred in boys' sports. A total of 25.3% of football athletes, followed by 17.3% of boys' lacrosse athletes and 13.0% of boys' ice hockey athletes, indicated nondisclosure. However, notably, the sample was heavily weighted toward male athletes. Additionally, the frequency of nondisclosure was highest in sports with the highest rates of concussion epidemiologically.^{29,30} Hence, the sports with the highest rates of concussion were also the highest in nondisclosure, reflecting the unknown true incidence of concussion. The only significant difference among individual sport comparisons between boys and girls was in lacrosse, as a greater percentage of boys (17.3%) reported nondisclosure than girls (4.2%). This result aligns with

previous findings, which showed that girls had more favorable reporting intentions³¹ and were more likely to disclose suspected concussions.^{3,5} Also, girls' and boys' lacrosse are stylistically diverse, with different levels of contact, rules, and equipment, which may explain differences in injury occurrence and nondisclosure between the sexes. In contrast, among our sample of soccer athletes, the percentage of boys reporting nondisclosure was lower than that of girls, although the lack of significant differences may have been due to the small sample size, indicating that continued research is needed for male and female comparisons in youth sports. Girls participating in soccer displayed higher concussion rates than boys³²; however, recent investigators^{32,33} identified that young boys with a concussion had greater odds of immediate removal from play. More work in this area is needed, but the aforementioned studies in which investigators examined the benefit of appropriate on-site medical coverage in detecting concussion may aid in mitigating concussion nondisclosure, especially in the youth sport setting. Overall, based on these results, we conclude that nondisclosure by male athletes participating in contact sports (especially football) may be more frequent than in female athletes. Therefore, early interventions at this youth level may cultivate a more favorable reporting culture while athletes are young.

We also provide insight into why youth athletes did not or may not report a suspected concussion. Of our athletes who indicated previous concussion nondisclosure, 2 of the most common reasons related to lost playing time (66.7%) and missing a game (56.3%). However, researchers of the aforementioned studies identified the benefits of early detection and removal, specifically shorter symptom resolution time and less time out of sport with immediate removal.^{15,24,25} The third most common reason for nondisclosure was not thinking it was a concussion (54.2%). Importantly, many authors^{4,6,17,18,20} suggested that increased knowledge does not always translate to increased reporting intentions; yet the foundational knowledge about concussion must also exist. We also present these percentages for reasons of nondisclosure by sport; still, due to the large proportion of nondisclosure in our football sample, youth athletes playing football dominated the reasons for nondisclosure responses. Our results are similar to those of a preliminary study of high school athletes,¹⁷ whose most common reasons for not reporting a concussion were that they did not think it was serious enough (70.2%), did not want to be removed from the game (36.5%), and did not want to let the coaches or teammates down (23.0% and 27.0%, respectively). Also, approximately 15% of the high school sample did not know they sustained a concussion.¹⁷ Notably, the eras (2008–2010 versus 2017–2019) of data collection in these studies reflected the fluidity of concussion awareness and management in recent years. Nonetheless, we think these discrepancies also indicate that different approaches may be needed when targeting high school versus youth athletes' nondisclosure practices, as the latter may not recognize the injury as a concussion and the former may not think it is serious enough to report. Even at the collegiate level, football athletes underestimate the risk of concussion,³⁴ emphasizing the importance of on-site medical coverage at every level of athletic participation.

In addition, the cumulative exposure to head impacts that may cause concussion is inherently less in youth sports, whose exposure is limited by the overall time in sport, than in older, more experienced athletes. Accordingly, we also described reasons why an athlete would not disclose a concussion. We found similarities in the top 3 reasons for nondisclosure in this sample: lost playing time, missing a game, and not thinking it was a concussion. We also observed more heterogeneity broken down by sport, which we attributed to the large sample of included sports. Importantly, Chandran et al²⁰ recently determined that high school athletes displayed greater concussion knowledge and greater perceived seriousness than middle school athletes; however, self-reporting intentions and positive feelings about self-reporting did not differ. As such, investigators are continuing to study ways of improving concussion reporting, given that improving subjective norms and reporting confidence,³⁵ reducing reporting barriers and emphasizing the benefits related to concussion reporting,³⁶ and increasing exposure to concussion education³⁷ may positively influence concussion reporting and care-seeking behaviors.

Limitations

This study had some limitations. Our participants were limited to a convenience sample of youth athletes involved in select contact sports (football, ice hockey, lacrosse, and soccer) in only 2 states. In addition, our sample was primarily composed of White youth sport athletes. Furthermore, for post hoc comparisons (eg, individual sport comparisons), our sample size was very small. Thus, future researchers examining the scope of self-reported concussion history and reporting behaviors should include a larger and more diverse sample of youth sport athletes. Moreover, our analyses were limited to self-reported concussion history and self-reported history of nondisclosure. Although we did not have records of medically documented concussions, as part of the larger survey, we identified substantial agreement between parent-reported and youth athlete self-reported concussion history, suggesting that the young athletes in this study accurately described their concussion history.³⁸ Notably, we did not provide a formal definition of *concussion*, as a major aim of the larger study was to determine knowledge of concussion in youth athletes, thereby leaving athletes to interpret their previous concussion experiences without a clear operational definition. Future authors using a medical definition of *concussion* may increase the number of recalled concussions, as earlier researchers³⁹ found more self-reported previous concussions after participants were provided with a medical definition. Also, including colloquial terms to describe concussions, especially in youth athletes, might be useful as these terms may minimize the injury in health care practice and enhance understanding. Reasons for nondisclosure were limited to a select list developed from a previously validated survey. To gain a deeper understanding as to why nondisclosure practices exist in this athletic setting, future investigators should use mixed-method approaches and assess the lived experiences of youth athletes. Moreover, although we recorded reasons why an athlete would not report, the full intent to not disclose was not addressed. As such, these results should not be

interpreted as meaning that all athletes may not disclose in the future. Instead, the common reasons why an athlete might not report a suspected concussion may inform educational interventions at earlier ages while motivating athletes to disclose suspected concussions in the future.

CONCLUSIONS

With the findings from our novel study, we have provided evidence that episodes of concussion nondisclosure occurred in athletes as young as 8 to 14 years old. The highest concussion nondisclosure percentages were in football, but nondisclosure was reported in all youth sports sampled. These discoveries alone are red flags that immediate intervention is needed at this level of play. The reasons why these youth athletes did not or may not report a concussion are consistent with the results from other athlete samples. Ultimately, the desire to remain in the game is a universal barrier that must be overcome to minimize concussion nondisclosure. Setting a strong foundation of understanding regarding the importance of immediately seeking medical care for a concussion at the youth level may produce more favorable injury reporting intentions as athletes advance to the next level of sport competition. It would be ideal to provide on-site sports medicine coverage for all individuals participating in sports, but this is not a foreseeable reality for most youth sport organizations due to a lack of financial resources. Thus, we must first alert adult stakeholders that youth athletes are already making poor concussion reporting decisions that could significantly affect their ability to thrive on and off the field. We also need to provide stakeholders, including youth athletes, parents, coaches, and referees, with stronger avenues for acquiring the knowledge and skills needed to recognize concussions quickly, so that removal from play occurs as soon as possible. Accordingly, those involved in future concussion awareness approaches in youth sport settings should engage target audiences with active learning interventions and incorporate evidence-based information.

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