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Concussion education in U.S. collegiate sport: what is happening and what do athletes want?

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Abstract

Concussion education for athletes has the potential to play a role in reducing the health burden of concussions from sport by modifying individual risk-related behaviors. In U.S. collegiate sport, decisions about content and delivery of concussion education are left up to the individual institution. This may result in a high degree of variability in what educational materials athletes receive, and is particularly problematic as few concussion education programs have demonstrated efficacy. Health educators can play an important role in working collaboratively with sports medicine clinicians to design and evaluate evidence-based concussion education materials for athletes that meet their learning needs. As a first step in this process, the present study characterizes the content, source, and delivery modalities of concussion currently being provided to U.S. collegiate athletes. It also describes the reported concussion education preferences of a sample of U.S. collegiate athletes. Participants were 789 athletic trainers from 276 schools and 325 athletes from four schools. Results indicated that education is most frequently provided by athletic trainers, but that many athletes would also like coaches and physicians to be involved in this process. Athletes also indicated a preference for content provision across a range of topics, including athletic and academic consequences of continued play with a concussion. Implications for the design and delivery of concussion education for athletes are discussed.

Reducing the health burden of concussions from sport is a multifactorial task (Benson et al., 2013) with relevant targets for change spanning the social ecological spectrum. These include factors such as cultural attitudes about playing through injury, sport rules, institutional concussion management practices, coaching behaviors, and the individual athlete's concussion safety behaviors (Benson et al., 2013; Rivara & Graham 2014). Concussion education for athletes has the potential to play a role in this process by helping modify individual safety-related cognitions and behaviors. After the critical exposure-related decision of whether or not to play a particular sport at a given level of competition, the

primary safety behavior under an athlete's control is disclosing symptoms of a concussion or suspected concussion to a parent, coach, or medical personnel. Although some symptoms of a concussion, such as loss of consciousness, are evident to observers, many others, such as dizziness or confusion, may be more difficult to identify (Echlin, 2010; Moreau, Langdon & Buckely, 2014). Continued play while symptomatic presents a health threat: symptomatic athletes who sustain an additional impact are at risk of magnified and potentially catastrophic neurologic sequelae (Borden, Tacchetti, Cantu, Knowles & Mueller, 2007; Prins, Alexander, Giza & Hovda, 2013). Despite the clear health risk of continued play while symptomatic, a growing body of evidence across a range of populations indicates that many athletes do not consistently engage in the important safety behavior of reporting symptoms of a possible concussion (Kerr et al., 2014).

A primary function of concussion education for athletes is thus to encourage honest and timely symptom disclosure to medical personnel. Consistent with this goal, concussion education for athletes is being increasingly required at all levels of sport. The majority of all U.S. states have passed legislation requiring some form of pre-participation information provision about concussions to high school athletes and/or their parents (Harvey, 2013; Baugh, Kroshus, Bourlas & Perry, 2014a). Similarly, National Collegiate Athletic Association (NCAA) instituted a policy in 2010 that requires that institutions provide athletes with "informational materials about concussions" on an annual basis (NCAA, 2013). However, questions have recently been raised about the effectiveness of these general information-provision mandates (Kroshus, Daneshvar, Baugh, Nowinski & Cantu, 2014a; Baugh et al., 2014a). For example, a pilot study of the information delivered to male collegiate ice hockey players found that when all of the decisions about concussion education are left to the institution or team there is marked variability in what information athletes receive, how it is delivered, and whether it changes any cognition related to concussion safety (Kroshus et al., 2014a). Further, when the athletes in this sample were surveyed one day after educational materials were delivered, many did not recall that they had even received these materials (Kroshus et al., 2014a).

As more concussion education programs are being evaluated, a growing body of evidence is finding inconsistent efficacy and is highlighting the need for evidence-based program development (Kroshus et al., 2014a, Kroshus, Baugh, Daneshvar & Viswanath, 2014b, Echlin et al., 2010; Bagley et al., 2012; Cook et al., 2003; Miyashita, Timpson, Frye, Gloeckner, 2013; Cusimano, Chipman, Donnelly & Hutchinson., 2013; Manasse-Cohick & Shapley, 2014). The Theory of Planned Behavior (Ajzen, 1991) in particular has been highlighted as a potentially appropriate framework for the development of concussion education programs for athletes (Register-Mihalik et al., 2013; Chrisman, Quitiquit & Rivara, 2013; Kroshus et al., 2014b). Provvidenza and colleagues (2013) have outlined the importance of designing concussion education that meets the knowledge needs of a given population and that is delivered in a population-appropriate manner. In addition to ensuring that the educational programs are theory-driven, decisions about how educational material is communicated to athletes are critical for how the information is processed and whether it is retained.

Public health professionals have an important role to play in designing, disseminating and evaluating concussion education materials for athletes. Despite growing concern about public health burden of concussions from sport (Rivara & Graham, 2014; Harmon et al., 2013) and increasingly widespread mandates about concussion education (Harvey, 2013; Baugh et al., 2014a; NCAA, 2013), the disciplines of health communication and health education are not well integrated with the disciplines of sports injury prevention in general or concussion-related research and practice in particular (King-Chung & Hagger, 2012; McGlashan & Finch, 2010; Verhagen, van Stalen & van Mechelen, 2010). A starting point for those seeking to improve the concussion education provided to athletes involves accurately characterizing the concussion education currently being provided, and understanding what athletes consider to be their needs and priorities (Gilmore, 2011; Dickinson & Raynor, 2003). While felt needs are only one dimension to consider in the program planning process, and while individuals do not always accurately characterize their true needs, they nonetheless represent an important first step.

The present study focuses on collegiate athletes at National Collegiate Athletic Association (NCAA) member institutions. More than 450,000 students at U.S. colleges compete in sport sponsored by the NCAA. The risk of injury at the collegiate level has been found to be higher than at lower levels of competition (Daneshvar, Nowinski, McKee & Cantu, 2011). The study had two aims. The first was to determine the content and delivery modalities of the concussion education currently being provided to U.S. collegiate athletes. The second aim was to report what a sample of athletes would like the concussion education delivered by their institution to look like in terms of content, source, and delivery modalities.

METHODS

Sample and procedure

Data were collected from two distinct populations: 1) athletic trainers who provide patient care for athletes at NCAA member institutions, and 2) U.S. collegiate athletes at NCAA member institutions.

Athletic trainers are assigned to cover a particular sports team and are almost always the party responsible for delivering concussion education to student-athletes; if they are not responsible directly they are involved in the coordination of its delivery (Kroshus et al., 2014a). Consequently, they were considered the party who would be most able to accurately characterize the concussion education provided to collegiate athletes. Athletic trainers were contacted in September 2013 using an email distribution service provided by the NCAA Sport Science Institute, and invited to complete an electronic survey about concussion management practices at their institution. Additional information about the broader study is available elsewhere (blinded for review). Of the 2462 athletic trainers from 1066 institutions who received the recruitment email, 789 individuals from 276 institutions participated in the study, for an individual response rate of 32.0% and an institutional participation rate of 25.9%. All participants provided informed consent prior to viewing survey questions. The survey was hosted on the Qualtrics platform. Study activities were approved by the Institutional Review Boards at Harvard School of Public Health and Boston University Medical Center.

To recruit the sample of college athletes, twelve institutions in the New England region of the U.S were contacted and invited to allow their athletes to participate in a survey about concussions. Institutions were eligible for inclusion if they participated in National Collegiate Athletic Association (NCAA) competition but were not a member of a “Power 5” conference (a designation given to the five most athletically competitive collegiate conferences; NCAA 2014). This decision was made so as to have the sample more closely reflect the competitive level of the majority of participants in U.S. collegiate sport. A total of four schools, two from Division I and one each from Divisions II and III, agreed to provide their coaches with the option of allowing their team members to participate on a voluntary basis. Participating schools were not significantly different from non-participating schools in terms of their enrollment, size of athletic program, public or private funding, or mean standardized test scores of entering students. At participating schools, contact or collision sports teams other than football or ice hockey were eligible for inclusion. These other contact or collision sports teams have an elevated risk of concussion (e.g., Hootman, Dick & Agel, 2007; Daneshvar et al., 2011; Rosenthal et al., 2014) but receive substantially less media and research focus. Of the 35 eligible teams at participating institutions, 19 teams coaches agreed to allow team members to participate on a voluntary basis. The sports included in the sample were soccer, lacrosse, basketball, volleyball, baseball, and softball. On these participating teams, a total of 325 athletes completed surveys. In sum, the institutional participation rate was 25%, the team participation rate at those institutions was 54% and the individual participation rate on those teams was 74%. Athletes provided informed consent prior to participation. Surveys were administered in-person by a member of the research team during the spring of 2014.

Measures

The survey questions asked of athletic trainers and of athletes were developed specifically for the purpose of this study and feedback was sought about the content and clarity of questions from a small sample of each target population. Athletic trainers completed questions that characterized the concussion education provided to athletes at their institution. Specific areas queried were who delivers the education to athletes (athletic trainer, physician, athletic department administrator, other), what format the education takes (e.g., lecture, video), and what content areas are covered in the education. All response options are listed in Tables 1 and 2. Athletic trainers were also asked whether all athletes at their institution receive the same concussion education, or whether there is variability by team.

Collegiate athletes completed questions starting with the stem “If you were in charge of designing concussion education for athletes at your school...” They were asked to indicate from whom they would want to education delivered (athletic trainer, physician, coach, other) and their preferred format for this education. For both areas queried they were permitted to select more than one response option and were provided with space to add unlisted response options. They were also asked to indicate the extent to which they would like a list of five topics to be covered. Response were on a five point scale, ranging from 1=not at all to 5=a lot. All response options are listed in Tables 3 and 4. Athletes also indicated whether they had received concussion education materials from their institution that year.

Analysis

Half of the responding athletic trainers (49.0%) indicated that different teams at their institution receive different forms of concussion education. Consequently, responses are described in the text at the level of the individual athletic trainer. Institution-level response rates are also presented in Tables 1 and 2. Where there were multiple respondents at an institution and their selections were not consistent, a category of “Mixed responses” is indicated. Among athletes, content preferences were classified as “Preferred” if the athlete selected a four or five on the five-point scale. The proportion of individuals endorsing a given response option for education delivery, format, and preferred content options are reported for the sample as a whole and separately for male and female athletes. For the question asking from whom they would like concussion education to be delivered, Pearson χ^2 tests for between-team differences in proportion were conducted to determine whether there are differences in educational preferences attributable to individual as opposed to role characteristics.

RESULTS

Education delivered

Nearly all of the responding athletic trainers (91.3%) indicated that athletic trainers were involved in delivering concussion education to athletes. Around ten percent (9.7%) indicated that physicians were involved in this process and 13.9% indicated that athletic department administrators were involved. The education was most frequently delivered through a formal meeting or lecture (77.9%) or with written materials (74.6%). Other formats employed with moderate frequency included providing directions to access online materials (21.5%), showing a video (30.7%) and hanging a poster (19.8%).

Nearly all of the responding athletic trainers indicated that athletes received information about symptoms of concussions (97.1%), the importance of reporting symptoms of concussions (92.4%), and information about proper management of a concussion (88.4%). Many also received information about the possible long-term consequences of concussions (76.9%) and the impact on athletic performance of continued play with an undiagnosed concussion (70.0%). Of the athletic trainers who indicated that athletes are provided with information about possible long-term consequences, most indicated that athletes were provided with information about Post-Concussion Syndrome (78.2%) or Second Impact Syndrome (55.4%). Some indicated that athletes were provided with information about possible changes in mood or behavior, such as impulsivity or depression (55.4%) or general cognitive decline (43.5%). Around a quarter were provided with information about the association between concussions and suicidal ideation or suicide (22.5%) or with Chronic Traumatic Encephalopathy (24.7%).

Athlete preferences

Eighty percent of the responding athletes indicated that they received educational information from their school this year. Most athletes indicated that they would like concussion education to be delivered by their athletic trainer (83.1%), but many also wanted a physician (54.5%) or their coach (40.9%) to be involved in this process. There were

significant differences in the extent to which different teams preferred specific stakeholders as a source for education delivery. There were significant differences between teams in whether or not athletic trainers (Pearson $\chi^2 = 45.11$, $p < 0.001$) or physicians (Pearson $\chi^2 = 39.15$, $p = 0.003$) were preferred. There were no between-team differences in whether coaches were a preferred source of information (Pearson $\chi^2 = 21.16$, $p = 0.271$).

Over half of the athletes indicated that they would like the information delivered in the form of a lecture (57.4%) or a video (54.0%). Fewer indicated that they would like information in the form of a written handout (28.7%), poster (21.3%), email (19.8%), online materials (13.0%), or webinar (7.1%).

Most athletes indicated that they would like to have concussion education cover all of the content areas that were provided as response options in the survey. These include symptoms of a concussion (89.0%), information about proper management of a concussion (84.9%), information about possible long-term consequences of concussions (84.5%), the impact of concussions on athletic performance (87.0%), or academic performance (86.1%), and information about the importance of reporting concussion symptoms (82.6%). On average, athletes indicated a preference for obtaining information from around four content areas.

DISCUSSION

Concussion education for athletes has the potential to help reduce the public health burden of these prevalent sport injuries. Characterizing the concussion education currently being provided to U.S. collegiate athletes, and understanding their preferences in terms of content and delivery, are important first steps in the program planning process. The present study finds that at most U.S. colleges, concussion education is being provided to athletes by the team's athletic trainer. While most of the athletes surveyed indicated that they would like concussion education from their athletic trainer, many also indicated a preference to have information from other sources. Around 40% of athletes indicated that they wanted information about concussions from their team's coach. As coaches are clearly less expert in medical issues than physicians or athletic trainers, it is possible that these athletes are indicating that in addition to the content of the safety information they want to know that their coach knows about and endorses this information. Consequently, expanding the focus of individuals who deliver concussion education from solely physicians and athletic trainers to also include coaches (potentially in tandem with medical personnel) may be an appropriate delivery strategy in some settings.

Regardless of whether coaches are the person or among the persons formally delivering concussion education to athletes, they can play an important role in establishing a team's culture of safety. Recent evidence from a sample of collegiate football players finds that a perception that the team coach would want them to report their concussion was significantly associated with the likelihood that individual engaged in that safety behavior (Baugh, Kroshus, Daneshvar & Stern, 2014b). Verbal communication between coaches and athletes is one way in which these preferences may be revealed. Involving coaches in helping deliver concussion education materials to athletes, alongside athletic trainers and/or team physicians, may be one strategy to encourage coach-athlete safety communication.

Concussion education for coaches themselves may help facilitate this type of informational communication: coaches who are more knowledgeable about concussions and who more strongly hold attitudes supporting concussion safety are more likely to communicate to their athletes in support of concussion safety (Kroshus, Baugh & Daneshvar, 2015). However, just as there is variable and often limited effectiveness of the concussion education delivered to athletes so too can there be limited effectiveness in the materials delivered to coaches (Rivara et al., 2014). Thus, to the extent institutions decide to engage coaches in helping deliver concussion education to athletes, it is important that institutions also ensure that the coaches themselves are adequately and appropriately educated.

Of note is that variability was found between teams in the proportion of team members preferring delivery of concussion education from athletic trainers or team physicians. This finding raises the possibility that individual personalities or perceived clinician attributes (e.g., perceived credibility) matter and that different sources may be more or less appropriate in a particular setting. Given this between-team variation, institutional officials designated with coordinating concussion education delivery should consider asking team captains about whether there are strong preferences about from whom they receive concussion education. Additional research is needed to identify whether there are clinician attributes that make them be perceived by athletes to be more or less credible sources of concussion information.

In the format of the information there was divergence between what athletic trainers reported was being delivered and the expressed preferences of the athletes surveyed. Most athletic trainers indicated that information was delivered through a formal lecture or with written materials. It is not surprising that most information was delivered in these formats: the most easily accessible concussion education for collegiate athletes is a downloadable written handout (CDC, 2014). Giving athletes a brief talk about concussion safety while passing out the handout was the format employed by most of the athletic trainers in a pilot study of male collegiate ice hockey teams (Kroshus et al., 2014a). However, there is little evidence about the efficacy of these frequently utilized handouts, and there is likely a high degree of variability in the nature of the “lecture” provided by athletic trainers to athletes about concussion. While more than half of the athletes in the present sample indicated that they would like information delivered through a formal lecture, only around a quarter indicated that they would like information delivered through a written handout. More than half indicated a preference for information delivered in the form of a video. An advantage of video delivery is that the content can be standardized, and as compared to a lecture the quality of concussion education that athletes receive is not contingent on the knowledge and enthusiasm of the institutional personnel from whom it is delivered. However, at present it is not apparent whether there are any concussion education videos with demonstrated efficacy among college athletes. A recent randomized evaluation of two existing publically available concussion education videos found a complete absence of efficacy in changing concussion knowledge, concussion safety cognitions or concussion safety behaviors (Kroshus et al., 2014b). Thus, there is a clear need for theory-driven population-appropriate concussion education videos to be developed and evaluated. Public health professionals are encouraged to work closely with athletes to develop and iteratively evaluate video or other multimedia programming about concussions that meets the target population’s knowledge needs and communication preferences.

Most of the content areas that athletic trainers indicated were covered in the education provided to athletes were also those areas that athletes desired to be covered; however, there were a few areas of divergence. Most (84.5%) athletes indicated that they would like information about the athletic consequences of continued play with a concussion; however fewer (70.0%) of the responding athletic trainers indicated that this information was provided to athletes. Perceptions about the athletic consequences of continued play with a concussion have been identified as a particularly important correlate of concussion reporting behavior (Kroshus et al., 2014b). More broadly, a growing body of evidence is finding that symptom reporting is a volitional process with cognitive predictors other than just the ability to recognize when a concussion has occurred—these include modifiable factors such as perceived norms and perceived outcomes of symptoms reporting (Kroshus et al., 2014a; Kroshus et al., 2014b; Kroshus, Baugh, Daneshvar, Nowinski & Cantu, 2014c; Register-Mihalik et al., 2013; Chrisman, Quitituit & Rivara, 2013). The Theory of Planned Behavior (TPB; Ajzen, 1991) has been suggested by several recent publications as a potentially relevant framework for concussion education program design (Chrisman et al., 2013; Register-Mihalik et al., 2013a; Kroshus et al., 2014b). Although no athlete-education programs with published evaluations have to-date explicitly used TPB in their design, suggestions have been made about the types of intervention components that could help address its constructs. To modify attitudes about the expected outcomes of concussion reporting, corrective information could be provided. For example, to the extent athletes believe that if they report a concussion and are removed from play they will be letting their team down, information could be provided about how athletes who continue playing while symptomatic have slower reaction time (Eckner et al., 2014) and may in fact be hurting their team (Kroshus et al., 2014b). To modify team norms, one possibility is to provide team members and coaches with an opportunity to clarify their shared values about concussion safety and to establish safer injunctive team norms (Kroshus, Kubzansky, Goldman & Austin, 2014d). This strategy has been successfully employed in college cross-country running to shape team norms about help seeking for disordered eating (Kroshus, Goldman, Kubzansky & Austin, 2014e). To the extent concussion reporting norms are misperceived (Kroshus et al., 2014d), efficacious interventions to correct norms could be build from existing programming that has demonstrated efficacy in correcting alcohol consumption norms among college students. For example, an interactive educational session with college athletes that provided real-time feedback about the alcohol consumption attitudes of other athletes in attendance and was found to be effective in correcting alcohol consumption norms (Labrie, Hummer, Grant & Lac, 2010). This type of interactive approach could be evaluated for possible inclusion in concussion education programming.

Limitations

A primary limitation of this study is its generalizability. While all athletic trainers at NCAA member institutions were included in the sampling frame, only 32.0% chose to participate in the study. Those who responded by have been more knowledgeable about concussions and may have provided their athletes with concussion education that is notably different from that provided by non-responding athletic trainers. It is also possible that the results from the athlete sample are not generalizable to all U.S. collegiate student-athletes, or to athletes at other levels of competition. While the response rates among participating teams was high,

athletes were only recruited from one region of the country, and participation was contingent on both institutional and coach agreement. Consequently, those athletes who participated in this study may have been in sport environments in which concussion safety was taken more seriously than in other sporting environments, and this may be related to their preferences for concussion education. Another way in which the generalizability of this study may be limited is that there were no participants from football or ice hockey teams. This was a purposive choice as the majority of research in this area to-date has focused on football and male ice hockey teams to the exclusion of other contact and collision sports, however it does limit the generalizability of the results to all sports. Additionally, because of the small number of participating teams per sport, between-sport comparisons were not appropriate. Research in larger samples is encouraged to explore whether there are between-sport differences in concussion education preferences.

Additionally, it is possible that the observed incongruence between what the athletes want in terms of concussion education and what is currently delivered may be a function of the imperfect match between the samples of athletic trainers and athletes. Athletic trainers were recruited nationally and athletes were recruited from a small number of institutions from one region of the country. Needs assessments should be conducted in other sporting populations before developing concussion education programming targeted at those specific populations.

Conclusion

This study finds some disconnect between the concussion education that athletes indicate they want and the education that tends to be currently received, in terms of content, source, and delivery modality. Ensuring that concussion education meets the learning preferences of athletes is an important step in making these materials more efficacious. While the present findings point to some areas of preference for a subset of collegiate athletes, the broader message is that institutional officials who are responsible for overseeing the selection of concussion education should consider obtaining regular feedback from the athletes to whom the education is being delivered to ensure that it is meeting their felt needs. However, this is only one part of ensuring that effective concussion education is delivered to athletes. Although not the empirical focus of the present manuscript, existing evidence indicates that there is a lack of concussion education programming for collegiate athletes with demonstrated effectiveness.

Improving concussion education—to meet the felt needs of athletes and to ensure that the materials delivered do in fact change concussion-safety related cognitions—is a task that invites an interdisciplinary approach. Clinicians who work with athletes and those who study concussions from a biomedical perspective bring critical information about the nature, symptoms and consequences of concussions and what risk reducing actions athletes can take. However, designing effective communication strategies to change behavior is a discipline unto itself and health education and health behavior specialists can work collaboratively with sports medicine clinicians to develop and evaluate materials that are both consistent with athlete preferences and rooted in theories of health communication and best practices for program planning, dissemination and evaluation.

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Table 1

Report by athletic trainers about the source and delivery modalities of concussion education delivered to U.S. collegiate athletes

Who delivers education about concussions? (n=309 individual, 184 institutions)		
	Individual level n (%)	Institution % (n)
Athletic trainer	91.3% (282)	Yes 91.3% (168) Mixed 1.1% (2)
Physician	9.7% (30)	Yes 7.6% (14) Mixed 0.5% (1)
Athletic department administrator	13.9% (43)	Yes 11.4% (21) Mixed 2.2% (4)
In what format is education about concussions delivered? (n=489 individuals, 276 institutions)		
	Individual level % (n)	Institution % (n)
Formal meeting/lecture	77.9% (381)	Yes: 73.2% (202) Mixed: 4.4% (12)
Informal conversation	14.3% (70)	Yes: 9.8% (27) Mixed: 6.5% (18)
Written materials	74.6% (365)	Yes: 73.2% (202) Mixed: 6.2% (17)
Directions to access online materials	21.5% (105)	Yes: 21.0% (58) Mixed: 7.0% (19)
Webinar	0.6% (3)	Yes: 0.4% (1) Mixed: 0.4% (1)
Email	4.3% (21)	Yes: 3.6% (10) Mixed: 1.9% (5)
Video	30.7% (150)	Yes: 29.3% (81) Mixed: 3.7% (10)
Poster	19.8% (97)	Yes: 17.8% (49) Mixed: 5.1% (14)
Other	2.7% (13)	Yes: 2.2% (6) Mixed: 1.5% (4)

Table 2

Report by athletic trainers about the content of concussion information is delivered to athletes? (n=490 individuals, 276 institutions)

	Individual level % (n)	Institution % (n)
List of symptoms of a concussion	97.1% (476)	Yes 266 (96.4%) Mixed 2 (0.7%)
Information about proper management of a concussion (e.g., concussion evaluation, return to play protocol)	88.4% (433)	Yes 239 (86.6%) Mixed 11 (4.0%)
Information about the long-term consequences of concussions ^I	76.9% (377)	Yes 201 (72.8%) Mixed 20 (7.3%)
Post-Concussion Syndrome (PCS)	78.2% (295)	Yes 161 (75.9%) Mixed 12 (5.6%)
Second Impact Syndrome (SIS)	83.0% (313)	Yes 170 (80.2%) Mixed 11 (5.2%)
Chronic Traumatic Encephalopathy (CTE)	24.7% (93)	Yes 49 (23.1%) Mixed 12 (5.6%)
Other types of dementia (e.g., Alzheimer's disease)	13.0% (49)	Yes 19 (9.0%) Mixed 13 (6.1%)
Motor Neuron Disease (e.g., Lou Gehrig's Disease/ALS)	4.0% (15)	Yes 9 (4.2%) Mixed 4 (1.8%)
Parkinson's Disease	4.8% (18)	Yes 9 (4.2%) Mixed 5 (2.3%)
General cognitive decline	43.5% (164)	Yes 82 (38.7%) Mixed 24 (11.4%)
Changes in mood or behavior (e.g., impulsivity, depression)	55.4% (209)	Yes 115 (54.2%) Mixed 21 (9.8%)
Suicidal ideation/suicide	22.5% (85)	Yes 38 (17.9%) Mixed 14 (6.6%)
Other	1.3% (5)	Yes 4 (1.9%)
Impact on athletic performance of continuing playing with an undiagnosed concussion	70.0% (343)	Yes 67.0% (185) Mixed 7.7% (21)
Importance of reporting symptoms of concussions	92.4% (453)	Yes 91.3% (252) Mixed 2.2% (6)
Other	2.0% (10)	Yes 1.1% (3) Mixed 1.5% (4)

^I Only those people who answered yes to info provided about long-term consequences as a general category (n=377) were included in the assessment of responses to specific questions about long-term consequences

Table 3

Report by U.S. collegiate athletes about the content they would like covered in the concussion education provided by their institution (n=318)

	% (n)
List of symptoms of a concussion	89.0% (283)
Information about proper management of a concussion	84.9% (270)
Information about the long-term consequences of concussions	84.5% (269)
Impact on athletic performance of concussions	87.0% (277)
Impact on academic performance of concussions	86.1% (274)
Information about the importance of reporting concussion symptoms	82.6% (263)

Table 4

Report by U.S. collegiate athletes about their preferred delivery modalities for concussion education provided by their institution (n=324)

Format	% (n)
Lecture	57.4% (186)
Handout	28.7% (93)
Online	13.0% (42)
Webinar	7.1% (23)
Email	19.8% (64)
Video	54.0% (175)
Poster	21.3% (69)

Table 5

Report by U.S. collegiate athletes about their preferred source of concussion education provided by their institution, and between team comparisons (n=325 individuals, 19 teams)

Source	% (n)	Pearson χ^2 (p) ^I
Athletic trainer	83.1% (270)	45.11 (<0.001)
Physician	54.5% (177)	39.15 (0.003)
Coach	40.9% (133)	21.16 (0.271)

^I Pearson χ^2 for between-team differences in proportion wanting information delivered from each source; 18 degrees of freedom.

Note: Respondents were allowed to select more than one source.