

Student-athlete concussion disclosure and coach communication within collegiate athletics

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Abstract:

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Keywords: Concussion | athlete | college | disclosure

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Keywords

Concussion, athlete, college, disclosure

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Introduction

Between 1.6 and 3.8 million sports- and recreation-related traumatic concussions occur in the United States annually, and this number is steadily increases.¹ Among a nationally represented sample of collegiate student-athletes, the overall concussion rate was 4.47 per 10,000 student-athlete exposures (95% CI, 4.25–4.68).² These data, along with the myriad of consequences related to concussion underscore a growing public health concern.

A concussion is a subset of mild traumatic brain injury caused either by a direct blow to the head, face, neck, or elsewhere on the body with a force

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diffused to the head.^{1,3} If properly treated and managed, most individuals who suffer a concussion recover in approximately 7–14 days.^{3–5} Conversely, an untreated concussion can lead to a variety of complications including delayed recovery, potentially more complicated brain injuries over time as well as irreversible damage to the developing brain.^{4–6} The symptomatic period post-injury is a particularly vulnerable time as sustaining additional head trauma during this period has been linked to prolonged recovery and possibly second impact syndrome.^{7,8}

Monitoring a student-athlete who has sustained a potentially concussive impact from play is critical for risk reduction and treatment.⁹ Subsequently, they should be immediately removed from practice/competition if they begin to show any signs and symptoms of a concussion. For this to happen the concussive event must either be directly observed or disclosed by the athlete; however, in many cases, the concussive event is not observable and the symptoms (e.g. dizziness, confusion) are internal to the student-athlete.^{3,6,10} Significant proportions of student-athletes who experienced symptoms of a potential concussion did not disclose their symptoms; for example, among high school and college student-athletes, more than 50% of potential sport-related concussions go undisclosed.^{11–13} Their non-disclosure may be attributed to limited concussion knowledge^{6,14}; however, it is more likely due to a variety of factors such as gender, sport, level of competition, prior concussion diagnosis, perceived severity or seriousness of the injury, concussion attitudes, and/or perceived reporting norms.^{6,7,10–12,15–23}

Individual level factors, like those already noted, are important to understand concussion non-disclosure but there are external factors that likely contribute to delayed or non-disclosure as well. The Social Cognitive Theory specifies that learning occurs in a social context with reciprocal interaction between the person, environment, and behavior.²⁴ The coach–student-athlete relationship is one that has received much attention in previous research and within the context of the concussion disclosure and education. Coaches serve as external factors that can reinforce and set expectations of student-athlete behavior. The impact of coach–student-athlete relationships is well established^{25–29} and has been associated with student-athlete behaviors such as sportsmanship,³⁰ psychosocial, and team outcomes,³¹ and intrapersonal factors such as self-esteem, performance anxiety, and motivation.³² Specific to concussion disclosure, coach–athlete attachment has been associated with concussion disclosure intentions among National Collegiate Athletic Association (NCAA) collegiate student-athletes.³³ This study demonstrated that as coach–student-athlete anxiousness decreased, and coach–student-athlete secureness increased, concussion disclosure intentions

increased. Thus, further illuminating the important role coach–athlete relationships have on student-athlete behaviors.

The purpose of this study was to investigate the potential impact of coach communication about concussion disclosure on NCAA student-athlete intentions to disclose symptoms of a concussion. For this study, we used intentions to report because previous studies have identified them as a reliable measure for predicting future athlete reporting behavior.²⁰ This study also attempted to investigate the impact of coach communication about concussion disclosure on NCAA student-athlete intentions to encourage another student-athlete to disclose their symptoms of a concussion. Specifically, this study aimed to answer the following research questions: (a) to what degree is coach communication about concussion disclosure associated with student-athlete's intentions to disclose concussion symptoms to a coach or athletic trainer/sports medicine staff member and (b) to what degree is coach communication about concussion disclosure associated with student-athlete intentions to encourage another student-athlete to disclose their concussion symptoms? It was hypothesized that coach communication about concussion disclosure positively impacts intentions to disclose symptoms of a concussion to a coach or athletic trainer/sports medicine staff member. Similarly, it was hypothesized that coach communication positively impacts student-athlete intentions to encourage another student-athlete to disclose their concussion symptoms. Lastly, due to the potential influence of biological sex, year in school, athletic division, sport category (e.g. collision, contact, limited contact), and season status, these variables were also included in the final statistical models.

Methods

Participants

Participating schools for this study were recruited by promoting the study by way of a national athletic trainers' listserv that serves collegiate athletic trainers located in the United States. Then, once a school agreed to participate, the athletic trainer then promoted the study with their respective student-athletes. Additional recruitment details are provided in the Procedures section below and illustrated in Table 1. The final sample was equally represented by male and female student-athletes, all academic years, and student-athletes who were involved in collision, contact, or limited contact sports. The sample included more NCAA Division I student-athletes when compared to Divisions II and III as well as more student-athletes who indicated

Table 1. Sample characteristics (n = 2881).

Demographic	n	%
Sex		
Male	1379	48.2
Female	1477	51.6
Age		
18	708	27
19	651	24.9
20	539	20.6
21	476	18.2
22	167	6.4
23	38	1.5
24	9	0.3
25+	11	0.4
Year		
First year	966	36.9
Second year	650	24.8
Third year	509	19.5
Fourth year	430	16.4
Fifth year	61	2.3
Division		
I	1382	48.0
II	747	25.9
III	751	26.1
Sport category		
Collision	1157	40.7
Contact	681	23.9
Limited contact	1007	35.4
Season		
In	1869	65.3
Out	992	34.7
Race/ethnicity		
White	1865	71.0
Black	369	14.1
Hispanic/Latino	183	7.0
Other	208	7.9

that they were in-season. Lastly, the sample was represented by a greater number of White student-athletes when compared to all other races/ethnicities. The study protocol was approved by a review committee on the protection of human participants.

Measures

Coach communication. As a measure of coach communication, student-athletes reported their coach's communication practices concerning concussion safety across multiple items. Student-athletes endorsed either "no" = 1 or "yes" = 2 to the following six survey items: (a) *my coach talked to our team about the importance of managing concussions properly*; (b) *my coach keeps an open dialogue about concussion safety on our team*; (c) *my coach told our team that we should keep a look out for teammates who may have sustained a concussion*; (d) *my coach told our team that if we think a*

teammate is experiencing symptoms of a concussion, we should encourage him/her to seek medical attention; (e) *my coach told our team if we think a teammate is experiencing symptoms of a concussion and not seeking medical attention, we should tell a coach, athletic trainer, or other medical personnel ourselves*; and (f) *after a teammate experienced a concussion, our coach encouraged him/her to take all the time he/she needed to recover properly*. A coach communication score was computed by summing the student-athlete coach communication responses. The internal consistency reliability of the computed coach communication measure was established ($\alpha = .95$) prior to subsequent analyses.

Intentions to disclose concussion symptoms. Intentions to disclose concussion symptoms were measured by eliciting from student-athletes how likely it would be for them to disclose symptoms of a concussion to specific members of their athletic community (i.e. their coach or an athletic trainer/sports medicine staff member). Student-athletes were asked (a) *"If you were to experience a blow to the head/body after which you had experienced signs of a concussion, how likely are you to tell your coach?"* and (b) *"If you were to experience a blow to the head/body after which you had experienced signs of a concussion, how likely are you to tell an athletic trainer/sports medicine staff member?"*. The same type of question was used in relation to their willingness to encourage another student-athlete to disclose their symptoms. Student-athletes were asked *"If you suspected another student-athlete was experiencing symptoms of a concussion, how likely are you to encourage another student-athlete to disclose concussion symptoms of a concussion"*. For each intentions question, response options included 1 = extremely unlikely to 5 = extremely likely. Adequate levels of internal consistency reliability were established for the intentions to disclose concussion symptoms to a coach measure ($\alpha = .88$), intentions to disclose concussion symptoms to an athletic trainer/sports medicine staff measure ($\alpha = .89$), and intentions to encourage another student-athlete to disclose their concussion symptoms measure ($\alpha = .86$).

Demographic information. Student-athlete participants were invited to indicate their *biological sex*, *age*, *year in school* (first year, second year, third year, fourth year, or fifth year), *athletic division* (e.g. divisions I, II, or III), *age*, *season status* (e.g. in-season, out of season), and *race*. Additionally, based on self-reported sport participation, student-athletes were assigned to a sport category variable which classified them as a *collision*, *contact*, or *limited contact* sport participant. This classification was defined by NCAA's definition of contact sport category.³⁴

Student-athletes who participated in field hockey, football, ice hockey, lacrosse, pole vault, rugby, skiing, soccer, and wrestling were coded as *collision*. Student-athletes who participated in baseball, basketball, cheerleading, diving, equestrian, gymnastics, softball, or water polo were coded as *contact*. Student-athletes who participated in bowling, cross country, fencing, golf, rifle, rowing, swimming tennis, track and field, or volleyball were coded as *limited contact*.

Procedures

Data for this study were collected during the Fall of 2016. A two-level recruitment process was used to invite NCAA collegiate student-athletes to participate in the study. First, institutions were recruited through a national athletic trainers' listserv that serves many collegiate athletic trainers located in the United States. If an interested athletic trainer reached out to our research team, they were then provided with additional details of the study. Once a school agreed to participate, the athletic trainer (who served as an institutional liaison) was provided participation instructions. Initially, 28 colleges/universities expressed interest to participate in the study; ultimately a total of 16 schools agreed to participate. Next, after institutions agreed to participate an institutional liaison was identified to assist with individual participation. At all institutions the liaison was the head or assistant athletic trainer. The institutional liaison worked with their respective athletic department to gather and deliver all current student-athlete names and email addresses ($N = 4214$) to the research team. Student-athletes were included if they were a current NCAA student-athlete attending an NCAA member institution. As part of the consent process, student-athletes under the age of 18 bypassed data collection instruments but still received access to any subsequent programming associated with the study. To initiate data collection, student-athletes received a personalized email that included information related to their institution's participation in the study, additional study details, and instructions on how to participate. The email invitation also included unique log-in information (username and password) that provided each student-athlete access to consent documents and data collection instruments. A total of 2881 (68.36%) student-athletes completed the pre-test survey, which is the focus of the present study.

Data analysis

Multiple linear regression was conducted to investigate the predictive relationships of *coach communication*, *biological sex*, *year in school*, *athletic division*, and *sport category* (e.g. contact vs. collision vs. limited

contact) on *intentions to disclose concussion symptoms*. Dummy codes were used for nominal independent variables: *male*, *first year*, *division I*, and *contact* served as referent groups in the analyses. Three separate models were created to test the effects of the independent variables on intentions to disclose concussion to a coach, intentions to disclose concussion to an athletic trainer/sports medicine staff member, and intentions to encourage another student-athlete to disclose their concussion symptoms.

Results

Table 2 provides descriptive statistics of coach communication practices reported by student-athletes and Table 3 provides descriptive statistics of student-athlete concussion disclosure intentions.

Intentions to report to a coach

Endorsement of *coach communication* by student-athletes significantly predicted student-athlete intentions to disclose concussion symptoms to their coach. That is, as coach communication endorsement increased, likelihood to disclose their concussion symptoms to a coach in the future also increased. *Biological sex*, *division*, and *sport category* also significantly contributed to intentions to report concussion symptoms to a coach. Female student-athletes were more likely to disclose symptoms of a concussion to a coach. Division II student-athletes were more likely to disclose their concussion symptoms to a coach when compared to the referent group (division I). Lastly, student-athletes who compete in a contact or limited contact sport were more likely to disclose their concussion symptoms to a coach when compared to the referent group (i.e. collision sport). Detailed results of this model are provided in Table 4.

Intentions to report to an athletic trainer/sports medicine staff member

Endorsement by student-athletes of *coach communication* significantly predicted their intentions to disclose concussion symptoms to an athletic trainer/sports medicine staff member. In other words, the more a student-athlete reported that their coach communicated with them about concussion-like issues (e.g. safety and disclosure), likelihood of disclosing their concussion symptoms to an athletic trainer/sports medicine staff member in the future also increased. *Biological sex* and *sport category* also significantly contributed to intentions to report concussion symptoms to an athletic trainer/sports medicine staff member. Female student-athletes were more likely to disclose symptoms

Table 2. Descriptive statistics for perceived coach communication.

Variable/item	No (%)	Yes (%)
<i>My coach talked to our team about the importance of managing concussions properly</i>	513 (25)	1457 (74)
<i>My coach keeps an open dialogue about concussion safety on our team</i>	537 (29)	1330 (71)
<i>My coach told our team that we should keep a look out for teammates who may have sustained a concussion</i>	611 (33)	1247 (67)
<i>My coach told our team that if we think a teammate is experiencing symptoms of a concussion, we should encourage him/her to seek medical attention</i>	540 (28)	1357 (72)
<i>My coach told our team if we think a teammate is experiencing symptoms of a concussion and not seeking medical attention, we should tell some coach, athletic trainer, or other medical personnel ourselves</i>	548 (29)	1326 (71)
<i>After a teammate experienced a concussion, our coach encouraged him/her to take all the time he/she needed to recover properly</i>	262 (17)	1553 (83)

Table 3. Descriptive statistics for intentions to disclose ($n = 2529$).

Variable/item	M(SD)
Intentions . . .	
<i>to report concussion symptoms to coach</i>	3.8 (.90)
<i>to report concussion symptoms to an athletic trainer/sports medicine staff member</i>	3.9 (.90)
<i>to use bystander behavior</i>	3.9 (.79)

Table 4. Linear regression model of intentions to disclose concussion symptoms to a coach.

Independent variables	B	SE B	β	P-value
Female	.139	.050	.075	.006
Second year	-.032	.062	-.015	.603
Third year	-.047	.066	-.021	.470
Fourth year	.026	.071	.010	.718
Fifth year	-.233	.163	-.037	.154
Division II	.174	.058	.082	.003
Division III	.030	.058	.014	.609
In season	-.073	.054	-.037	.178
Contact sport	.184	.065	.085	.005
Limited contact sport	.309	.058	.154	.000
Coach communication	.105	.011	.260	.000

Note: $R^2 = .086$.

of a concussion to an athletic trainer/sports medicine staff member, so too were student-athletes who were either a contact or limited contact sport participant. Detailed results of this model are provided in Table 5.

Intentions to encourage another student-athlete to disclose concussion symptoms of a concussion

Endorsement of *coach communication* by student-athletes significantly predicted student-athlete intentions to encourage another student-athlete to disclose

Table 5. Linear regression model of intentions to disclose concussion symptoms to an athletic trainer/sports medicine staff member.

Independent variables	B	SE B	β	P-value
Female	.187	.050	.102	.000
Second year	-.023	.062	-.011	.714
Third year	-.079	.066	-.035	.229
Fourth year	.056	.070	.023	.428
Fifth year	-.229	.166	-.036	.168
Division II	.112	.058	.053	.054
Division III	.005	.058	.002	.936
In season	-.059	.054	-.030	.273
Contact sport	.168	.065	.078	.010
Limited contact sport	.283	.058	.142	.000
Coach communication	.079	.011	.198	.000

Note: $R^2 = .062$.

concussion symptoms of a concussion. That is, as endorsement of coach communication increased, so too did intentions to encourage another student-athlete to disclose their concussion symptoms. *Biological sex* and *sport category* also significantly contributed to intentions to encourage another student-athlete to disclose concussion symptoms of a concussion. Female student-athletes were more likely to encourage another student-athlete to disclose symptoms of a concussion. Student-athletes who compete in a contact or limited contact sport were also more likely to encourage another student-athlete to disclose symptoms of a concussion when compared to the referent group (i.e. collision sport). Detailed results of this model are provided in Table 6.

Discussion

The purpose of this study was to investigate the potential impact of coach communication about concussion disclosure on student-athlete intentions to disclose

Table 6. Linear regression model of intentions to encourage another student-athlete to disclose concussion symptoms.

Independent variables	B	SE B	β	P-value
Female	.200	.043	.126	.000
Second year	-.097	.053	-.053	.067
Third year	-.060	.057	-.030	.289
Fourth year	-.075	.061	-.035	.217
Fifth year	-.066	.140	-.012	.635
Division II	.095	.050	.052	.058
Division III	-.010	.050	-.005	.848
In season	-.047	.046	-.028	.312
Contact sport	.194	.056	.105	.001
Limited contact sport	.253	.050	.147	.000
Coach communication	.085	.009	.246	.000

Note: $R^2 = .085$.

symptoms of a concussion as well as student-athlete intentions to encourage another student-athlete to disclose their concussion symptoms.

Consistent with previously indicated hypotheses, coach communication significantly positively impacted student-athlete intentions to disclose symptoms of a concussion to a coach and intentions to disclose symptoms of a concussion to an athletic trainer/sports medicine staff member. The NCAA requires members institutions to provide their student-athletes, coaches, team physicians, athletic trainers, and directors of athletics with a concussion fact sheet as part of the institution's preseason education. To support member institutions, the NCAA Sport Science Institute provides a variety of educational materials on their website. However, based on the findings of this study significant attention should be given to the role a coach can play regarding concussion safety and disclosure. Coaches play an important role in a student-athlete's life, including their health and safety. Collegiate coaches are presented with many opportunities to communicate their concussion disclosure sentiments with student-athletes. Coaches should use these opportunities to purposefully communicate with their athletes during pre-season team meetings, during team meetings throughout their season and more indirectly through everyday conversation. To support coaches and their concussion safety efforts, education and training is critical. Because they have the potential to impact student-athletes' intentions and possible behaviors, more effective educational strategies should be used to assist them in supporting student-athlete well-being. Educational efforts must first target coach attitudes related to concussion disclosure and then prepare them to use effective communication skills needed to actively communicate supportive concussion disclosure ideals to their student-athletes.³⁵

This study also investigated the relationship between coach communication about concussion disclosure and student-athlete intentions to encourage another student-athlete to disclose their concussion symptoms. Consistent with previously stated hypotheses, coach communication predicts student-athlete intentions to encourage another student-athlete to disclose their concussion symptoms to a coach or athletic trainer/sports medicine staff member. This is a unique and important finding and has not been investigated in other studies. Not only does supportive communication from a coach regarding concussion safety encourage student-athletes to disclose concussion symptoms, it appears that coach communication promotes a culture of support between players as well. The idea of looking out for the well-being of others is known as bystander intervention behavior and is built on the processes of diffusion of responsibility, audience inhibition, and social influences.³⁶ In the context of concussion disclosure, findings from this study suggest that coach communication impacts student-athlete intentions to use a type of bystander behavior and encourage another student-athlete to disclose potential concussive symptoms. Sport naturally provides an environment where athletes look out for one another (e.g. team unity). Coaches can capitalize on this and use the sport environment to support concussion safety by encouraging their student-athletes to look out for one another. Educational efforts for coaches ought to instruct coaches on how to (a) communicate support for concussion bystander behavior and (b) utilize the sport environment to encourage bystander behavior of student-athletes. Since the concept of applying bystander intervention theory to concussion disclosure is new, additional research is warranted to further explore how it can be used to promote concussion safety among student-athletes.

In addition to investigating the relationship between coach communication and student-athlete intentions to disclose concussion symptoms, this study also assessed the impact of biological sex, year in school, athletic division, sport category (e.g. collision, contact, limited contact), and season status.

Female student-athletes reported greater intentions to disclose concussion symptoms to a coach, athletic trainer/sports medicine staff member, and encourage another student-athlete to disclose their symptoms when compared to their male counterparts. This finding is consistent with other studies^{15,37} and highlights the potential need to tailored concussion intervention for male student-athlete. Whereas tailored intervention for male student-athletes may be beneficial, it is possible that intentions to disclose concussion symptoms are not purely a product of biological sex but another underlying/related factor. For example, the culture of

a sport such as football (a masculine-driven sport) may influence players to be tough and in-turn influences their intent to report. This is an important consideration for concussion safety and was first discussed by Kroshus et al.³⁷ who introduced the role of sport ethos (i.e. gendered behavior), rather than biologically determined sex, regarding concussion disclosure. Whereas current literature identifies biological sex as an important factor related to concussion disclosure, future research should consider using additional measures of masculinity, sport culture, and ethos. Those developing concussion education programming ought to consider integrating and evaluating specific intervention messaging and strategies tailored to male and female student-athletes that include messaging that challenges norms related to sport culture and sport ethos.

Like biological sex, participating in a contact and participating in a limited contact sport significantly impacted each of the outcomes of interest when compared to the referent group (collision). Limited contact sport had the greatest impact on intentions to disclose concussion symptoms to a coach, to an athletic trainer/sports medicine staff member, and to encourage another student-athlete to disclose their concussion symptoms when compared to other sport types. Since concussions are less likely for limited contact sport student-athletes, if they do happen to experience symptoms, they take the potential injury seriously. In contrast, a student-athlete who participates in a collision sport where concussions may be more of the norm (e.g. football, hockey, lacrosse) may be more likely to self-diagnose their symptoms as “normal” or not in need of attention. Similarly, related to the commonplace of injury, collision sport student-athletes who may have suffered a concussion in the past are more likely to continue play while symptomatic.²² Particular attention should be given to collision sport student-athletes who are also more at risk for potential future studies as well as interventions ought to consider ways to specifically target this at risk population.

Lastly, when compared to NCAA division I participation, division II athletes were more likely to disclose their concussion symptoms to a coach. This was not the case for intentions to disclose concussion symptoms to an athletic trainer/sports medicine staff member or to encourage another student-athlete to disclose their concussion symptoms. Whereas differences between athletic division do exist (e.g. scholarships, number of men and woman teams, type of school), this study did not deconstruct the athletic division variable so that these differences could be investigated further. Therefore, although findings of this study suggest that factors associated with division II sport participation significantly contribute to student-athlete intentions to

disclose concussion symptoms to a coach, additional research is needed to further parse out variables inherent to division II that are potentially producing outcomes noted in this study.

Limitations and implications for future directions

As with many studies, this one is not without its limitations. A participation rate of 68% indicates that there were approximately one-third of student-athletes who chose not to participate in the study. It must be noted that it is potential that the one-third of student-athletes who did not participate also included a higher number of student-athletes who have not or will not disclose concussion symptoms to a coach, athletic trainer, or other sports medicine staff member. Whereas survey response is important, more critical is whether the sample is representative of the target population. In this study, the demographics of the current sample are similar to that of NCAA's student-athlete population³⁴ and can be considered generalizable. Additionally, based on typical participation rates for online surveys,³⁸ a participation rate approaching 70% that includes over 2800 participants should be noted as sufficient for a cross-sectional study such as the one presented in this paper.

Based on an article by Kroshus et al.,³⁷ and noted previously, gendered behavior rather than biological sex is an important factor to consider related to concussion disclosure. The present study did not include a measure of gendered behaviors (e.g. conformity to masculine norms) and this may have proven to be a more accurate explanation of concussion disclosure. Future studies investigating concussion disclosure ought to thoughtfully consider including variables related to sport culture, student-athlete ethos, and/or masculinity.

In this study, the main independent variable of interest (coach communication) was included in each of the final models alongside other important variables related to concussion disclosure. Even though significant predictor variables emerged, each of the final models only accounted for a relatively small amount of variance in intentions to disclose symptoms of a concussion (see R^2). While coach communication appears to be a factor related to intentions to disclose symptoms of a concussion, it is also evident the models presented in this article do not present full explanation of concussion disclosure among collegiate student-athlete; for example, it is important to note that concussion history was not included in the data and could be a factor that is not accounted for. Regardless of the relatively low explanation of intentions to disclose concussion symptoms by the presented models, coach communication ought to be considered as a potentially important

predictor variable in future studies investigating concussion disclosure among collegiate student-athletes.

Conclusions

Findings from this study provide additional support of the important role coaches play in a student-athlete's life and introduce preliminary evidence suggesting the impact of coach communication on student-athlete intentions to disclose concussion symptoms. Additionally, this study presented unique findings related to student-athlete bystander intervention intentions; specifically, how coach communication influences student-athlete intentions to encourage another student-athlete to disclose their concussion symptoms. Finally, this study noted important differences between contact/limited contact student-athletes and collision student-athletes. Future studies and behavioral interventions ought to include coach communication or other coach-related variables when exploring and/or attempting to impact concussion disclosure among athletes as well as consider the efficiency of targeting most at risk populations such as student-athletes who participate in collision sports.

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References

- Institute of Medicine (IOM) and National Research Council (NRC). *Sports-related concussions in youth: improving the science, changing the culture*. Washington: The National Academies Press, 2014.
- Zuckerman SL, Kerr ZY, Yengo-Kahn A, et al. Epidemiology of sports-related concussion in NCAA student-athletes from 2009–2010 to 2013–2014: incidence, recurrence, and mechanisms. *Am J Sports Med* 2015; 43: 2654–2662.
- McCrory P, Meeuwisse W, Aubry M, et al. Consensus statement on concussion in sport – the 4th international conference on concussion in sport held in Zurich. *Clin J Sport Med* 2013; 23: 89–117.
- Choe MC, Babikian T, DiFiori J, et al. A pediatric perspective on concussion pathophysiology. *Curr Opin Pediatr* 2012; 24: 689–695.
- Shrey DW, Griesbach GS and Giza CC. The pathophysiology of concussions in youth. *Phys Med Rehabil Clin North America* 2011; 22: 577–602.
- Register-Mihalik JK, Guskiewicz KM, Valovich McLeod TC, et al. Knowledge, attitude, and concussion-reporting behaviors among high school student-athletes: a preliminary study. *J Athl Train* 2013; 48: 645–53.
- Kroshus E, Daneshvar DH, Baugh CM, et al. NCAA concussion education in ice hockey: an ineffective mandate. *Br J Sports Med* 2013; 48: 135–140.
- Kroshus E, Kubzansky LD, Goldman RE, et al. Norms, athletic identity, and concussion symptom under-reporting among male collegiate ice hockey players: a prospective cohort study. *Ann Behav Med* 2015; 49: 95–103.
- Asken BM, Bauer RM and Guskiewicz KM. Immediate removal from activity after Sport-Related Concussion is associated with shorter clinical recovery and less severe symptoms in collegiate student-athletes. *Am J Sports Med* 2018; 46(6): 1465–1474.
- Kerr ZY, Register-Mihalik JK, Marshall SW, et al. Disclosure and non-disclosure of concussion and concussion symptoms in student-athletes: review and application of the socio-ecological framework. *Brain Inj* 2014; 28: 1009–1021.
- Torres DM, Galetta KM, Phillips HW, et al. Sports-related concussion: anonymous survey of a collegiate cohort. *Neurology Clin Pract* 2013; 3: 279–287.
- Llewellyn T, Burdette GT, Joyner AB, et al. Concussion reporting rates at the conclusion of an intercollegiate athletic career. *Clin J Sport Med* 2014; 24: 76–79.
- Meehan WP, Mannix RC, O'Brien MJ, et al. The prevalence of undiagnosed concussions in athletes. *Clin J Sport Med* 2013; 23: 339–342.
- Delaney JS, Lacroix VJ, Leclerc S, et al. Concussions among university football and soccer players. *Clin J Sport Med* 2002; 12: 331–338.
- Brown DA, Elsass JA, Miller AJ, et al. Differences in symptom reporting between males and females at baseline and after a Sports-Related Concussion: a systematic review and meta-analysis. *Sports Med* 2015; 45: 1027–1040.
- Chrisman SP, Quitiquit C and Rivara FP. Qualitative study of barriers to concussive symptom reporting in high school athletics. *J Adolesc Health* 2013; 52: 330–335.
- Davies SC and Bird BM. Motivations for underreporting suspected concussion in college athletics. *J Clin Sport Psychol* 2015; 9: 101–115.
- Kerr ZY, Register-Mihalik JK, Kroshus E, et al. Motivations associated with nondisclosure of self-reported concussions in former collegiate student-athletes. *Am J Sports Med* 2015; 44: 220–225.
- Kroshus E, Baugh CM, Daneshvar DH, et al. Understanding concussion reporting using a model based on the Theory of Planned Behavior. *J Adol Health* 2014; 54: 269–274.
- Kroshus E, Baugh CM, Daneshvar DH, et al. Concussion reporting intention: a valuable metric for

- predicting reporting behavior and evaluating concussion education. *Clin J Sport Med* 2015; 25: 243–247.
21. Kroshus E, Garnett BR, Baugh CM, et al. Social Norms Theory and concussion education. *Health Educ Res* 2015; 30: 1004–1013.
 22. Kroshus E, Chrissman SPD, Milroy JJ, et al. History of concussion diagnosis, differences in concussion reporting behavior, and self-described reasons for non-report. *J Clin Sport Psychol* 2018. <https://doi.org/10.1123/jcsp.2017-0036>
 23. Baugh CM, Kroshus E, Daneshvar DH, et al. Perceived coach support and concussion symptom-reporting: differences between freshmen and non-freshmen college football players. *J Law, Med Ethics* 2014; 42: 314–322.
 24. Bandura A. Health promotion by social cognitive means. *Health Educ Behav* 2004; 31: 143–164.
 25. Jowett S and Cockerill IM. Olympic Medalists' perspective of the student-athlete-coach relationship. *Psychol Sport Exerc* 2003; 4: 313–331.
 26. Kish CR and Woodward RJ. The impact of positive motivational techniques by coaches on the achievement levels of men's junior college basketball players. *Missouri J Health Phys Educ Recreation Dance* 2005; 15: 6–15.
 27. Gould D, Collins K, Lauer L, et al. Coaching life skills through football: a study of award winning high school coaches. *J Appl Sport Psychol* 2007; 19: 16–37.
 28. Miller PS, Salmela JH and Kerr G. Coaches' perceived role in mentoring student-athletes. *Int J Sport Psychol* 2002; 33: 410–430.
 29. Rhind DJA and Jowett S. Relationship maintenance strategies in the coach-student-athlete relationship: the development of the COMPASS model. *J Appl Sport Psychol* 2010; 22: 106–121.
 30. Bolter ND and Weiss MR. Coaching behaviors and adolescent athletes' sportpersonship outcomes: further validation of the Sportsmanship Coaching Behaviors Scale (SCBS). *Sport Exerc Perform Psychol* 2013; 1: 72–90.
 31. Price MS and Weiss MR. Relationships among coach leadership, peer leadership, and adolescent athletes' psychosocial and team outcomes: A test of transformational leadership theory. *J Appl Sport Psychol* 2013; 25: 265–279.
 32. O'Rourke DJ, Smith RE, Smoll FL, et al. Relations of parent- and coach-initiated motivational climates to young athletes' self-esteem, performance anxiety, and autonomous motivation: who is more influential? *J Appl Sport Psychol* 2014; 26: 395–408.
 33. Milroy JJ, Hebard S, Kroshus E, et al. Sport-related concussion reporting and coach-student-athlete attachment among collegiate student-athletes. *J Clin Sport Psychol* 2018; 12(2): 268–81.
 34. National Collegiate Athletic Association. NCAA demographics database (data visualization dashboard), www.ncaa.org/about/resources/research/ncaa-demographics-database (2018, accessed 10 December 2019).
 35. Kroshus E, Garnett BR, Hawrilenko M, et al. Concussion under-reporting and pressure from coaches, teammates, fans, and parents. *Soc Sci Med* 2015; 134: 66–75.
 36. Latané B and Darley JM. Group inhibition of bystander intervention in emergencies. *J Pers Soc Psychol* 1968; 10: 215–221.
 37. Kroshus E, Baugh C, Stein CJ, et al. Concussion reporting, sex, and conformity to traditional gender norms in young adults. *J Adolesc* 2017; 54: 110–119.
 38. Fosnacht K, Sarraf S, Howe E, et al. How important are high response rates for college surveys? *Rev Higher Educ* 2017; 40: 245–265.