

Improving Concussion-Reporting Behavior in National Collegiate Athletic Association Division I Football Players: Evidence for the Applicability of the Socioecological Model for Athletic Trainers

Monica R. Lininger, PhD, LAT, ATC*; Heidi A. Wayment, PhD†; Debbie I. Craig, PhD, LAT, ATC‡; Ann Hergatt Huffman, PhD†; Taylor S. Lane, MA†

Departments of *Physical Therapy and Athletic Training and †Psychological Sciences and ‡Athletic Training Program, Northern Arizona University, Flagstaff

Context: Few researchers have examined the views of important stakeholders in football student-athletes' spheres of influence and whether their views map well in a systems approach to understanding concussion-reporting behavior (CRB).

Objective: To examine the extent to which stakeholders' beliefs about what influences football players' CRBs reflect system-level influences that go beyond individual-level factors.

Design: Qualitative study.

Setting: Four National Collegiate Athletic Association Division I university athletic programs.

Patients or Other Participants: A total of 26 individuals (athletic directors = 5, athletic trainers [ATs] = 10, football coaches = 11).

Data Collection and Analysis: Semistructured interviews with stakeholders were transcribed and analyzed using the socioecological model according to the Miles and Huberman coding methods.

Results: Stakeholders largely identified individual-level factors (attitudes), followed by exosystem-level factors (university policies and support for ATs), with fewer microsystem- and mesosystem-level factors (coach influence and communication between coaches and ATs, respectively) and almost no macrosystem-level factors (media influence, cultural norms about aggression and toughness in football).

Conclusions: Promising evidence indicates growing stakeholder awareness of the importance of exosystem-level factors (eg, medical personnel and CRB policies) in influencing CRB rates. However, frontline stakeholders and policy makers may benefit from practices that bridge these influences (eg, coach involvement and communication), allowing for a more integrated approach to influence student-athletes' willingness to improve their CRBs.

Key Words: theories, mild traumatic brain injuries, head trauma

Key Points

- Stakeholders most frequently commented on individual-level factors.
- Consideration of microsystem, mesosystem, exosystem, and macrosystem factors is critical for improving concussion-education interventions.

Authors of recent studies^{1–3} in the area of sport-related–concussion (SRC) prevention argued effectively that increasing the rates at which student-athletes report SRCs requires an understanding of the factors affecting concussion-reporting behavior (CRB) that go beyond a student-athlete's knowledge of the risks and symptoms. The most well-known systems theory is the *Bronfenbrenner socioecological model* (SEM),⁴ which posits that human behavior is a function of synergistic and reciprocal influences between the individual and the settings in which he or she operates (microsystem), the interaction among those settings (mesosystem), the environments that indirectly affect the settings (exosystem), and cultural ideologies (macrosystem). Several researchers^{2,5–20} have used elements of this model to make similar arguments. Register-Mihalik et al² recommended that in order for athletic trainers (ATs) to design more effective

interventions, they should consider factors at multiple levels, such as community or interpersonal levels of influence. Although CRB researchers have referred to the Bronfenbrenner SEM,^{1,2} have tested part of the model,^{5–20} or have adapted the model by collapsing across systems categories,^{1,2} to our knowledge, no investigators have used the full Bronfenbrenner model to assess factors that contribute to CRBs. Consideration of microsystem, mesosystem, exosystem, and macrosystem factors, in addition to individual-level factors, is critically important if novel interventions are to be designed, implemented, and examined for effectiveness.

OVERVIEW OF THE SEM AND CRB

At the center of the SEM is the individual and his or her behavior. In the context of football-related CRBs, we

assume a player's willingness to report is influenced by his or her attitudes, perceptions, and motivations. The 3 factors that have received the most empirical attention related to CRB are perceptions of the seriousness of SRC (attitudes), the role of social support (social norms), and the willingness to report (self-efficacy). Additional factors that are believed to affect these predictors include knowledge of SRC symptoms²¹ and the health risks associated with not reporting, athletic identity, and playing technique.

Moving from the innermost portion of the SEM, the *microsystem* includes the settings where student-athletes spend their time and the individuals with whom they interact in these settings.^{22–25} Factors at the microsystem level that could influence players' perceptions and attitudes about concussion reporting include the relationships the student-athlete has with others in those important settings (ie, football-related, academic, and social settings) such as coaches, teammates, ATs, and parents. Examples of microsystem factors include how individuals in these settings feel about concussion reporting, their knowledge of symptoms and risks, how they communicate about SRC concerns, and any pressure that may be applied by those individuals to report or not report. *Mesosystem* factors reflect the relationships among microsystem settings. The frequency with which coaches and ATs communicate about SRCs could be assessed and would reflect the connections among important microsystem influences on a student-athlete. The extent to which coaches and ATs are disconnected in their messaging about the importance of reporting brain-injury symptoms may adversely affect a player's decision making.

Exosystem factors include the institutions (policies, history, culture) that influence settings. Specific institutional-level examples are the requirements and policies implemented by institutions such as the National Collegiate Athletic Association (NCAA) regarding athletic and academic concerns. Further examples are how entities such as universities or professional football teams enact SRC safety regulations, including providing safe playing and practice environments; support for adequate medical staff; provision of SRC education to student-athletes; and the implementation of preventive and SRC management strategies. Other examples are the development and dissemination, enforcement, evaluation, and revision of policies related to SRCs (eg, NCAA concussion legislation, state policies, return-to-play criteria at collegiate institutions and rule changes to the game of football).

Finally, *macrosystem*, or broad cultural, factors influence the institutions at the exosystem level. Cultural norms about football and its centrality in American culture, including norms of masculinity and athletic prowess, likely influence the attitudes of key stakeholders at the exosystem, microsystem, and individual levels. The popularity of football and the pressures from fans, alumni, and the media on coaches and players may indirectly affect a student-athlete's perception about whether to report an injury.^{26,27} Cultural norms addressing toughness and aggressiveness common in football²⁸ may influence players', coaches', and parents' beliefs (ie, social norms of playing with SRC symptoms) about the need to report injuries.²⁹ Examples of these cultural influences are evident in even casual remarks coaches make about their own football-playing days and how having one's "bell rung" is a normal part of the game.

Most authors^{5–13} who investigated factors influencing CRB have primarily assessed individual-level factors, such as a player's intention to report his or her symptoms. Only a handful of studies^{12,14–16} have examined the attitudes and beliefs of important individuals in the student-athlete's life (microsystem level). Often, these data reflect players' perceptions rather than their actual attitudes and beliefs. Even fewer researchers^{17–20} have assessed exosystem-level factors such as the effect of rule changes and state laws on the number of reported SRCs in a season. Consequently, most of the educational interventions that have been implemented and studied had goals of increasing or strengthening individual-level factors, such as players' knowledge^{9,30,31} of concussion symptoms or players' perceptions of the potential risks associated with participating while experiencing concussion symptoms. The goal of our study was twofold. First, we applied the Bronfenbrenner SEM to obtain a comprehensive assessment of CRB. Second, we examined the extent to which stakeholders considered items beyond individual-level factors in predicting CRB. To assess the model (Figure), we used a qualitative method and interviewed 26 collegiate football stakeholders from 4 Division I collegiate football programs in the United States.

METHODS

Research Design

The results described in this article were part of a larger mixed-methods study in which we used a modified, community-based participatory research approach to assess factors associated with CRB and implement strategies to improve these behaviors. For this portion of the study, a qualitative design including semistructured in-person interviews was applied to determine the CRB perceptions of the stakeholders associated with football student-athletes at the Division I level.

Participants and Procedure

Participants who were employed by 1 of 4 football programs were contacted by a member of the research team with details of the institutional review board–approved study. Through a purposeful sampling method, stakeholders from 2 football championship subdivision programs and 2 football bowl subdivision programs were invited to participate. These individuals had to interact directly with the student-athletes of their football program. A total of 27 stakeholders were contacted, but 1 declined to participate. Interviews were scheduled at a convenient time for the interviewee during the research team's visit to the university campus. Those interviewed were stakeholders from 4 NCAA Division I university football programs (5 athletic directors [ADs], 10 ATs, and 11 coaches). Before the interview, each recruit completed the informed consent process, which addressed the purposes of the study, specific methods used to maintain confidentiality of the data, and how the data might be used in the future as well as a statement that participation was completely voluntary. Each semistructured interview was conducted by a lead interviewer and a secondary interviewer. All interviewers (a total of 4 individuals) were trained and alternated between acting as lead and secondary interviewers. The lead

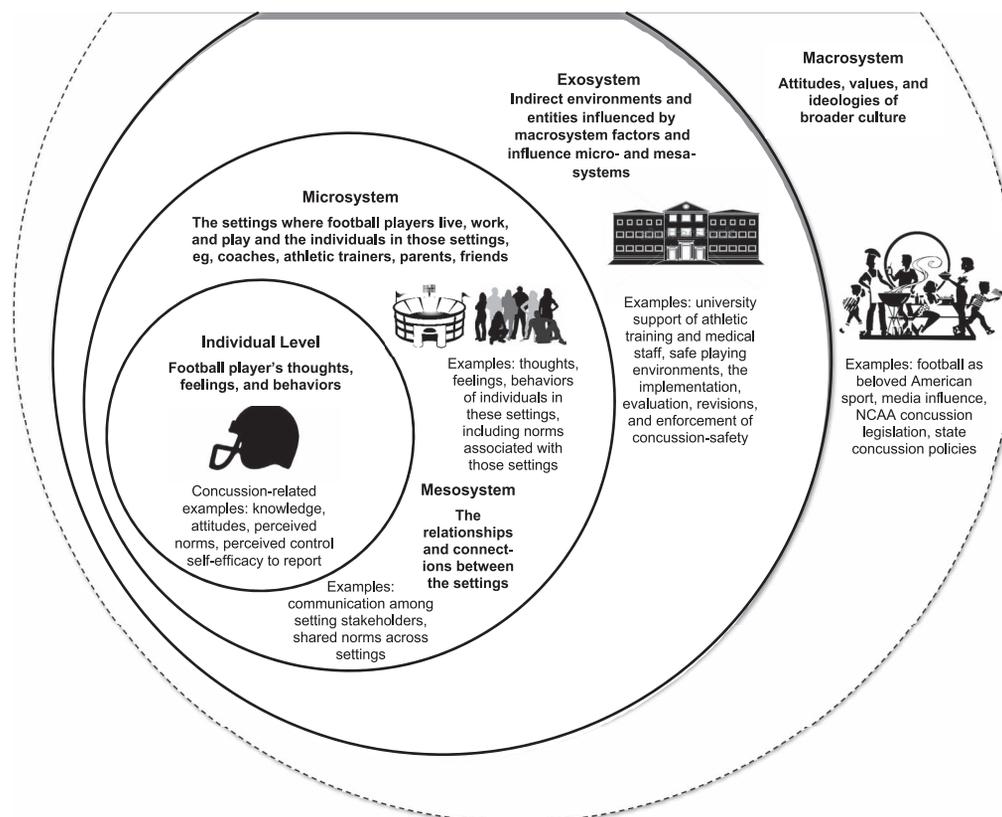


Figure. Examples of factors associated with each level of the socio-ecological model, from closest to the student-athlete to most removed. Abbreviation: NCAA, National Collegiate Athletic Association.

Table 1. Demographic Information by Participant

Participant Pseudonym	Stakeholder	Sex	Experience in Current Role	FBS or FCS
Bill	AD	M	7 y	FBS
Rich	AD	M	11 y	FBS
Ryan	AD	M	3 y	FCS
Steve	AD	M	6 y	FCS
Tom	AD	M	10 y	FCS
Benjamin	AT	M	3 y	FCS
Carl	AT	M	2 y	FCS
Chris	AT	M	24 y	FBS
Collin	AT	M	7 y	FBS
Jacob	AT	M	1 y	FCS
Joey	AT	M	3 y	FCS
Matthew	AT	M	3 y	FCS
Noah	AT	M	3 mo	FBS
Ron	AT	M	5 y	FBS
Taylor	AT	F	2 y	FBS
Charles	DC	M	3 y	FCS
Eric	DC	M	1 y	FBS
Tyler	DC	M	1 y	FBS
Brandon	HC	M	3 y	FCS
Henry	HC	M	1 y	FBS
Luke	HC	M	5 y	FBS
Michael	HC	M	6 y	FCS
Bradley	OC	M	3 y	FCS
Corey	OC	M	1 y	FBS
James	OC	M	9 y	FCS
Sean	OC	M	5 y	FBS

Abbreviations: AD, athletic director; AT, athletic trainer; DC, defensive coordinator; FBS, Football Bowl Subdivision; FCS, Football Championship Subdivision; HC, head coach; OC, offensive coordinator.

interviewer asked all of the questions while the secondary interviewer took notes. Interviews lasted an average of 45 minutes and were completed in each interviewee's office. All interviews were recorded for later transcription. Interviews were transcribed using ExpressScribe (NCH Software, Greenwood Village, CO) and an Infinity USB foot pedal (VEC Electronics Corp, Palisades Park, NJ). The transcriptionist was a member of the research team but was not involved in the analytic process. All transcriptions were labeled with a pseudocode and quotes were edited (eg, removing "uh," "um") to improve coherence of the interview for data analysis. The 26 participants were mostly men (2 women, 24 men) with a median of 4 years (range, 3 months to 24 years) of experience at their respective football programs (Table 1).

Interview Instrument

Three semistructured interviews were created so we could better understand CRB from the stakeholders' perspectives. Separate interviews were created for ADs, football coaches, and ATs (Table 2). During the pilot phase of the study, all questions and responses were evaluated and revised by the research team and then piloted at another institution's football program. The pilot interviews were administered to an AD, a head football coach, and an AT, all employed by the university athletics program. Neither the institution nor the participants from the pilot testing were included in the formal data-collection and -analysis process. In addition to this phase of pilot testing, 3 content experts reviewed each semistructured-interview script and provided feedback. After the pilot testing, minimal wording

Table 2. Semistructured In-Person Interview Guide^a

Question	Stakeholder
How do legal responsibilities affect how concussions are regarded and treated in your program? Can you think of a specific example where this legal responsibility has affected your program directly? What is your responsibility to these student-athletes after they graduate?	AD
What are the concussion screening practices here at your institution, with regards to: Do you ever have student-athletes report “after the fact” (a day or more after an event)? Do you have any insights as to why they chose to come to you a few days later?	AT
We are very interested in a student-athlete’s thought process he makes before making a decision to report a concussion. If you put yourself in the shoes of a football player that has just sustained what might be a concussion, what do you think the athlete is thinking? What thoughts or decisions would lead him to report it? What thoughts or decisions would lead him to not report at that time?	AD, AT, C
Do you think that some student-athletes are reluctant to report concussions? If so, why; if not, why not.	AD, AT, C
Based on your experiences, if you could design one or more strategies to help increase the reporting of a concussion, what would you recommend?	AD, AT, C
How would you describe the football coaching staff’s general attitudes toward concussion reporting? Can you provide an example that showcases these attitudes?	AD, AT

Abbreviations: AD, athletic director; AT, athletic trainer; C, coach.

^a Instrument is reproduced in its original form.

changes were made. Some questions were similar across all 3 interview protocols (eg, “Do you think that some student-athletes are reluctant to report concussions?”), whereas other questions were specific to the type of stakeholder (eg, “How would you describe the football coaching staff’s general attitudes toward concussion reporting?”).

Data Analysis

We chose to examine participants’ responses to 10 questions most likely to yield answers that would help explain their beliefs about why student-athletes reported or did not report SRC symptoms (Table 2). We implemented the Miles and Huberman³² approach to the SEM conceptual framework⁴ for data analysis. The codes used to analyze participant responses were derived from the SEM levels and operationally defined using specific examples (Table 3). All 5 members of the research team reviewed the coding matrix before the analytic process. Three members of the research team (M.R.L., D.I.C., T.S.L.) each identified themes associated with each SEM level and each predetermined code. After each member completed coding, the 3 met to compare results and reach consensus. Consensus was achieved when 2 of the 3 researchers were in agreement. Coding checks were performed after 25% and 75% of the analysis had taken place. Interrater reliability was calculated according to Miles and Huber-

Table 3. Levels of Socioecological Model and Codes

Socioecological Level	Code
Individual	Athlete’s knowledge Athlete’s attitudes Athlete’s perceived social norms Athlete’s perceived control Athlete’s self-efficacy
Microsystem	Knowledge and attitudes of coach, teammates, athletic trainers, and parents Perceived pressure from coach, teammates, athletic trainers, and parents
Mesosystem	Communication by and among coaches, teammates, athletic trainers, and parents
Exosystem	Support for institutional medical staff Safe playing environments Institutional-level review of policies and procedures Institutional support to enforce policies
Macrosystem	Cultural factors Media

man,³² whereby the number of agreements was divided by the sum of the total number of agreements and the number of disagreements. At the first coding check, the reliability measure was 88% (70/70 + 10); it increased to 92% (72/72 + 6) for the second coding check. Both reliability coefficients aligned with the parameters set forth by Miles and Huberman.³² Data saturation occurred when no new themes emerged during the analytic phase. Data saturation could not have occurred during sampling because this was part of a larger study of 4 institutions.

Trustworthiness of the Data

Several methods were used to establish trustworthiness of the data. First, the interviews were transcribed verbatim before analysis to ensure accuracy. Second, each member who completed the data analysis independently coded the data before the 3 met for discussion. Finally, the reliability measures presented previously ensured consistency in the coding process. These strategies, taken together, improved the rigor of this work.

RESULTS

We present the themes that emerged during the 20 hours of interviews with ADs, ATs, and coaches regarding the factors they believed to be most influential in understanding and trying to improve CRBs of football student-athletes. Quotes are provided with specific codes for each of the 5 SEM levels (individual, microsystem, mesosystem, exosystem, and macrosystem) in order of frequency. The quotes were from the AD, an AT, or a coach from one of the participating institutions. Descriptions are presented in order of frequency.

Individual-Level Factors

The vast majority, 25 of the 26 stakeholders, expressed ideas associated with individual-level factors that have been primarily examined in the literature on CRB, including student-athletes’ knowledge about the seriousness of SRCs, athletic identity, and SRC symptom knowledge. Participants described both positive and negative attitudes that

they believed student-athletes held toward SRCs and CRBs. Furthermore, they provided many examples suggesting that they believed student-athletes might not perceive SRCs as serious enough to report. Respondents often commented that they believed student-athletes played through injuries because they thought they were not at risk and could control their playing behavior. One coach, James, said, “They’re afraid of not being who they believe they are,” and Taylor, an AT, stated, “They think they’ll let the team down if they don’t play.” Rich, an AD, stated, “Kids today are assuming there is a reset button that ‘I can just press this button and it’s all better’”; whereas a coach postulated that student-athletes think “it’s like, ‘I’ll recover from this, that’s not a problem, I just want to play.’” An AT focused on the limited career many players have, commenting

So, I know the mentality of the athlete is that they’re out there to play football, and they only get a certain number of years to play football. So, they want to maximize their opportunities to be on the field.

The common idea was that student-athletes thought they could fix their health once they were done playing football competitively. One AD described many players who did not report concussions because of the investment in their athletic identity: “They’re competitive and they want to compete and so that’s part of what you’re fighting against.” However, a coach noted that attitudes associated with CRB might be changing:

I think more of them are now saying that, even if it’s the next day, they’re saying ‘You know I went to bed last night and I still had the headache and I’m not feeling right’ and that starts the protocol.

Other stakeholders believed that many student-athletes were concerned about the possible future health consequences of SRCs. Tom remarked, “I think most kids are pretty bright young people and are worried about their future, the long-term future,” whereas Ron, an AT, said, “I think the decision for them to report it is going to be concern for their health.” A coach, Tyler, described the thought process a student-athlete went through after sustaining a possible SRC:

There’s something wrong with me. I don’t feel comfortable with how I feel. I’m now aware that I may have something wrong with my head. That’s more important than me playing that 12th game.

Participants appeared to share the belief that student-athletes were becoming more aware of their future brain health; however, this awareness may not currently be enough to improve CRBs.

Although most of the recent efforts to improve CRBs have focused on increasing student-athlete knowledge, respondents spent little time discussing the importance of student-athletes’ SRC knowledge. Carl, an AT, suggested that student-athletes were becoming more knowledgeable about the severity of the injury:

With all the research coming out and as much as the NCAA and [National Football League] have done

toward concussions, I think players are starting to realize just how serious they are.

A coach, Tyler, referred to a behavior that an individual would exhibit even when the risks and consequences were known:

You can get cancer from this—and we smoke. Well, right? Well, if you have a head, your head hurts and you get hit, you could have a concussion that could lead to serious damage. [But we still do it.]

In general, stakeholders thought that student-athletes’ knowledge was indeed related to their CRBs.

Exosystem Factors

Of the 26 participants, 16 discussed factors at the exosystem level, or institutional influences that are affected by the larger culture but also influence systems, settings, and situations that influence players. Examples included the importance of medical staff, support for safe playing environments, and the value of SRC policies. Overall, the stakeholders expressed a great deal of support for having medical staff available to evaluate and diagnose those athletes with a possible SRC at each institution. This was evident from ATs’ statements such as “[Coaches] are very supportive and I think they trust us to do our jobs” or “[Coaches] are gonna let us do our job.” An AD, Ryan, showed his support by saying, “I think if I was aware of an assistant coach pushing a kid to get back to play, I know I would’ve said something to either [head coach] or that coach directly.” A different AD, Steve, commented: “But I tell the coach, ‘You know what? It is what it is. It’s the doc’s call.’” This perceived support allows the medical staff to care appropriately for those with SRC, which may lead to an increase in CRBs. For example, Steve noted, “I think anything regarding medical, your student-athlete’s well-being has got to be number 1. Student-athlete safety.” Brandon, a coach, remarked, “I believe there is a culture [here] that if in doubt, there’s confidence to be able to go in and talk to our doctors and [athletic] trainers.” Regarding the coaching staff, one AD, Ryan, suggested, “I really believe that he [head coach] is really here to make these kids better, not football.”

Respondents elaborated on their thoughts regarding important exosystem factors and referred to the significant influence of policy and legal concerns that can influence CRBs. Two ADs mentioned the legal ramifications associated with enforcing SRC policies. One said:

I think, for us, legally and morally, all of those things, it’s our duty as coaches, sports medicine, administrators, campus overall, to do what we say we’re going to do, which is take care of our student-athletes.

And the other said:

We’re very cautious about following protocol, in my opinion. And I think our doctor and [director of sports medicine] are very cautious about it. Concerned about it. Because we want to make sure we follow [protocol], so that there aren’t legal issues down the road.

An AT, Jacob, was impressed by how the medical staff enforced policy:

But especially here, since I've been here with [head AT], if anybody is going to say they have symptoms after getting a hit to the head, if they can remember taking a hit, we will hold them out and treat it as a concussion.

Stakeholders also provided examples regarding the importance of ADs, ATs, and coaches coming together to discuss the concern: "We sat down and said, 'We have a problem'" or "then we start having sessions about it [SRC] and start changing protocols." One coach, Charles, described how these meetings led to changes in the educational materials that were being delivered:

So, with it being a serious issue, understanding the repercussions and the seminars that we've gone to and show films and things of that nature that now, "Hey, this is a serious deal. So, if you feel this type of way, don't look past it and continue to move on and put yourself in a terrible situation where, as we know permanent damage of the head and neurologically that a lot of times that's it."

Rich spoke to revising policies:

And we probably have been more attuned to doing some things before we were told that we should do them. Perhaps would we have changed practice protocol for football if the [conference] wouldn't have said to do it? I don't know. That'd be a hypothetical question. We voted in favor of it and we had a football coach in favor of it.

Overall, participants supported the medical staff, safety of the student-athletes, and revisions to concussion-related policies.

Microsystem Factors

The next most frequent ideas were microsystem factors that reflected influences emanating from the student-athlete's important relationships (eg, friends, families, coaches, athletic training staff). Of the 26 stakeholders, 14 commented on themes associated with this level. Many of the statements mirrored the idea that the knowledge and attitudes of coaches, specifically, affected CRBs. One coach observed that student-athletes thought, "I gotta get through this so coach doesn't think I'm soft." An AT, Joey, recalled a student-athlete saying, "Coach pulled me [the student-athlete] from practice because I was having symptoms and didn't let me go back in," showing the progression of knowledge and attitudes specific to coaches. Joey continued, "We've also had coaches bring in kids a day later that said that they have a headache and couldn't focus in meetings." Respondents referred to the idea that student-athletes may feel pressure from those they consider important in their lives, such as parents or coaches. As Michael described, "So, sometimes there may be pressure from 'my parents are coming this weekend,' 'I want to see him [my kid] play,' and so on and so forth." Speaking as an AT, Benjamin explained the pressure from coaches in that they "don't want to lose their job because they don't have

their player on the field." The vast majority of the comments from ATs and ADs suggested that pressure, especially from coaches, could exert a negative influence on student-athletes' CRBs. Examples of negative influences were the perceptions student-athletes had about their coaches, such as the idea that a coach may perceive players who reported symptoms as "soft."

Mesosystem Factors

Mesosystem-level factors are related to the degree of communication among important stakeholders regarding CRB. Only 8 participants mentioned these ideas. In some cases, those responsible for student-athletes (eg, coaches, ATs, administrators) appeared to be working collaboratively, whereas others were not. With respect to the responsibilities of reporting and coaches' acceptance of players being sidelined with an SRC, a respondent said, "And I also know from my interactions with our doctors and sports medicine staff that there's been good mutual respect and I haven't heard any kind of grumblings [of disagreement]." A lack of communication could influence CRB. For example, Matthew discussed how "it's more difficult to get [coach's] attention in games [to communicate results of a concussion evaluation]." Communication among the stakeholders in regard to CRBs was largely positive.

Macrosystem Factors

Macrosystem-level factors are those broader cultural beliefs and ideologies that influence systems, settings, and ultimately student-athletes' individual-level attitudes, feelings, and behaviors. We had ample examples of these types of influences, most often presented as the cultural norms around football that value aggressive play and tough-minded players as well as how the national media shape the discourse regarding the SRC risk. This was the least discussed level of the SEM (only 6 of 26 stakeholders). Some participants believed that student-athletes might be reluctant to report a possible SRC because of the cultural ideologies regarding masculinity and aggression in American football. Many respondents addressed toughness: "That's just ingrained. It's a show of weakness and it's a sense of manliness and pride to play hurt"; "don't want to be perceived as a wimp"; "a culture of manly football"; and "concussions are just part of the game." However, at the same time, stakeholders believe this mentality might be changing in regard to CRB. An AD, Bill, acknowledged the change in attitudes of the coaching staff, stating that "even 10 years ago, it was 'Battle and fight through it.' . . . I see very little if any pushback [now]." An AT, Chris, observed that "It used to be, 'We have to be tougher than the other team.' Now it's like, 'I'll get another guy in there.'" Sport-related concussions are readily discussed in the mainstream media, which student-athletes view constantly. One coach, Michael, suggested that "All of the media attention has helped inform them [student-athletes] of the dangers. So, they might be more willing to report now." One AD commented on litigation in the media:

The great thing that came out of the class action [lawsuit] wasn't the monetary [settlement], it was getting

us to change protocols. Because that's ultimately what's going to make it better.

The common consensus among this sample of stakeholders was that the media attention on SRCs will improve overall CRBs.

DISCUSSION

In the past decade, the number of studies that examined factors associated with CRB has increased.^{12–15,18,33} In most cases, these authors^{5–20} have assessed individual-level factors; few^{1,2} investigated the influence of microsystem, mesosystem, exosystem, or macrosystem factors that influence CRB. As our results indicate, important stakeholders also recognized higher-order influences affecting student-athletes' CRB perceptions and attitudes. However, the fact that nearly all interventions focused solely on individual-level factors might explain why the interventions to date (which largely emphasized educating the individual student-athlete) have been unsuccessful in increasing CRB rates.^{7,21,34,35} To our knowledge, we are the first to examine the perceptions of frontline stakeholders' beliefs about what influences CRBs and whether these beliefs reflect an understanding of the microsystem, mesosystem, exosystem, and macrosystem influences on the individual student-athlete's willingness to report an SRC. Our rationale was that if these stakeholders are not able to recognize the importance of systems-level factors and their interaction, then "buy-in" to new and innovative efforts to increase CRB may be hampered. Our findings revealed a gap in that stakeholders' understanding focused on either individual-level factors or exosystem-level factors. Stakeholders focused mostly on these 2 levels for several reasons, but the primary reason was that educational interventions may be easier to implement than broader systems-level approaches. Furthermore, blaming larger cultural values may have unintended consequences: it is difficult to change entrenched cultural beliefs. Our results suggest that programs interested in strengthening CRBs among their athletes should consider steps they and their institutions can take using opportunities at the microsystem and mesosystem levels that may typically be overlooked or minimized.

Given that all 4 of our football programs placed great weight on following the NCAA guidelines for concussion education, it is not surprising that individual-level factors were the factors most commonly discussed by stakeholders and that the factors described were similar to those reported in the literature, such as attitudes about reporting,^{6,8,13} including student-athletes' desire to play,^{11,26,36} desire to not let their teammates down,^{26,37} and perceptions that SRCs may not be a serious risk.^{10,11,26} Although participants believed that student-athletes' knowledge of SRCs was increasing, this theme was not discussed as frequently as others within the individual level. Given that much of the research and many interventions to date have focused on increasing players' SRC knowledge, this finding was somewhat surprising.

We were encouraged that the next most frequent types of factors mentioned by respondents were those located in the exosystem, reflecting on the policies and procedures implemented at the university level. Stakeholders understood the important influence of the sports medicine staff,

safe playing environments, policies that positively affect CRBs, and the need for further support of these existing efforts. Our results showed strong backing for the idea that brain health and the number of reported SRCs were in the domain of a respected and trusted sports medicine staff. Participants also recognized the importance of the coach in student-athletes' well-being and safety. Higher-level sports administrators stressed the seriousness of enforcing, evaluating, and revising SRC policies. These findings are encouraging because they reflect an understanding of the important influences that lie outside the individual student-athlete looking out for his or her own health. The perception that these types of factors are important is not surprising given that the NCAA has charged football programs with implementing several policies regarding the role of ATs in SRC education, the development and oversight of concussion diagnostic tests, and return-to-play protocols.³⁸ Our results indicate that respondents were also aware of the significance of these exosystem-level factors. However, to date, only 3 groups^{17,19,20} have examined the effect of such factors on CRB rates.

The stakeholders we interviewed were least likely to identify factors influencing CRB that we classified as being at the microsystem, mesosystem, or macrosystem level. However, these factors may be especially important in strengthening the influence of system-level supports (eg, medical staff and reporting and treatment policies) on the individual student-athlete. The knowledge and attitudes of coaches were the most frequently mentioned topics at the microsystem level. Specifically, ATs often commented on their positive interactions with coaches (ie, coming to the ATs when they were concerned with the brain health of a student-athlete). Yet, stakeholders at different levels (ADs and ATs) discussed how external pressures (parents, coaches' jobs) could also affect the playing time of potentially concussed student-athletes. The only mesosystem factor identified by stakeholders was important: namely, communication between coaches and ATs. Taken together, these findings suggest that stakeholders may be inadvertently underestimating the importance of these factors. Coaches are hired to win football games, whereas the sports medicine staff is charged with keeping the student-athletes healthy and safe. A student-athlete is caught in the middle of these 2 authorities when appropriate communication does not transpire.

Finally, our analyses revealed minimal appreciation by participants of the macrosystem factors such as football's identification with toughness and the role of the media in perpetuating these messages or influencing public perceptions of SRCs. The idea that the "culture of football" influenced CRBs was suggested by several respondents. This is not surprising because the culture of football values playing through pain and giving one's all for the game and team.³⁷ It could also be that stakeholders understood that this influence, although important, may be the most challenging to overcome. An example of visible cultural change was reflected in stakeholders' comments about the media. Media attention was seen as a positive influence in reporting on SRCs and highlighting their potential dangers. Participants appeared to place less importance on such macrosystem factors for several reasons. First, the macrosystem factors are the furthest away from the individual making the reporting decision. Therefore, these distant

factors have less of an obvious influence on these individuals; the influence may be greater than our findings would indicate, but perhaps stakeholders did not think about these concerns when describing their perceptions related to CRBs. Second, cultural influences could be perceived as beyond their control. Though this may be true, understanding how these powerful cultural messages affect university policies and how those policies and supports influence the social networks of student-athletes is important.

Limitations and Future Research

As with any research, we must consider limitations. Because our sample comprised collegiate-level stakeholders from 4 university athletic programs, the extent to which our results generalize to other Division I football programs is uncertain. Furthermore, our findings may not apply to the perceived factors affecting CRBs among football student-athletes competing at other levels (eg, Division II, III, community college, high school) or athletes playing different sports. Another limitation is that our interviews were conducted at a single point in time, at the beginning of the 2016 football season, thereby limiting longitudinal assessment or understanding.

The quick pace of advances in concussion-related research suggests that we need long-term longitudinal research with timely assessment of the effectiveness of educational and intervention efforts to understand this rapidly changing area. For instance, the factors that influence student-athletes may change as a function of a player's football career. Longitudinal studies that measure factors across the system levels would also provide insight into the most influential factors (eg, exosystem: NCAA policies might effect change more than the National Junior College Athletic Association policies). Future authors could assess stakeholders' perceptions of all SEM-level factors by explaining the levels and asking for factors that exist at each level or simply asking stakeholders to think of all of the reasons that could explain student-athletes' CRBs. Finally, it is important to note that we studied the insights of ADs, ATs, and coaches and did not include those of student-athletes. Whereas this is a strength of the study, it would also be worthwhile to assess players' perceptions of how factors within different levels of the SEM affect their own CRBs.

CONCLUSIONS

We used the Bronfenbrenner SEM to categorize the perceptions of frontline stakeholders in NCAA Division I football programs regarding the factors they perceived as affecting CRBs. Athletic directors, ATs, and coaches continued to believe that CRB was primarily the responsibility of student-athletes. The implications of our findings are that in order to heed the call of researchers for more systems-level intervention approaches, frontline stakeholders in Division I football programs continue to need education. This education should include the systemic, situational, social, and cultural influences on CRBs that could be accompanied by recommendations regarding specific strategies that consider the athletes' social, educational, and athletic settings; how to strengthen the

program's safety culture; and how to strengthen institutional capacities to reach desired CRB goals.

ACKNOWLEDGMENTS

We thank the Research Grand Challenge: Changing Attitudes about Concussion in Young and Emerging Adults, which was sponsored by the NCAA and the US Department of Defense, for funding this research. The views expressed in this article do not necessarily represent the official policy or position of the NCAA or the US Department of Defense. We thank graduate assistants Patrick Doyle, MS; Keragan Cavolo, BS; and Emilee Jung, BA, for all their work in support of this research.

REFERENCES

1. Kerr ZY, Register-Mihalik JK, Marshall SW, Evenson KR, Mihalik JP, Guskiewicz KM. Disclosure and non-disclosure of concussion and concussion symptoms in athletes: review and application of the socio-ecological framework. *Brain Inj*. 2014;28(8):1009–1021.
2. Register-Mihalik J, Baugh C, Kroshus E, Kerr ZY, Valovich McLeod TC. A multifactorial approach to sport-related concussion prevention and education: application of the socioecological framework. *J Athl Train*. 2017;52(3):195–205.
3. Kroshus E, Baugh CM, Daneshvar DH, Viswanath K. Understanding concussion reporting using a model based on the theory of planned behavior. *J Adolesc Health*. 2014;54(3):269–274.e2.
4. Bronfenbrenner U. *The Ecology of Human Development: Experiments by Nature and by Design*. Cambridge, MA: Harvard University Press; 1979.
5. Wallace J, Covassin T, Nogle S, Gould D, Kovan J. Knowledge of concussion and reporting behaviors in high school athletes with or without access to an athletic trainer. *J Athl Train*. 2017;52(3):228–235.
6. Register-Mihalik JK, Guskiewicz KM, Valovich McLeod TC, Linnan LA, Mueller FO, Marshall SW. Knowledge, attitude, and concussion-reporting behaviors among high school athletes: a preliminary study. *J Athl Train*. 2013;48(5):645–653.
7. Kurowski B, Pomerantz WJ, Schaiper C, Gittelman MA. Factors that influence concussion knowledge and self-reported attitudes in high school athletes. *J Trauma Acute Care Surg*. 2014;77(3 suppl 1):S12–S17.
8. Anderson BL, Gittelman MA, Mann JK, Cyriac RL, Pomerantz WJ. High school football players' knowledge and attitudes about concussions. *Clin J Sport Med*. 2016;26(3):206–209.
9. Bramley H, Patrick K, Lehman E, Silvis M. High school soccer players with concussion education are more likely to notify their coach of a suspected concussion. *Clin Pediatr (Phila)*. 2012;51(4):332–336.
10. Delaney JS, Lamfookon C, Bloom GA, Al-Kashmiri A, Correa JA. Why university athletes choose not to reveal their concussion symptoms during a practice or game. *Clin J Sport Med*. 2015;25(2):113–125.
11. McCreary M, Hammeke T, Olsen G, Leo P, Guskiewicz K. Unreported concussion in high school football players: implications for prevention. *Clin J Sport Med*. 2004;14(1):13–17.
12. Kroshus E, Baugh CM, Daneshvar DH, Nowinski CJ, Cantu RC. Concussion reporting intention: a valuable metric for predicting reporting behavior and evaluating concussion education. *Clin J Sport Med*. 2015;25(3):243–247.
13. Register-Mihalik JK, Valovich McLeod TC, Linnan LA, Guskiewicz KM, Marshall SW. Relationship between concussion history and concussion knowledge, attitudes, and disclosure behavior in high school athletes. *Clin J Sport Med*. 2017;27(3):321–324.
14. Kroshus E, Garnett BR, Baugh CM, Calzo JP. Social norms theory and concussion education. *Health Educ Res*. 2015;30(6):1004–1013.

15. Kroshus E, Kubzansky LD, Goldman RE, Austin SB. Norms, athletic identity, and concussion symptom under-reporting among male collegiate ice hockey players: a prospective cohort study. *Ann Behav Med.* 2015;49(1):95–103.
16. Kroshus E, Baugh CM, Stein CJ, Austin SB, Calzo JP. Concussion reporting, sex, and conformity to traditional gender norms in young adults. *J Adolesc.* 2017;54:110–119.
17. LaRoche AA, Nelson LD, Connelly PK, Walter KD, McCrea MA. Sport-related concussion reporting and state legislative effects. *Clin J Sport Med.* 2016;26(1):33–39.
18. Rivara FP, Schiff MA, Chrisman SP, Chung SK, Ellenbogen RG, Herring SA. The effect of coach education on reporting of concussions among high school athletes after passage of a concussion law. *Am J Sports Med.* 2014;42(5):1197–1203.
19. Mackenzie B, Vivier P, Reinert S, Machan J, Kelley C, Jacobs E. Impact of a state concussion law on pediatric emergency department visits. *Pediatr Emerg Care.* 2015;31(1):25–30.
20. Flaherty MR, Raybould T, Jamal-Allial A, et al. Impact of a state law on physician practice in sports-related concussions. *J Pediatr.* 2016;178:268–274.
21. Register-Mihalik JK, Linnan LA, Marshall SW, Valovich McLeod TC, Mueller FO, Guskiewicz KM. Using theory to understand high school aged athletes' intentions to report sport-related concussion: implications for concussion education initiatives. *Brain Inj.* 2013;27(7–8):878–886.
22. Bloodgood B, Inokuchi D, Shawver W, et al. Exploration of awareness, knowledge, and perceptions of traumatic brain injury among American youth athletes and their parents. *J Adolesc Health.* 2013;53(1):34–39.
23. O'Donoghue EM, Onate JA, Van Lunen B, Peterson CL. Assessment of high school coaches' knowledge of sport-related concussions. *Athl Train Sports Health Care.* 2009;1(3):120–132.
24. Faure CE, Pemberton CLA. An examination of Idaho high school football coaches' general understanding of concussion. *Sport J.* 2011;14(1). <http://www.thesportjournal.org/article/examination-idaho-high-school-football-coaches-general-understanding-concussion>. Accessed November 19, 2018.
25. Sefton TAJ. Economic evaluation in the social welfare field: making ends meet. *Evaluation.* 2003;9(1):73–91.
26. Lininger MR, Wayment HA, Huffman AH, Craig DI, Irving LH. An exploratory study on concussion-reporting behaviors from collegiate student athletes' perspectives. *Athl Train Sports Health Care.* 2017;9(2):71–80.
27. Kroshus E, Garnett B, Hawrilenko M, Baugh CM, Calzo JP. Concussion under-reporting and pressure from coaches, teammates, fans, and parents. *Soc Sci Med.* 2015;134:66–75.
28. Furness Z. Reframing concussions, masculinity, and NFL mythology in *League of Denial*. *Pop Commun.* 2016;14(1):49–57.
29. Sanderson J, Weathers M, Grevious A, Tehan M, Warren S. A hero or sissy? Exploring media framing of NFL quarterbacks injury decisions. *Commun Sport.* 2014;4(1):3–22.
30. Kurowski BG, Pomerantz WJ, Schaiper C, Ho M, Gittelman MA. Impact of preseason concussion education on knowledge, attitudes, and behaviors of high school athletes. *J Trauma Acute Care Surg.* 2015;79(3 suppl 1):S21–S28.
31. Miyashita TL, Timpson WM, Frye MA, Gloeckner GW. The impact of an educational intervention of college athletes' knowledge of concussions. *Clin J Sport Med.* 2013;23(5):349–353.
32. Miles MB, Huberman M. *Qualitative Data Analysis: An Expanded Sourcebook*. Thousand Oaks, CA: SAGE Publications; 1994.
33. Wallace LM, Brown KE, Hilton S. Planning for, implementing and assessing the impact of health promotion and behaviour change interventions: a way forward for health psychologists. *Health Psychol Rev.* 2014;8(1):8–33.
34. Carroll-Alfano M. Mandated high school concussion education and collegiate athletes' understanding of concussion. *J Athl Train.* 2017;52(7):689–697.
35. Kroshus E, Daneshvar DH, Baugh CM, Nowinski CJ, Cantu RC. NCAA concussion education in ice hockey: an ineffective mandate. *Br J Sports Med.* 2014;48(2):135–140.
36. Kerr ZY, Register-Mihalik JK, Kroshus E, Baugh CM, Marshall SW. Motivations associated with nondisclosure of self-reported concussions in former collegiate athletes. *Am J Sports Med.* 2016;44(1):220–225.
37. Chrisman SP, Quitiquit C, Rivara FP. Qualitative study of barriers to concussive symptom reporting in high school athletics. *J Adolesc Health.* 2013;52(3):330–335.
38. National Collegiate Athletic Association Academic and Membership Affairs Staff. *2016–2017 NCAA Division I Manual*. Indianapolis, IN: National Collegiate Athletic Association; 2016.

Address correspondence to Monica R. Lininger, PhD, LAT, ATC, Department of Physical Therapy and Athletic Training, Northern Arizona University, PO Box 15094, Flagstaff, AZ 86011. Address e-mail to monica.lininger@nau.edu.