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Sport-Related Concussion Reporting and State Legislative Effects

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Abstract

Objective—To investigate concussion rates and reporting frequencies in high school and collegiate athletes in 2013, compare results to those obtained from 1999–2002,[1] and examine to what extent the 2012 Wisconsin state concussion law affected reporting in 2013.

Design—Retrospective 2013 survey compared to prior survey.

Setting—High schools and colleges in the Milwaukee, Wisconsin, area.

Participants—Athletes (*N* = 784) from multiple sports were surveyed in 2013. Football players (*N* = 1,532) from 1999–2002[1] completed the same measure.

Main Outcome Measures—Both surveys assessed concussion history, concussion incidence during the current season, whether incident concussions were reported, who concussions were reported to, and reasons for not reporting. The 2013 survey also assessed awareness of the Wisconsin state law and its effect on reporting.

Results—Rates of concussion in the surveyed season were comparable to previous findings from 1999–2002 (16.6% vs. 15.3%, *p*= .558). Notably, athletes were significantly more likely to report their concussions in 2013 (70.6% vs. 47.3% previously, *p*= .011). Among high school athletes surveyed, 59.5% were aware of the Wisconsin state law, with 55.1% stating it would make them more likely to report a concussion.

Conclusions—Rates of concussion for one sport season have not changed significantly over the past 14 years. The percentage of concussions that are reported to someone has increased significantly. Awareness of the Wisconsin state law does not fully account for the increase in concussion reporting.

[1]As raw data not available from original study, some cell sample sizes were derived from published percentages in order to statistically compare past and current survey results.

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Clinical Relevance—Given the finite amount of knowledge regarding the influence of concussion-related cultural and legal changes, these findings will help to inform clinicians of the current concussion milieu from the perspective of athletes. It will inform practitioners involved in concussion management to what extent athletes' are aware of and report concussions.

Keywords

sport concussion; head injury; mild traumatic brain injury; legislation; reporting

Introduction

Concerns about the short-term and potential long-term effects of concussions have inundated the popular press and research literature in recent decades. Lawsuits involving professional athletes concerned about prolonged effects of head trauma are well cited in the media, and the availability of empirical data regarding the impact of concussions on biopsychosocial functioning is increasing rapidly.[2,3] Although the degree to which chronic problems can occur following concussions is not adequately understood, it is well accepted that concussions result in short terms effects on various aspects of functioning (e.g., subjective symptoms, cognition, and postural instability).[4–7] Due to these issues, identifying and reporting concussions is essential so that athletes receive care from trained professionals and return to play safely.[8,9] Also, the rise in public awareness and focus on new regulations about concussions has made researchers increasingly interested in documenting how concussion rates and clinical management decisions are changing over time.

It is thought that 1.6–3.8 million concussions occur in sports and recreational activities in the United States annually,[10] but the true incidence of concussion is difficult to ascertain due to the varied means by which epidemiologic data have been collected and assumptions that many concussions are unreported.[1,11] Many larger scale studies have required athletic trainers to enter injury information on their athletes daily into databases such as the Reporting Information Online (RIO) for high schools and NCAA Electronic Injury Surveillance System (NEISS) for colleges.[12–15] Although studies employing this methodology have provided useful data regarding concussion rates, estimates of incidence based on athletic exposures (AEs)[12,14–18] could be imprecise due to the highly detailed documentation needed to quantify exposure. Perhaps more importantly, since such methods count only concussions that are reported to athletic trainers, they miss the large number of concussions that may be unrecognized or unreported by athletes.[1,19–24]

In a prior 1999–2002 survey of high school football players, athletes were provided with a definition of concussion and asked about their remote and recent history of concussion and reporting decisions. Rates of concussion (15.3% of athletes) were higher than previously documented by other methodologies,[25] with the majority (52.7%) unreported.[1] That nearly half of potential concussions went unreported fueled concerns that published estimates of concussion incidence may be dramatically underestimated. Further, most athletes who did not report a concussion indicated they did not think their injuries were serious enough to warrant medical attention (66.4%) or that they were unaware that they may have had a

concussion (35.1%), a finding that implicated the need for athlete education around concussion.

With the cascade of media stories about concussion and urgency for new rules and regulations in the past decade, an evaluation of how these cultural/historical changes may have affected rates at which athletes recognize and report concussive injuries is crucial in determining the true incidence of concussion and the influence of education efforts on athletes. Several large-scale studies have reported increased rates of concussion in recent years. For example, one study cited a 7% annual increase in the number of concussions in collegiate athletes from 1988–2004[13] and another cited a 15.5% annual increase in high school athletes from 1997–2008.[26] These studies suggest that increased awareness of the injury could have led to higher reporting rates, but it is also possible that there has been true increases in concussion incidence (e.g., due to increased intensity of play and individual exposure to athletic activities).[13,26–28]

Another hypothesis is that increases in formal protocols and legal regulation of concussion management in youth athletics may be decreasing reporting by athletes who wish to avoid being removed from play. Expert consensus statements, such as those developed at the 2008 and 2012 meetings of the International Conference on Concussion in Sport in Zurich, [9,29] recommend cognitive and physical rest with a graduated return-to-play. As of Jan 30, 2014, all states in the United States have passed legislation regarding concussions specific to student athletes.[30] Wisconsin's state law was enacted April 2, 2012 and requires consultation with the Wisconsin Interscholastic Athletic Association (WIAA) to develop guidelines to educate coaches, athletes, and parents about the risk of sport-related concussion. The law also requires that an athlete be removed from play if a coach, official, or health care provider suspects a concussion or if an athlete exhibits signs of a concussion.[31] As is the case in many other states, parents and athletes in Wisconsin are required to read, sign, and return an informational sheet to the person operating the youth activity. Although these laws and education efforts have appeared to improve public knowledge of concussion symptoms,[20,22,32,33] it is unclear whether they have affected reporting decisions in athletes who suspect they have sustained a concussion.[20,22,32]

Given the variability in estimated concussion rates, increase in documented concussions in recent years, and the changes in public awareness and policy, the primary aim of this study was to replicate our prior 1999–2002 study by surveying athletes' rates of unreported concussion in 2013.[1] We also aimed to expand the target population to include various high school and college sports and to estimate the effects of the 2012 Wisconsin state law on athletes' reporting decisions.

Methods

Subjects

Athletes from nine high schools and four colleges in the Milwaukee, Wisconsin area were surveyed at the end of their 2013 sport season. Athletes who completed baseline testing (N = 1,298) were targeted to participate. A total of 784 (60.4% response rate) athletes (205 men's high school football, 290 men's college football, 126 men's high school and college soccer,

140 women's high school and college soccer, 16 women's rugby, and 7 men's and women's lacrosse) responded to the survey and were included in data analyses. The findings were compared to a prior, similar survey conducted from 1999–2002[1] of 1,532 varsity football players from 20 high schools within the same region. [1]

Procedures

Study staff or the institutes' head athletic trainers distributed a confidential questionnaire (Figure 1) to eligible athletes. Players who did not fill out a paper questionnaire were e-mailed a link to an electronic version of the questionnaire.[34]

With the exception of the new items related to the 2012 Wisconsin state law, the survey was identical to the previous one.[1] The questionnaires provided this definition of concussion: "A blow to the head followed by a variety of symptoms that that may include any of the following: headache, dizziness, loss of balance, blurred vision, 'seeing stars,' feeling in a fog or slowed down, memory problems, poor concentration, nausea, or throwing up. Getting 'knocked out' or being unconscious does not always occur with a concussion." Athletes were asked about the number of concussions sustained prior to their most recent season and the number of concussions during the most recent season. Athletes who sustained a concussion for the surveyed season were asked if and to whom they reported it. Subjects who did not report concussions were asked why. Subjects were allowed to select multiple answers for who they reported to and reasons for not reporting. Additionally, athletes were asked if they were aware that Wisconsin had a state law regarding sport-related concussions and, if so, what effect the law had on their decisions to report concussions.

Data Management and Analysis

The study was approved by the institutional review board at the Medical College of Wisconsin. Study data were managed using REDCap[35] electronic data capture tools hosted at the Medical College of Wisconsin. Preliminary analyses were conducted using Chi-square and *t*-tests to explore predictors of survey nonresponse (with predictor variables collected at baseline testing as part of a larger study). Primary analyses involved computing the frequency of responses for each questionnaire item, with Chi-square and *t*-tests used to evaluate the relationship between demographics (e.g., age/level of play, sex) and self-reported concussion history and reporting tendencies. Chi-square analyses were conducted to compare response frequencies in the high school football group to those from the original 1999–2002 survey (Table 1), and to compare responses about the questions related to the Wisconsin state law for athletes who did versus did not sustain a concussion in the surveyed season (Table 2). Fisher's exact tests were also computed in instances in which expected cell sizes were less than 5, but because findings did not differ between statistics, chi-square values were presented for all analyses to minimize unnecessary complexity in the results. An alpha level of .05 was used to determine statistical significance. Statistical analyses were conducted using SPSS (Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, New York; IBM Corp.) and R (R Core Team. R: A Language and environment for

[1]As raw data not available from original study, some cell sample sizes were derived from published percentages in order to statistically compare past and current survey results.

statistical computing. Vol 3.0.3. Vienna, Austria: R Foundation for Statistical Computing; 2014).

Results

Sample Demographics

The overall response rate (60.4%) was lower than the previous survey (92.3% in McCrea et al., 2004; $p < .001$). For this reason, predictors of nonresponse were explored using two approaches: (1) comparison of respondents and nonrespondents and (2) comparison of respondents to the targeted population on variables collected at pre-season baseline evaluations. Fortunately, because we only targeted athletes who had completed a prior baseline testing protocol, we had a host of demographic, historic, and other information on the population from which to examine patterns of nonresponse.

Specifically, we compared groups on gender, race, age, level of competition (high school, college), sport, history of prior concussions, grade point average, estimated general intellectual ability (Wechsler Test of Adult Reading scale score), socioeconomic status (using a Hollingshead rating system), baseline (Sport Concussion Assessment Tool-3) symptoms, and self-reported ratings of emotional distress (Brief Symptom Inventory-18 global severity index). Demographics and other characteristics were statistically equivalent between respondents, nonrespondents, and the entire population on the vast majority of measures. However, football players were more heavily represented in the survey sample, 63.1% (95% *CI* = 59.6%–66.5%) vs. the population, 55.6% (53.7%–59.2%). In contrast, men's lacrosse players were less well represented in the respondent sample, .3% (.0%–1.0%) in comparison to the population 3.2% (2.4%–4.4%). These differences could be due to the highly organized nature of the men's football programs at the surveyed institutions and the fact that, due to the timing of the sport seasons and onset of this survey study, lacrosse players were only recruited via email (a survey modality known to reduce response rates).[36] Overall nonresponse appeared relatively unsystematic, suggesting that the data summarized below reflect reasonably unbiased estimates of the opinions of the target population.

Questionnaire Responses

Concussion rates—Questionnaire results and comparisons to the original are displayed in Table 1. Reported history of concussion (before the most recent sport season) was similar to previous levels (31.1% versus 29.9% in 1999–2002; $p = .730$). Concussion rates for the most recent season were also similar to previous levels (16.6% in 2013, versus 15.3% in 1999–2002; $p = .558$). In the current study, males were significantly more likely to report a history of prior concussion than females, $X^2(1) = 6.74$, $p = .009$, but males and females were equally likely to report having sustained a concussion in the surveyed season ($p = .396$). Athletes with a prior history of concussion were more likely to report that they sustained a concussion in the most recent sport season, $X^2(1) = 24.08$, $p < .001$). Male and female soccer players were equally likely to report a history of concussion ($p = .401$) and a concussion during the most recent season ($p = .180$). College athletes were more likely to have a history of concussion over high school athletes, $X^2(1) = 19.88$, $p < .001$, but no difference was noted

for concussion during the most recent season (p = .278). Household SES and WTAR standard score were not associated with remote history or recent-season concussion (ps > .05, ds = .02, .06) but those with a lower grade point average (GPA) were more likely to have a history of concussion, $t(769) = 3.15$, p = .002, d = .23.

Concussion reporting behaviors—Table 1 summarizes the concussion rates and reporting behaviors for the current study, with data from the prior 1999–2002 survey included for comparison. Among those who sustained a concussion in the most recent season, 78.6% reported it to someone. Reporting rates were significantly higher than previously, even when considering more comparable groups (i.e., high school football), with 70.6% reporting in 2013 versus 47.3% in 1999–2002; $X^2(1) = 6.50$, p = .011. Of all respondents in 2013, 92.2% of those that reported their concussion told their athletic trainer. For the 2013 and 1999–2002 high school football groups, athletes who reported their concussion to someone most frequently told (1) an athletic trainer (87.5% and 76.7%, respectively; p = .248) and (2) a coach (62.5% and 38.8%; p= .034). Totals may exceed 100%, as respondents could select that they reported to multiple individuals. Although the overall pattern of reporting (across trainers, coaches, parents, etc.) was similar in the current and past surveys, respondents in the current study were more likely than those in 1999–2002 to inform their coaches, $X^2(1) = 4.46$, p = .034. Level of play (high school vs. college), sex, household SES, and WTAR standard score was not associated with whether or not athletes reported their concussions (ps > .05, ds = .05–.08), but those with a lower GPA were less likely to report a concussion, $t(96) = -2.18$, p = .032, d = −.49.

Of all respondents in the current study, the most common reasons not to report concussions were that they did not think their injuries were serious enough (71.4%) and they did not want to be pulled from game/practice (61.9%). Comparing the high school football players in the current study to the prior study sample, athletes were more likely to cite “didn’t want to be pulled from game/practice” as a reason for not reporting, 70% currently vs. 36.1% previously; X^2 (1) = 4.40, p = .036. Other reasons for not reporting were comparable between the two groups $ps \geq .05$).

Awareness and effect of Wisconsin state law on concussion reporting—Results of the questions about the Wisconsin state law are provided in Table 2. Analyses of these questions excluded collegiate athletes, since the law does not pertain to college or university athletic programs.[31] In addition to the 37 high school respondents with a concussion this season, 298 respondents without a concussion responded to these questions and their responses were interpreted as indicating how their awareness of the law would have affected their reporting had they sustained a concussion this season. Overall, 59.5% of high school students were aware that Wisconsin has a state law regarding sport-related concussions. No differences were noted by sport, sex, WTAR standard score, GPA, or household SES regarding knowledge of the law for all respondents. Of respondents aware of the law, 55.1% said it would make them more likely to report a concussion, 37.4% stated it would make no difference, and 7.5% said it would make them less likely to report. Males were more likely than females to state that the law would make it more likely for them to report a concussion, $X^2(3) = 9.95$, p = .019. Football players were more likely to state the

law would make it more likely to report than women's soccer players, $X^2(3) = 9.17$, $p = .027$, but no difference was noted between football and men's soccer, or men's soccer and women's soccer ($ps > .05$).

Discussion

This survey study demonstrated that self-reported concussion rates have not changed significantly since the prior survey conducted approximately 14 years ago, but the rate at which athletes report suspected concussions has increased significantly (78.6% in 2013, vs. 47.3% in the 1999–2002). This suggests that the apparent rising incidence documented by other studies[13,26,27] is probably best explained by changes in athletes' reporting decisions rather than true increases in injury rates.

The percentage of potential concussions that were unreported (21.4%) in this sample fell somewhat in between estimates from other studies (which ranged from 11–55%),[11,19–23] but the broad range from other literature is likely due to the year/time in which the studies were conducted, the sports targeted, and the variable durations of time during which athletes were asked to report injuries. Given that we compared the current study data to data on an equivalent measure from comparable samples of athletes within the same geographic region, it is reasonable to conclude that there has been an increase in concussion reporting in our population.

Athletic trainers and coaches were the people concussions were most frequently reported to in both the prior and current surveys. Interestingly, athletes from 2013 were significantly more likely to report to a coach than 1999–2002. This could be an effect of the many state laws that require coach education. If this is the case, athletes may be more willing to report to coaches if they perceive that having a concussion will not be frowned upon by coaches as much as they were in the past.

Reasons for not reporting remained relatively unchanged, with a majority of those who didn't report stating they didn't think their injuries were serious enough. Reasons for not reporting were also similar across other studies using the same or similar questions to assess reasoning.[11,22,23] However, high school football players in 2013 were more likely to state that they did not want to be pulled from a game or practice versus those in 1999–2002. This is consistent with the increased regulation of athletic programs that require athletes to be pulled from play if there is a suspected concussion. Before the law, athletes could return to play the same day as their injury. In accordance with WIAA policy,[37] athletes must follow a graded program of exertion (multiple days) before return to play.

For all high school athletes surveyed, only 59.5% were aware that Wisconsin has a state law regarding sport-related concussions, even though all athletes are required to sign the informational sheet regarding the law. Subjects who sustained a concussion during the surveyed season most frequently stated the law made no difference in whether or not they reported (68.0%). Those without a concussion most frequently stated the law would make it more likely for them to report if they sustained a concussion (64.2%). This suggests that in theory, athletes believe the law would have a positive effect on their behavior of reporting,

but in reality, the law does not appear to influence decision-making in the majority of concussed athletes. A limiting factor in the effectiveness of the state legislation is athletes' awareness of the law, as four in ten athletes reported being unaware of it. When looking at just those who reported awareness of the law, 55.1% stated it made it more likely that they reported a concussive injury. This does not account for the full increase in reporting rates but certainly sheds light on one of the factors that may have contributed to the rise in reporting. Interestingly, those who did not report concussions were more likely than previously to want to avoid being pulled from play, suggesting general knowledge of concussion management policies despite a lack of specific knowledge of the law.

As a retrospective survey study, we relied on athlete's recollection of concussive events, yet retrospective recall is known to be flawed and concussive injury known to cause memory problems (amnesia) in some individuals.[38] Also, the description of concussion was derived from the original survey for consistency and was intended to help our athletes have a consistent and accurate knowledge base from which to answer questions. This definition was also used to assist student athletes to understand the definition of concussion as opposed to the consensus statement. Although published definitions of concussion have varied over the past decade, it is considered unlikely that our results are explained by the definition and description we used for this study. Although the questionnaire measure provided athletes with a common definition, we could not verify whether respondents read this information or instead answered the questions based on their own preconceived ideas about concussions. Finally, while our analyses of nonresponse patterns ruled out the potential for substantial nonresponse bias due to host of demographic and other personal variables collected at pre-season baseline testing, given the nonresponse rate in this survey, it is possible that such bias exists in ways that cannot be measured by our available participant data.

In summary, our results suggest that self-reported concussion rates have not changed drastically in the past 11–14 years, but the rate at which concussions are reported has increased significantly. Although this trend is headed in the right direction, a considerable number of athletes still do not report potential concussions and therefore are not getting recommended evaluation and treatment. In light of the finding that nearly half of athletes in our sample were unaware of the state law about concussion management, more focus is needed on engaging athletes in education efforts. Although new state laws may encourage injured athletes' removal from play, for most athletes, the laws do not appear to hinder reporting decisions. It should be noted that for a minority of athletes, the knowledge of the law and its implication for being removed from play may be an important determinant of whether concussions are reported. Although the Wisconsin law appears to have some positive role on reporting, there are probably numerous other reasons for reporting concussions that will be interesting to identify in future research. Social media (Facebook, Twitter), mass media (ESPN, news stories on pro-athletes, etc.), parental influence, coach rapport, and sport ethos all play a likely role.

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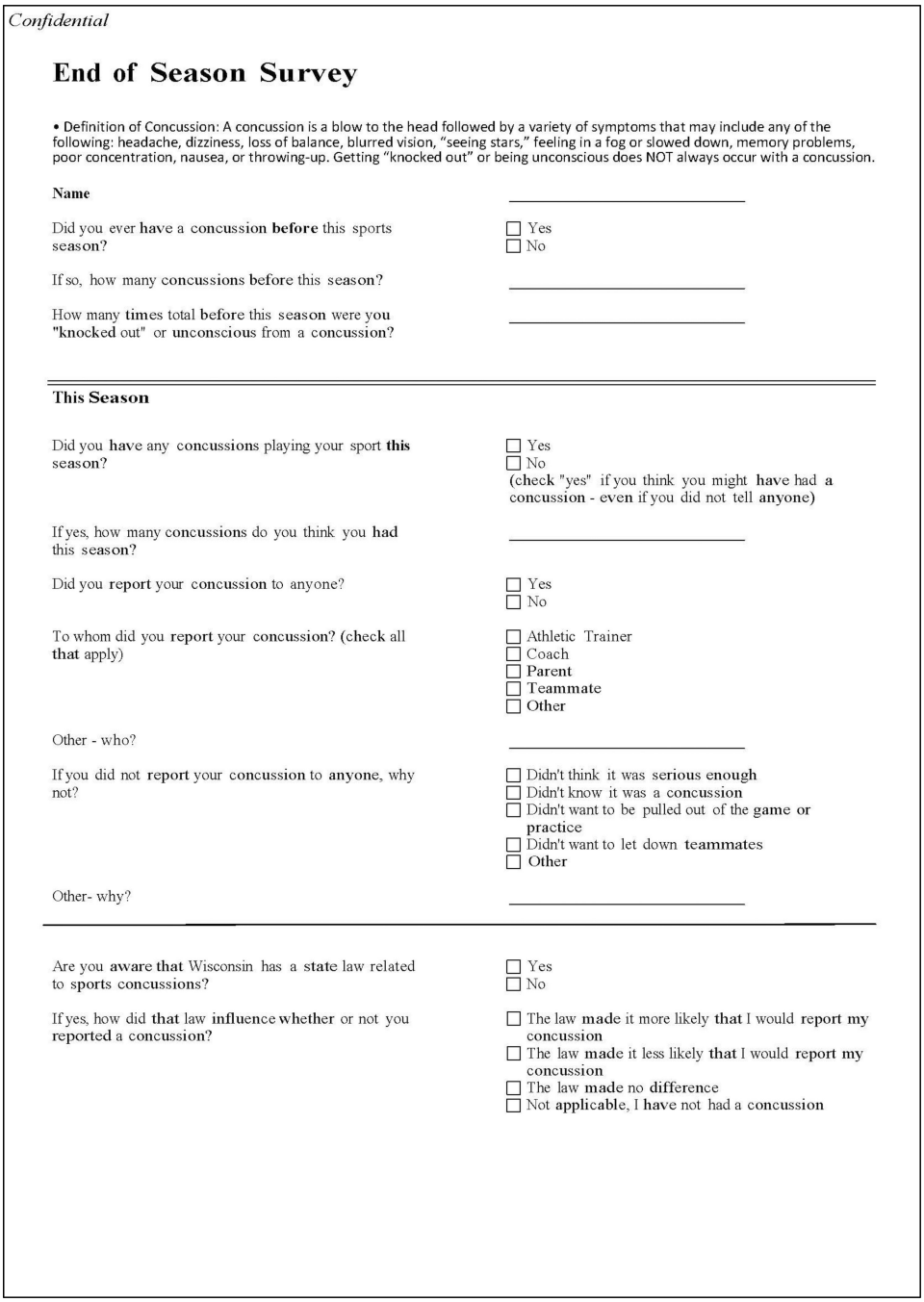

Confidential

End of Season Survey

• Definition of Concussion: A concussion is a blow to the head followed by a variety of symptoms that may include any of the following: headache, dizziness, loss of balance, blurred vision, "seeing stars," feeling in a fog or slowed down, memory problems, poor concentration, nausea, or throwing-up. Getting "knocked out" or being unconscious does NOT always occur with a concussion.

Name _____

Did you ever **have** a **concussion before** this sports season?
☐ Yes
☐ No

If so, how many **concussions before** this season? _____

How many **times** total **before** this season were you **"knocked** out" or **unconscious** from a **concussion**? _____

This Season

Did you **have** any **concussions** playing your sport **this** season?
☐ Yes
☐ No
(**check** "yes" if you think you might **have** had **a concussion** - **even** if you did not tell **anyone**)

If yes, how many **concussions** do you think you **had** this season? _____

Did you **report** your **concussion** to anyone?
☐ Yes
☐ No

To whom did you **report** your **concussion**? (**check** all **that** apply)
☐ Athletic Trainer
☐ Coach
☐ **Parent**
☐ **Teammate**
☐ **Other**

Other - who? _____

If you did not **report** your **concussion** to **anyone**, why not?
☐ Didn't think it was **serious enough**
☐ Didn't know it was a **concussion**
☐ Didn't want to be pulled out of the **game or practice**
☐ Didn't want to let down **teammates**
☐ **Other**

Other- why? _____

Are you **aware that** Wisconsin has a **state** law related to **sports concussions**?
☐ Yes
☐ No

If yes, how did **that** law **influence whether** or not you **reported** a **concussion**?
☐ The law **made** it more likely **that** I would **report my concussion**
☐ The law **made** it less likely **that** I would **report my concussion**
☐ The law **made** no **difference**
☐ Not **applicable**, I **have** not had a **concussion**

Figure 1.
Questionnaire

Table 1

Concussion Incidence and Reporting Decisions for 2013 versus 1999–2002 Survey

	2013 % All Respondents (95% *CI*)	**2013 % High School FB**	**1999–2002 % High School FB**	***p***
	(*n* = 784)	**(*n* = 206)**	**(*n* = 1532)**	
History of Prior Concussion	38.6 (35.6, 42.4)	31.1	29.9	.730
Concussion this Season	12.5 (10.2, 14.8)	16.6	15.3	.558
Reported to Anyone? (Yes)	78.6 (70.5, 86.7)	70.6	47.3	**.011**
Reported to Who	(*n* = 77)	(*n* = 24)	(*n* = 108)	
Athletic Trainer	92.2 (86.2, 98.2)	87.5	76.7	.248
Coach	55.8 (44.7, 66.9)	62.5	38.8	**.034**
Parent	46.8 (35.7, 57.9)	50.0	35.9	.206
Teammate	40.3 (29.3, 51.3)	45.8	27.2	.067
Other	7.8 (1.9, 13.7)	4.2	11.7	.257
If Not Reported, Why?	(*n* = 21)	(*n* = 10)	(*n* = 121)	
Didn’t think it was serious enough	71.4 (52.1, 90.7)	60.0	66.4	.696
Didn’t know it was a concussion	38.1 (17.3, 58.9)	30.0	41.0	.483
Didn’t want to be pulled from game/practice	61.9 (41.1, 82.7)	70.0	36.1	**.036**
Didn’t want to let teammates down	38.1 (17.3, 58.9)	50.0	22.1	.050
Other	9.5 (0, 22.0)	10.0	9.8	.999

Note. FB = football. Participants were allowed to select more than one option regarding to whom they reported concussions or their reason for not reporting.

Table 2

Influence of 2012 Wisconsin State Law on Concussion Reporting

	2013 % All High School (95% *CI*)	2013 % HS With SRC This Season	2013 % HS No SRC This Season	*p*
	(*n* = 346)	(*n* = 47)	(*n* =298)	
Aware of WI state law (yes)	59.5 (54.3, 64.7)	55.3	60.1	.632
If yes, how did law influence whether or not concussion was reported				**.001**
Less likely to report	7.5 (3.5, 14.6)	8.0	7.4	
Law made no difference	37.4 (28.4, 47.3)	68.0	28.4	
More likely to report	55.1 (45.2, 64.7)	24.0	64.2	

Note. HS=high school, SRC=sport-related concussion. The Wisconsin state law requires athletes to sign an information sheet before they can participate in sports. The law also requires athletes to be removed from play if there is a suspected concussion.