RESEARCH REVIEW

CE 1.5 ANCC Contact Hours

A Systematic Review of Barriers and Facilitators for Concussion Reporting Behavior Among Student Athletes

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ABSTRACT

Despite increasing attention to concussion safety, many young athletes still do not report concussion-like symptoms to athletic staff. This systematic review was conducted to identify barriers and facilitators to reporting of concussions by high school and collegiate athletes. The review was conducted using PubMed, SCOPUS, CINAHL Complete, and Cochrane Library. Original research articles were deemed eligible if they contained either qualitative or quantitative data on barriers and facilitators of high school and collegiate athletes self-reporting concussion symptoms to athletic staff. For those articles that met inclusion criteria, both authors critically read each article, summarized reasons given by the authors, and then categorized this information into a barrier or a facilitator of concussion-reporting behavior. Of the 878 articles returned, 24 articles met inclusion criteria. Major facilitators were female sex and younger age. Major barriers were a fear of losing current or future playing time, a misconception that concussive injury is not serious, a fear of letting one's team down, and a lack of knowledge of concussion signs and symptoms. Future interventions should address these issues, incorporate primary and secondary prevention strategies, and emphasize the long-term risks of playing while concussed.

Key Words

Athlete, Concussion, Mild traumatic brain injury, Reporting behavior

Although it is commonly estimated that between 1.1 million and 1.9 million sports-related concussions occur in U.S. youth each year, many of these are not reported (Bryan, Rowhani-Rahbar, Comstock, Rivara, & Seattle Sports Concussion Research Collaborative, 2016). Accurate and prompt reporting behavior is imperative, as a diagnosis is largely dependent on self-reported symptoms. Symptoms may vary in their quality and severity but frequently include headache, confusion, reduced coordination, dizziness, and ringing in the ears. To date, more objective biomarkers of concussion remain elusive (Kim, Tsao, & Stanfill, 2018).

Although there are studies that measure coaches', athletic trainers', and athletes' knowledge of concussion symptoms (Kaut, DePompei, Kerr, & Congeni, 2003; Naftel, Yust, Nichols, King, & Davis, 2014; Torres et al., 2013; White et al., 2014), some studies show that despite an adequate knowledge base, concussion symptoms are still minimized or unreported (Anderson, Gittelman, Mann, Cyriac, & Pomerantz, 2016; Kurowski, Pomerantz, Schaiper, Ho, & Gittelman, 2015). If the athlete continues to play while injured, this may place the athlete at risk for further injury or possible long-term sequelae. At the very least, a failure to be immediately removed from athletic activity when concussed predicts a prolonged recovery trajectory (Asken et al., 2016). Underreporting behaviors have been shown to be especially common among high school (McDonald, Burghart, & Nazir, 2016; Register-Mihalik, Guskiewicz, et al., 2013) and collegiate athletes (Meier et al., 2015). Although education about concussions, coaches' attitudes, and social norms have been shown to be associated with concussion-reporting behaviors in secondary school athletes, these factors are tempered by the availability of medical professionals and a fear of not letting people down (Kay, Welch, & Valovich McLeod, 2015). Other factors may also be found to play a role for both high school and collegiate athletes, given the recent explosion in concussion literature on such topics.

The purpose of this systematic review was to describe barriers and facilitators for concussion reporting among high school and college athletes. The goal of this work was to enhance our knowledge of these factors in order to design more effective interventions that will then increase reporting behavior for these athletes.

METHODS

A systematic review was completed using PubMed, SCOPUS, CINAHL Complete, and Cochrane Library to better

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identify barriers and facilitators to reporting of concussions by high school and collegiate student athletes. Search terms included "concussion" OR "mild traumatic brain injury" AND "athlete." These were combined with the terms "self-report," OR "reporting," OR "reporting behavior." Other terms were used early on in the development of this systematic review, including "brain injury," "traumatic brain injury," and "*report*" (allowing for wildcards on either end that would include unreported/unreporting/nonreported/nonreporting), but these were not found to be precise enough for our research question and returned many results on more severe forms of traumatic brain injury. Results were limited to those published in English and to studies using human subjects. Original research articles were deemed eligible if they contained either qualitative or quantitative data on facilitators and barriers of high school and collegiate athletes self-reporting concussion symptoms to athletic staff (defined for our purposes as any adult acting in an official capacity on behalf of the athletic team). Specific reasons must have been stated in the article for either reporting or not reporting these symptoms, although no particular symptom or category of symptom (i.e., physical, cognitive, or emotional) of concussion weighed more heavily than any other. Rather, the focus for our review was on an athlete having any possible symptom of concussion and then reporting or not reporting that information to athletic staff. Furthermore, an intention or attitude related to reporting was not sufficient; only the actual act of reporting was considered sufficient for inclusion in this review as this is what will decrease playing while injured and will enable the athlete to get proper medical attention. The search was deemed complete on October 10, 2018. After duplicates were removed, the reference lists of articles included in this review were searched for other relevant articles, and more recent studies were identified through a reverse-citation search on Google Scholar.

RESULTS

The aforementioned search parameters resulted in 878 articles from which 24 met criteria to be included in this review. During the screening phase, the majority of articles (827) were eliminated for the following reasons (most to least common): did not measure reasons for reporting or not reporting to athletic staff; population was not high school or collegiate athletes; article was a review article; article discussed only the likelihood of experiencing a particular symptom; study was not performed in human subjects; and publication was in a language other than English. For a PRISMA-style diagram of the included articles and a brief description of those that were screened but removed during the eligibility phase, see Figure 1 (Liberati et al., 2009).

The authors critically read each article and summarized reasons for reporting or not reporting concussive symptoms to athletic staff. For each reason, the authors categorized this into a barrier or a facilitator of concussion-reporting behavior. The summary of these reasons is included in Table 1 and further described later.

Facilitators

Demographic characteristics may contribute to concussion-reporting behaviors. Female sex was the most common facilitator for reporting symptoms of concussion to athletic staff (Cusimano et al., 2017; Kurowski, Pomerantz, Schaiper, & Gittelman, 2014; Miyashita, Diakogeorgiou, & VanderVegt, 2016; Wallace, Covassin, & Beidler, 2017), whereas younger age (Baugh, Kroshus, Daneshvar, & Stern, 2014; Davies & Bird, 2015; Kurowski et al., 2014) and participation in soccer (Kurowski et al., 2014) were other facilitators for reporting behavior. Increased knowledge of potential long-term effects of untreated concussion was cited in three studies (Chrisman, Quitiquit, & Rivara, 2013; Kurowski et al., 2014; Lininger, Wayment, Huffman, Craig, & Irving, 2017). Two studies discussed that having a medical professional present at the time of the injury may increase reporting behavior (Delaney, Lamfookon, Bloom, Al-Kashmiri, & Correa, 2015; Register-Mihalik, Linnan, et al., 2013).

Barriers

The most common barrier to reporting of concussion symptoms by student athletes was a fear of losing current or future playing time. This was cited in the majority (16/24) of included studies (Chinn & Porter, 2016; Chrisman et al., 2013; Davies & Bird, 2015; Delaney et al., 2015; Donnell, Hoffman, Sarmiento, & Hays, 2018; Kerr, Register-Mihalik, Kroshus, Baugh, & Marshall, 2016; Kroshus, Baugh, Daneshvar, & Viswanath, 2014; LaRoche, Nelson, Connelly, Walter, & McCrea, 2016; Llewellyn, Burdette, Joyner, & Buckley, 2014; McCrea, Hammeke, Olsen, Leo, & Guskiewicz, 2004; McDonald et al., 2016; Miyashita et al., 2016; Register-Mihalik, Guskiewicz, et al., 2013; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, Gould, & Kovan, 2017a, 2017b). Other common barriers were that the student athletes did not feel that their injury was serious (n = 15 studies; Chinn & Porter, 2016; Cusimano et al., 2017; Davies & Bird, 2015; Delaney et al., 2015; Donnell et al., 2018; Kerr et al., 2016; LaRoche et al., 2016; Llewellyn et al., 2014; McCrea et al., 2004; McDonald et al., 2016; Miyashita et al., 2016; Register-Mihalik, Guskiewicz, et al., 2013; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, et al., 2017a, 2017b), they did not want to let their team down (n = 14 studies; Anderson et al., 2016; Chrisman et al., 2013; Davies & Bird, 2015; Delaney et al., 2015; Donnell et al., 2018; Kerr et al., 2016; Kroshus

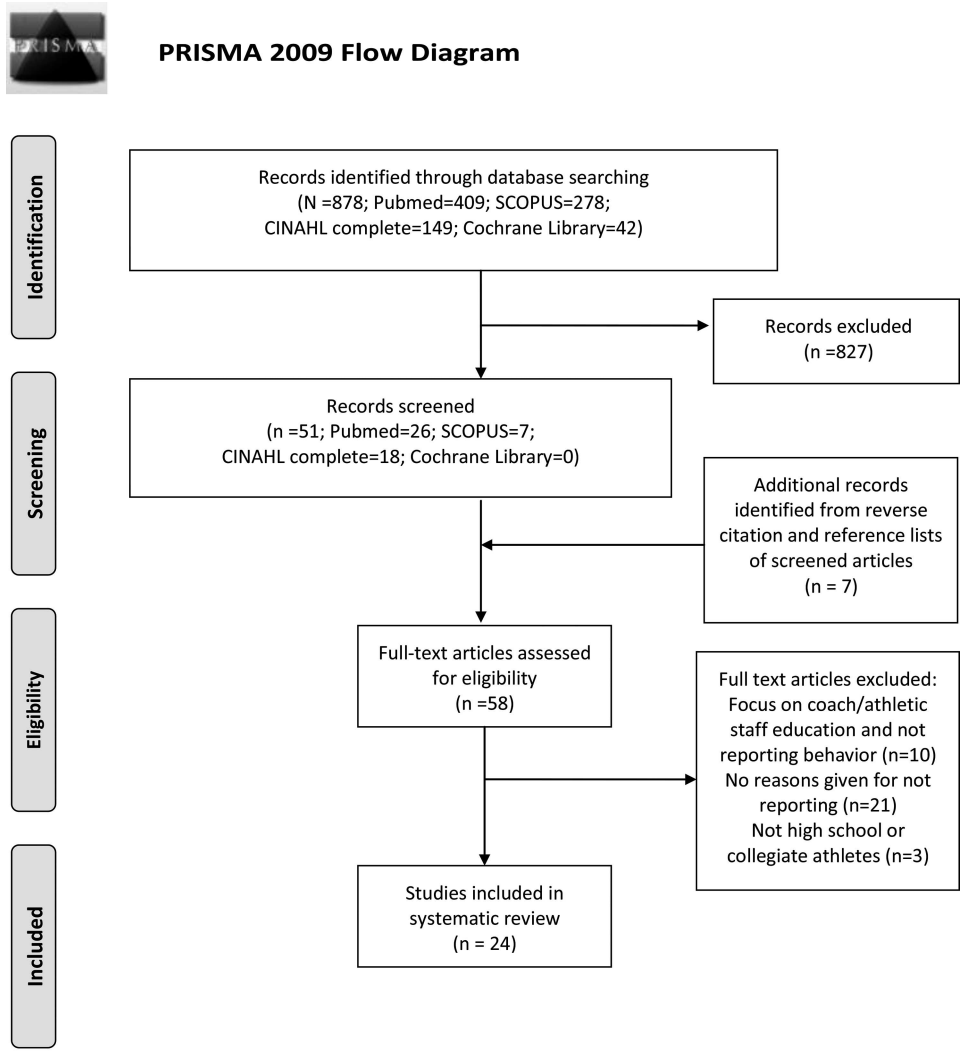

Figure 1. PRISMA diagram of included and excluded studies (http://www.prisma-statement.org). From "The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration," by A. Liberati, D. G. Altman, J. Tetzlaff, C. Mulrow, P. C. Gotzsche, J. P. Ioannidis, … D. Moher, 2009, PLoS Medicine, 6(7), p. e1000100.

et al., 2014; Lininger et al., 2017; Llewellyn et al., 2014; McCrea et al., 2004; Register-Mihalik, Guskiewicz, et al., 2013; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, et al., 2017a, 2017b), or they were not sure that the injury was a concussion (n = 13 studies; Chinn & Porter, 2016; Chrisman et al., 2013; Cusimano et al., 2017; Davies & Bird, 2015; Kerr et al., 2016; Lininger et al., 2017; Llewellyn et al., 2014; McCrea et al., 2004; McDonald et al., 2016; Register-Mihalik, Guskiewicz, et al., 2013; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, et al., 2017a, 2017b). Some form of external pressure to not report was mentioned in many studies (Chinn & Porter, 2016; Chrisman et al., 2013; Cusimano et al., 2017; Delaney et al., 2015; Donnell et al., 2018; Kroshus et al., 2014; Kroshus, Kubzansky, Goldman, & Austin, 2015; Lininger et al., 2017; Register-Mihalik, Guskiewicz, et al., 2013). This pressure were attributed to teammates, coaches, fans, or parents (Chinn & Porter, 2016; Chrisman et al., 2013; Cusimano et al., 2017; Delaney et al., 2015; Donnell et al., 2018; Kroshus et al., 2014; Kroshus et al., 2015; Lininger et al., 2017; Register-Mihalik, Guskiewicz, et al., 2013). Other studies reported that student athletes stated that they did not want to be seen as "weak" or that they felt that it was embarrassing to report a concussive injury (n = 7 studies; Chrisman et al., 2013; Cusimano et al., 2017; Donnell

TABLE 1 Facilitators and Barriers to Reporting of Sports-Related Concussion Among High School and Collegiate Athletes

	Anderson et al. (2016)	Baugh et al. (2014)	Chinn and Porter (2016)	Chrisman et al. (2013)	Cusimano (2017)	Davies and Bird (2015)	Delaney et al. (2015)	Donnell et al. (2018)	Kerr et al. (2016)	Kroshus et al. (2015)
Study characteristic										
N	120	717	986	50	31	193	469	1,005	797	116
Sex of participants	100% male	100% male	76% male	60% male	82% male	70% male	68.7% male	52.4% male	65.9% male	100% male
Type of school	High school	High school	Collegiate	High school	High school	Collegiate	Collegiate	High school	Collegiate	Collegiate
Sport studied	Football	Football	Football Soccer Volleyball Water polo	Football Soccer	Hockey	Football Soccer Baseball Softball Basketball Cheerleading	Hockey Football Soccer Basketball Rugby	Not given	Football Soccer Lacrosse	Hockey

Study characteristic	Kroshus et al. (2014)	Kroshus et al. (2015)	Kurowski et al. (2014)	LaRoche et al. (2016)	Lininger et al. (2017)	Llewellyn et al. (2014)	McCrea et al. (2004)	McDonald et al. (2016)	Miyashita et al. (2016)	Register-Mihalik, Guskiewicz, et al. (2013)	Register-Mihalik, Linnan, et al. (2013)	Wallace, Covassin, & Beidler (2017)	Wallace, Covassin, Nogle, et al. (2017a)	Wallace, Covassin, Nogle, et al. (2017b)
	256	328	496	2013 portion: 784 1999–2002 portion: 1,532	11	161	1,532	77	454	167	167	288	715	715
	100% male	47% male	77.4% male	92.9% male	100% male	43.5% male	100% male	0% male	53.3% male	58.1% male	58.1% male	68.8% male	70.3% male	70.3% male
	Collegiate	Collegiate	High school	High school and collegiate	Collegiate	Collegiate	High school	High school	High school	High school	High school	High school	High school	High school
	Hockey	Soccer Lacrosse Baseball Softball Basketball Volleyball Field hockey	Football Soccer Basketball Wrestling	Football Soccer Lacrosse Rugby	Football	Football Soccer Lacrosse Baseball Softball Basketball Cheerleading Volleyball Field hockey Tennis Golf Ice hockey Rowing Skiing Cross country	Football	Soccer Softball Basketball Cheerleading Volleyball Tennis Cross country Track Dance Equestrian Swimming Gymnastics Bowling Motocross	Football Soccer Lacrosse Basketball Volleyball Cheerleading Wrestling Volleyball	Football Soccer Lacrosse Cheerleading	Football Soccer Lacrosse Cheerleading	Football Soccer Basketball Volleyball Wrestling	Football Soccer Basketball Cheerleading Volleyball Wrestling	Football Soccer Basketball Cheerleading Volleyball Wrestling

(*continues*)

TABLE 1 Facilitators and Barriers to Reporting of Sports-Related Concussion Among High School and Collegiate Athletes (*Continued*)

	Anderson et al. (2016)	Baugh et al. (2014)	Chinn and Porter (2016)	Chrisman et al. (2013)	Cusimano (2017)	Davies and Bird (2015)	Delaney et al. (2015)	Donnell et al. (2018)	Kerr et al. (2016)	Kroshus et al. (2015)
Study characteristic										
Study instruments	◆ Rosenbaum Concussion Knowledge And Attitude Survey Student Edition (fixed response) ◆ Survey created by study team (fixed response)	Survey created by study team (fixed response, with open-ended questions regarding number of concussions etc.)	◆ Rosenbaum Concussion Knowledge and Attitude Survey Student Edition (fixed response) ◆ Qualitative interviews (open-ended questions)	Focus groups (open-ended questions)	Qualitative interviews (open-ended questions)	Adapted from McCrea 2004 survey (fixed response)	Survey created by the study team (fixed response)	Youth styles survey (fixed response)	Adapted from McCrea 2004 survey (fixed response)	◆ Concussion Knowledge Index portion of the Rosenbaum Concussion Knowledge and Attitude Survey Student Edition (fixed response) ◆ Adapted from Rosenbaum and Arnett's Concussion Attitudes Index (fixed response) ◆ Question on the number of diagnosed concussions (fixed response) ◆ Kaut Head Injury Questionnaire, with symptom reporting item modified (fixed response) ◆ Athletic Identity Measurement Scale modified by Brewer and Cornelius (fixed response)
Facilitator										
Female sex					✓					
Younger age		✓				✓				
Awareness of long-term effects				✓						
Presence of medical professional							✓			
Soccer participation										

	Kroshus et al. (2014)	Kroshus et al. (2015)	Kurowski et al. (2014)	LaRoche et al. (2016)	Lininger et al. (2017)	Llewellyn et al. (2014)	McCrea et al. (2004)	McDonald et al. (2016)	Miyashita et al. (2016)	Register-Mihalik, Guskiewicz, et al. (2013)	Register-Mihalik, Linnan, et al. (2013)	Wallace, Covassin, & Beidler (2017)	Wallace, Covassin, Nogle, et al. (2017a)	Wallace, Covassin, Nogle, et al. (2017b)
Study characteristic														
	Survey created by study team (fixed response)	◆ Concussion Knowledge Index portion of the Rosenbaum Concussion Knowledge and Attitude Survey Student Edition, with added measures (fixed response) ◆ Survey created by the study team (fixed response)	Survey created by the study team (fixed response)	Survey created by the study team (fixed response)	Focus groups (open-ended questions)	Survey created by the study team (fixed response)	Survey created by the study team (fixed response)	Adapted from LaBotz 2005 survey (fixed response)	Survey created by study team (fixed response)	Survey created by study team (fixed response)	Survey created by the study team (fixed response)	Adapted from Register-Mihalik 2013 survey (fixed response)	Adapted from Register-Mihalik 2013 survey (fixed response)	Adapted from Register-Mihalik 2013 survey (fixed response)
			✓						✓			✓		
			✓											
	✓				✓									
											✓			
			✓											

(*continues*)

TABLE 1 Facilitators and Barriers to Reporting of Sports-Related Concussion Among High School and Collegiate Athletes (*Continued*)

	Anderson et al. (2016)	Baugh et al. (2014)	Chinn and Porter (2016)	Chrisman et al. (2013)	Cusimano (2017)	Davies and Bird (2015)	Delaney et al. (2015)	Donnell et al. (2018)	Kerr et al. (2016)	Kroshus et al. (2015)
Study characteristic										
Knowledge of shortened recovery time through early care										
Barrier										
May lose current and future play time			✓	✓		✓	✓	✓	✓	
Did not feel injury was serious			✓		✓	✓	✓	✓	✓	
Do not want to let the team down	✓			✓		✓	✓	✓	✓	
Not sure it was a concussion			✓	✓	✓	✓			✓	
Pressure from teammates, coaches, parents, and fans			✓	✓	✓		✓	✓		
Do not want to be seen as weak by the coach and teammates/embarrassing to report				✓	✓			✓		
Coach attitudes (mad or upset with, or disappointment in the athlete)		✓	✓	✓						
Did not want to risk future sports career/athletic scholarship			✓				✓	✓		
Did not want to upset or worry family							✓			
Concussion occurred in an important game or important time of season							✓			

Study characteristic	Kroshus et al. (2014)	Kroshus et al. (2015)	Kurowski et al. (2014)	LaRoche et al. (2016)	Lininger et al. (2017)	Llewellyn et al. (2014)	McCrea et al. (2004)	McDonald et al. (2016)	Miyashita et al. (2016)	Register-Mihalik, Guskiewicz, et al. (2013)	Register-Mihalik, Linnan, et al. (2013)	Wallace, Covassin, & Beidler (2017)	Wallace, Covassin, Nogle, et al. (2017a)	Wallace, Covassin, Nogle, et al. (2017b)
	✓													
	✓			✓		✓	✓	✓	✓	✓		✓	✓	✓
				✓		✓	✓	✓	✓	✓		✓	✓	✓
	✓				✓	✓	✓			✓		✓	✓	✓
					✓	✓	✓	✓		✓		✓	✓	✓
	✓	✓			✓						✓			
	✓											✓	✓	✓
									✓	✓				✓
												✓	✓	✓
												✓	✓	✓
												✓	✓	✓

(*continues*)

TABLE 1 Facilitators and Barriers to Reporting of Sports-Related Concussion Among High School and Collegiate Athletes (*Continued*)

	Anderson et al. (2016)	Baugh et al. (2014)	Chinn and Porter (2016)	Chrisman et al. (2013)	Cusimano (2017)	Davies and Bird (2015)	Delaney et al. (2015)	Donnell et al. (2018)	Kerr et al. (2016)	Kroshus et al. (2015)
Study characteristic										
May affect standing within the team/ future teams							✓	✓		
Strong identity as "an athlete"				✓						✓
Culture of specific sport (hockey and football)					✓		✓			
Did not want to go to the doctor										
Did not have health insurance										
Culture of not reporting										✓
Feared isolation from teammates							✓			
Felt it was not risky to play injured							✓			
Cannot return to play when ready										
Lower GPA										
Ability to sandbag diagnostic testing										
Perceived control of concussion-reporting behavior										

et al., 2018; Kroshus et al., 2014; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, et al., 2017a, 2017b). Some (n = 6) studies reported that the coaches' attitudes (whether the coach became angry or upset or was disappointed in the student) influenced reporting behavior (Baugh et al., 2014; Chinn & Porter, 2016; Chrisman et al., 2013; Miyashita et al., 2016; Register-Mihalik, Guskiewicz, et al., 2013; Wallace, Covassin, Nogle, et al., 2017a). Some student athletes did not report because they were concerned that they would jeopardize their future athletic career by reporting or they felt that they might risk an athletic scholarship if they were to report (n = 6 studies; Chinn & Porter, 2016; Delaney et al., 2015; Donnell et al., 2018; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, et al., 2017a, 2017b). Finally, other less common reasons related to the timing of the concussion (n = 4 studies; Delaney et al., 2015; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, et al.,

Study characteristic	Kroshus et al. (2014)	Kroshus et al. (2015)	Kurowski et al. (2014)	LaRoche et al. (2016)	Lininger et al. (2017)	Llewellyn et al. (2014)	McCrea et al. (2004)	McDonald et al. (2016)	Miyashita et al. (2016)	Register-Mihalik, Guskiewicz, et al. (2013)	Register-Mihalik, Linnan, et al. (2013)	Wallace, Covassin, & Beidler (2017)	Wallace, Covassin, Nogle, et al. (2017a)	Wallace, Covassin, Nogle, et al. (2017b)
	✓													
					✓									
					✓									
												✓	✓	✓
												✓	✓	✓
											✓			
	✓													
				✓										
					✓									
											✓			

2017a, 2017b) were mentioned, including concerns for upsetting the family of the student athlete (n = 4 studies; Delaney et al., 2015; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, et al., 2017a, 2017b), not wanting to go to the doctor (n = 3 studies; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, et al., 2017a, 2017b), a lack of health insurance (n = 3 studies; Wallace, Covassin, & Beidler, 2017; Wallace, Covassin, Nogle, et al., 2017a, 2017b), strong identity as "an athlete" (n = 3 studies; Chrisman et al., 2013; Kroshus et al., 2015; Lininger et al., 2017), sports-specific cultural issues (n = 3 studies; Cusimano et al., 2017; Delaney et al., 2015; Lininger et al., 2017), and concerns for how reporting might affect the athlete's standing within the team (n = 3 studies; Delaney et al., 2015; Donnell et al., 2018; Kroshus et al., 2014). A general culture of underreporting behavior was mentioned in two studies (Kroshus et al., 2015; Register-Mihalik, Linnan, et al., 2013), and

the latter mentioned that a perception of control over reporting behavior could be influential (Register-Mihalik, Linnan, et al., 2013). Single studies also mentioned that a lower GPA was associated with underreporting (LaRoche et al., 2016), along with other reasons such as a fear of isolation from teammates (Delaney et al., 2015), a misconception that it is not risky to play when injured (Delaney et al., 2015), a concern that he or she cannot return to play when ready (Kroshus et al., 2014), and the ability to sandbag diagnostic testing (Lininger et al., 2017).

DISCUSSION

Our systematic review found that major facilitators in reporting of sports-related concussions are female sex and younger age. The major barriers are a fear of losing current or future playing time, a misconception that concussive injury is not serious, a fear of letting the team down, and a lack of knowledge of concussive injury signs and symptoms. All of these would be amenable to educational intervention, as has been suggested or incorporated into interventions by different groups (Carroll-Alfano, 2017; Daugherty et al., 2019; Greenwald, Chu, Beckwith, & Crisco, 2012).

Yet, underreporting of concussion symptoms remains a serious problem for high school and collegiate athletes. This problem has been addressed through legislation to increase education and to earmark funds for prevention and treatment programs (National Conference of State Legislatures, 2018). Although the specifics vary by state, all 50 states have some requirements in place. More specifically, these programs aim to protect young athletes from further injury and/or returning to play too early, with many states requiring concussion training for coaches (see www.ncls.org/research/health/traumatic-brain-injuries-among-youth-athletes.aspx for further information; National Conference of State Legislatures, 2015). Although these efforts have led to improved general knowledge of concussion symptoms, many concussions are still going unreported despite an adequate knowledge base (Kurowski et al., 2014, 2015). Many of the mandated educational efforts have focused more on recognizing the symptoms of concussion and have not specifically emphasized the risk of continued play while concussed. It is reasonable to think that an increased knowledge of the risks of not reporting a concussion would have the potential to foster safe behaviors, although Anderson et al. (2016) and Chinn and Porter (2016) have shown that despite having knowledge of both concussion symptoms and risks of playing while concussed, underreporting remains an issue. Despite this, future educational and intervention efforts should focus on the dual prongs of concussion symptom recognition and the dangers of playing while concussed.

Adding to this underreporting problem, educational efforts to increase reporting behavior suffer from disparities by age, parental income, sex, and geographical area (Donnell et al., 2018). We have shown here that a younger age and female sex are facilitators to better reporting behavior. Thus, disparities in these characteristics are concerning. One study even demonstrated that girls are more likely than boys to alter their reporting behavior after educational interventions (Miyashita et al., 2016). Ideally, future student athletes should be indoctrinated into safe concussion-reporting behaviors prior to their involvement in sports at the more advanced level as seen in high school and college (Daugherty et al., 2019). Educational efforts must occur then in primary schools, with age-appropriate information being given at each level. As the athlete develops, additional detail and reasoning can be given such that information is tailored as the child advances in cognitive capability and in educational status. But in any circumstance, all efforts should be made to reduce concussion education disparities to eliminate some of these effects and to specifically target those who are more likely to exhibit behavioral change in response to education (i.e., younger and female athletes).

But researchers and health care providers must intervene in other areas outside of player education. Educational efforts need to also focus on coaches, as we found here that pressure from coaches and the attitudes of coaches were possible barriers to reporting behavior. It is imperative that coaches understand the importance of being approachable by their athletes to better evaluate their possible symptoms of concussion. Coaches who present a supportive attitude will likely have safer reporting behaviors practiced within their teams. Likewise, effective education for parents, teammates, and fans is likely to promote more supportive practices. Future interventions should include relationship-building activities to promote trusting relationships among athletes, teammates, and coaches in order to increase reporting behavior. Parents of student athletes would benefit from focused and interactive education with coaches in order to increase communication and trust. Fans would also benefit from further education on the serious nature of playing while concussed so that they will not inadvertently create further pressure on an athlete to continue play.

Ongoing availability of on-site athletic trainers present during all practices and games may also be important to increasing reporting behaviors (Delaney et al., 2015; Register-Mihalik, Linnan, et al., 2013). An injured student athlete may take comfort in being evaluated by a dispassionate professional who is uninvolved in the outcome of the game (vs. being evaluated by a coach who is motivated to win). An unaffiliated health care professional may be one of the best options to alleviate any ongoing player concerns about the partiality of assessment. The student athlete knows that the evaluation is unbiased, and return-to-play decisions become clearly secondary to medical

TABLE 2 Specific Suggestions for Future Concussion-Reporting Interventions

Focus education on both concussion symptom recognition and the dangers of playing while concussed
Design educational and intervention efforts to be inclusive of all ages, genders, parental income levels, and geographical areas
More focused intervention should be used in high-risk groups and for those that are more likely to exhibit behavioral change in response to education (e.g., younger and female athletes)
Promote interventional relationship-building activities among athletes, teammates, and coaches in order to increase trust and foster reporting behavior
Parents of student athletes should be included in any interventional activities as age appropriate
Target fans with educational efforts on the serious nature of playing while concussed so that they will not inadvertently create further pressure for an athlete to continue play
Provide for accessible and trusted medical professionals to be easily accessible for student athletes

need. It is imperative that health care professionals and athletic trainers should be easily accessible and trusted by the student athletes in any concussion interventions (Table 2).

Any future interventions will also utilize all of the following strategies, which can be categorized into either primary or secondary prevention (Pless & Hagel, 2005). A primary prevention strategy is one whereby injury is prevented and includes items such as the implementation of more effective safety equipment, hit counts or head impact monitoring (though the precise "danger" threshold may as of yet be up for debate), and coaching or playing strategies that decrease the potential for injury (Greenwald et al., 2012). Sports that are most likely to have head impact could even undergo a modification of the rules in order to minimize injury (e.g., flag football instead of tackle football).

However, it is unrealistic to think that all sports-related concussions are preventable. Secondary prevention strategies can then help prevent future injury after a concussive injury has already occurred. These include educational efforts to increase knowledge of concussion signs/symptoms and the risks of playing while concussed, the development of strict guidelines for removal from play (along with consequences for athletic departments if they are not followed), the engagement of sideline concussion-specific medical personnel, and threshold-based head impact monitoring, in which any head impact that registers at a potentially concussive threshold triggers automatic removal from play (Greenwald et al., 2012).

Limitations

Given the relatively small number of studies meeting inclusion criteria for this review, a formal analysis of study quality or bias could not be completed. However, several concerns were identified. Many of the included studies had relatively small sample sizes, which may introduce bias. Chrisman et al. (2013), Cusimano et al. (2017), Lininger et al. (2017), and McDonald et al. (2016) all had sample sizes of less than 100. It is not clear whether this may have biased some of our results.

Our review included articles with both fixed response and open-ended questions (Table 1). These methods of questioning could elicit very different responses and also introduce bias if only fixed responses are used. Furthermore, data collection instruments were not available for many of the included studies, and so it was not clear whether all studies evaluated each of the possible barriers and each of the possible facilitators to concussion-reporting behavior. Future researchers should include all data collection instruments in publications such that this information could be easily evaluated.

Another limitation lies in the nature of the specific barriers and facilitators that were reported. Each barrier and facilitator is reported in the language that was used by the original authors, and so it is possible that the opposite characteristic could potentially also be associated with reporting behavior. For instance, female sex was found to be a facilitator of reporting behavior in four studies. But we cannot fully conclude from this information that male sex would be a barrier for reporting behavior.

CONCLUSIONS

Despite these limitations, we found that female sex and younger age are facilitators for concussion reporting, while a fear of losing current or future playing time, a misconception that concussive injury is not serious, a fear of letting the team down, and a lack of knowledge of concussive injury signs and symptoms are barriers to reporting of concussion symptoms. Educational efforts should focus on these factors and should be inclusive of players, teammates, coaches, and fans. Early intervention and education will be key to increasing reporting behavior among high school and collegiate student athletes.

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KEY POINTS

- Female sex and younger age were found to be major facilitators of concussion-reporting behavior.
- Barriers were a fear of losing playing time and of letting one's team down.
- A lack of knowledge of concussion symptoms and severity also was a barrier.
- Future interventions should address these issues and emphasize the long-term risks of playing while concussed.

REFERENCES

Anderson, B. L., Gittelman, M. A., Mann, J. K., Cyriac, R. L., & Pomerantz, W. J. (2016). High school football players' knowledge and attitudes about concussions. *Clinical Journal of Sport Medicine*, *26*(3), 206–209.

Asken, B. M., McCrea, M. A., Clugston, J. R., Snyder, A. R., Houck, Z. M., & Bauer, R. M. (2016). "Playing through it": Delayed reporting and removal from athletic activity after concussion predicts prolonged recovery. *Journal of Athletic Training*, *51*(4), 329–335.

Baugh, C. M., Kroshus, E., Daneshvar, D. H., & Stern, R. A. (2014). Perceived coach support and concussion symptom-reporting: Differences between freshmen and non-freshmen college football players. *Journal of Law, Medicine and Ethics*, *42*(3), 314–322.

Bryan, M. A., Rowhani-Rahbar, A., Comstock, R. D., & Rivara, F., & Seattle Sports Concussion Research Collaborative. (2016). Sports- and recreation-related concussions in US youth. *Pediatrics*, *138*(1). doi:10.1542/peds.2015-4635

Carroll-Alfano, M. (2017). Mandated high school concussion education and collegiate athletes' understanding of concussion. *Journal of Athletic Training*, *52*(7), 689–697.

Chinn, N. R., & Porter, P. (2016). Concussion reporting behaviours of community college student-athletes and limits of transferring concussion knowledge during the stress of competition. *BMJ Open Sport & Exercise Medicine*, *2*(1), e000118.

Chrisman, S. P., Quitiquit, C., & Rivara, F. P. (2013). Qualitative study of barriers to concussive symptom reporting in high school athletics. *Journal of Adolescent Health*, *52*(3), 330.e333–335.e333.

Cusimano, M. D., Topolovec-Vranic, J., Zhang, S., Mullen, S. J., Wong, M., & Ilie, G. (2017). Factors influencing the underreporting of concussion in sports: A qualitative study of minor hockey participants. *Clinical Journal of Sport Medicine*, *27*(4), 375–380.

Daugherty, J., Miles, I., Sarmiento, K., Sansone, C., Kroshus, E., & Bethea, B. (2019). A description and evaluation of the concussion education application HEADS UP Rocket Blades. *Health Promotion Practice*, *20*(1), 22–30. doi:10.1177/1524839918764670.

Davies, S., & Bird, B. (2015). Motivations for underreporting suspected concussion in college athletics. *Journal of Clinical Sport Psychology*, *9*(2), 101–105.

Delaney, J. S., Lamfookon, C., Bloom, G. A., Al-Kashmiri, A., & Correa, J. A. (2015). Why university athletes choose not to reveal their concussion symptoms during a practice or game. *Clinical Journal of Sport Medicine*, *25*(2), 113–125.

Donnell, Z., Hoffman, R., Sarmiento, K., & Hays, C. (2018). Concussion attitudes, behaviors, and education among youth ages 12–17: Results from the 2014 YouthStyles survey. *Journal of Safety Research*, *64*, 163–169.

Greenwald, R. M., Chu, J. J., Beckwith, J. G., & Crisco, J. J. (2012). A proposed method to reduce underreporting of brain injury in sports. *Clinical Journal of Sport Medicine*, *22*(2), 83–85.

Kaut, K. P., DePompei, R., Kerr, J., & Congeni, J. (2003). Reports of head injury and symptom knowledge among college athletes: Implications for assessment and educational intervention. *Clinical Journal of Sport Medicine*, *13*(4), 213–221.

Kay, M. C., Welch, C. E., & Valovich McLeod, T. C. (2015). Positive and negative factors that influence concussion reporting among secondary-school athletes. *Journal of Sport Rehabilitation*, *24*(2), 210–213.

Kerr, Z. Y., Register-Mihalik, J. K., Kroshus, E., Baugh, C. M., & Marshall, S. W. (2016). Motivations associated with nondisclosure of self-reported concussions in former collegiate athletes. *American Journal of Sports Medicine*, *44*(1), 220–225.

Kim, H. J., Tsao, J. W., & Stanfill, A. G. (2018). The current state of biomarkers of mild traumatic brain injury. *JCI Insight*, *3*(1). doi:10.1172/jci.insight.97105

Kroshus, E., Baugh, C. M., Daneshvar, D. H., & Viswanath, K. (2014). Understanding concussion reporting using a model based on the theory of planned behavior. *Journal of Adolescent Health*, *54*(3), 269.e262–274.e262.

Kroshus, E., Kubzansky, L. D., Goldman, R. E., & Austin, S. B. (2015). Norms, athletic identity, and concussion symptom under-reporting among male collegiate ice hockey players: A prospective cohort study. *Annals of Behavioral Medicine*, *49*(1), 95–103.

Kurowski, B., Pomerantz, W. J., Schaiper, C., & Gittelman, M. A. (2014). Factors that influence concussion knowledge and self-reported attitudes in high school athletes. *The Journal of Trauma and Acute Care Surgery*, *77*(3, Suppl. 1), S12–S17.

Kurowski, B. G., Pomerantz, W. J., Schaiper, C., Ho, M., & Gittelman, M. A. (2015). Impact of preseason concussion education on knowledge, attitudes, and behaviors of high school athletes. *The Journal of Trauma and Acute Care Surgery*, *79*(3, Suppl. 1), S21–S28.

LaRoche, A. A., Nelson, L. D., Connelly, P. K., Walter, K. D., & McCrea, M. A. (2016). Sport-related concussion reporting and state legislative effects. *Clinical Journal of Sport Medicine*, *26*(1), 33–39.

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gotzsche, P. C., Ioannidis, J. P., … Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLoS Medicine*, *6*(7), e1000100.

Lininger, M., Wayment, H., Huffman, A., Craig, D., & Irving, L. (2017). An exploratory study on concussion-reporting behaviors from collegiate student athletes' perspectives. *Athletic Training & Sports Health Care*, *9*(2), 71–80.

Llewellyn, T., Burdette, G. T., Joyner, A. B., & Buckley, T. A. (2014). Concussion reporting rates at the conclusion of an intercollegiate athletic career. *Clinical Journal of Sport Medicine*, *24*(1), 76–79.

McCrea, M., Hammeke, T., Olsen, G., Leo, P., & Guskiewicz, K. (2004). Unreported concussion in high school football players: Implications for prevention. *Clinical Journal of Sport Medicine*, *14*(1), 13–17.

McDonald, T., Burghart, M. A., & Nazir, N. (2016). Underreporting of concussions and concussion-like symptoms in female high school athletes. *Journal of Trauma Nursing*, *23*(5), 241–246.

Meier, T. B., Brummel, B. J., Singh, R., Nerio, C. J., Polanski, D. W., & Bellgowan, P. S. (2015). The underreporting of self-reported symptoms following sports-related concussion. *Journal of Science and Medicine in Sport*, *18*(5), 507–511.

Miyashita, T. L., Diakogeorgiou, E., & VanderVegt, C. (2016). Gender differences in concussion reporting among high school athletes. *Sports Health*, *8*(4), 359–363.

Naftel, K. G., Yust, E. M., Nichols, M. H., King, W. D., & Davis, D. (2014). Knowledge and management of sports concussions among coaches and certified athletic trainers in Alabama. *Southern Medical Journal*, *107*(7), 418–423.

National Conference of State Legislatures. (2015, October 18). *Traumatic brain injuries among youth athletes*. Retrieved from www.ncls.org/research/health/traumatic-brain-injuries-among-youth-athletes.aspx

National Conference of State Legislatures. (2018, October 11). *Traumatic brain injury legislation*. Retrieved from http://www.ncsl.org/research/health/traumatic-brain-injury-legislation.aspx

Pless, I. B., & Hagel, B. E. (2005). Injury prevention: A glossary of terms. *Journal of Epidemiology and Community Health*, *59*(3), 182–185.

Register-Mihalik, J. K., Guskiewicz, K. M., McLeod, T. C., Linnan, L. A., Mueller, F. O., & Marshall, S. W. (2013). Knowledge, attitude, and concussion-reporting behaviors among high school athletes: A preliminary study. *Journal of Athletic Training*, *48*(5), 645–653.

Register-Mihalik, J. K., Linnan, L. A., Marshall, S. W., Valovich McLeod, T. C., Mueller, F. O., & Guskiewicz, K. M. (2013). Using theory to understand high school aged athletes' intentions to report sport-related concussion: Implications for concussion education initiatives. *Brain Injury*, *27*(7–8), 878–886.

Torres, D. M., Galetta, K. M., Phillips, H. W., Dziemianowicz, E. M., Wilson, J. A., Dorman, E. S., … Balcer, L. J. (2013). Sports-related concussion: Anonymous survey of a collegiate cohort. *Neurology Clinical Practice*, *3*(4), 279–287.

Wallace, J., Covassin, T., & Beidler, E. (2017). Sex differences in high school athletes' knowledge of sport-related concussion symptoms and reporting behaviors. *Journal of Athletic Training*, *52*(7), 682–688.

Wallace, J., Covassin, T., Nogle, S., Gould, D., & Kovan, J. (2017a). Concussion knowledge and reporting behavior differences between high school athletes at urban and suburban high schools. *Journal of School Health*, *87*(9), 665–674.

Wallace, J., Covassin, T., Nogle, S., Gould, D., & Kovan, J. (2017b). Knowledge of concussion and reporting behaviors in high school athletes with or without access to an athletic trainer. *Journal of Athletic Training*, *52*(3), 228–235.

White, P. E., Newton, J. D., Makdissi, M., Sullivan, S. J., Davis, G., McCrory, P., … Finch, C. F. (2014). Knowledge about sports-related concussion: Is the message getting through to coaches and trainers? *British Journal of Sports Medicine*, *48*(2), 119–124.

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