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Predictors of Concussion Symptom-Reporting Intention Among Collegiate Athletes

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Context: Underreporting of concussion symptoms in college athletics presents a challenge for sports medicine clinicians in evaluating and diagnosing such injuries. Some athletes do not report concussion symptoms because they do not recognize that they have a brain injury; however, many athletes intentionally withhold symptoms to avoid removal from sport participation.

Objective: To examine individual factors that influence college athletes' intentions to report concussion symptoms.

Design: Cross-sectional study.

Setting: Collegiate athletics.

Patients or Other Participants: Participants were 2649 student-athletes from 23 sports, across 22 colleges and universities.

Main Outcome Measure(s): The primary outcome was intention to report concussion symptoms. Predictor variables included demographics (age, race/ethnicity, sex, sport type, number of years in sport, number of previous concussions, and perceived concussion symptom knowledge), athletic identity, attitudes toward symptom reporting, perceived social pressure (injunctive and descriptive norms), and perceived behavioral control (capacity and autonomy).

Results: Hierarchical ordinary least-squares regression revealed positive effects of attitude ($b = 0.063$, $P = .005$), descriptive norms ($b = 0.131$, $P < .001$), injunctive norms ($b = 0.107$, $P < .001$), and capacity ($b = 0.196$, $P < .001$) on intention to report symptoms. Athletic identity and participation in collision sports had small negative indirect effects on intention, and perceived concussion knowledge had a small positive indirect effect. The full regression model explained 14.24% of the variance in concussion-reporting intention.

Conclusions: These findings may help clinicians develop more focused interventions that address key social and individual determinants of underreporting, including attitude, injunctive and descriptive norms, and capacity to report. Athletic identity, sport type, and perceived understanding of concussion symptoms also influence reporting intention to a lesser extent. Previous research in this area has often failed to address a diverse population of college-age athletes from different sports and National Collegiate Athletic Association divisions.

Key Words: concussion underreporting, reasoned action, athletic identity

Key Points

- College athletes' attitudes toward concussion symptom reporting, perceived norms related to reporting, and capacity (perceived ability) to report were the strongest predictors of intention to report concussion symptoms.
- Athletes with stronger athletic identities, those with lower perceived concussion knowledge, and those in collision sports (football, ice hockey, men's lacrosse, rugby, wrestling) had lower intentions to report symptoms, but these effects were mediated by attitudes, norms, and capacity.
- Strategies to improve concussion reporting should go beyond education about symptoms and should incorporate a multipronged approach to improve attitudes toward reporting, correct norm misperceptions, and empower athletes to seek appropriate care.

The emergence of sport-related concussion as a public health concern over the past 2 decades has increased awareness and understanding of the potential dangers of traumatic brain injuries in sports.[1–4] The likelihood of negative outcomes following such injuries increases when brain injuries go undiagnosed and/or unmanaged.[5–10] Many researchers and clinicians recommend a comprehensive multidimensional concussion assessment battery; however, despite efforts in the medical community to make concussion assessment as objective as possible, accurate evaluation often relies on subjective information reported by patients.[3,4,11]

Ample evidence exists to demonstrate the unwillingness of patients participating in organized sports to disclose concussion symptoms or seek medical care for a variety of interpersonal, intrapersonal, cultural, and policy-related reasons.[1,12–14] The large percentage of undiagnosed injuries makes the actual incidence of sport-related concussion difficult to identify; however, existing evidence suggests that 33% to 69% of sport-related concussions go undiagnosed.[1,14–20] Among collegiate athletes, Kroshus et al[16] found that 47.6% of male and female athletes continued to participate in their sports despite experiencing concussion symptoms after an impact. Torres et al[21] corroborated this trend in collegiate athletes, noting that despite formal concussion education, 43% of previously concussed athletes had consciously hidden symptoms, and 22%

of athletes indicated that they would be unlikely or very unlikely to report future concussions.

Many interventions designed to improve concussion reporting focus on educating athletes about the potential negative outcomes associated with sport-related traumatic brain injuries and teaching them to recognize concussion symptoms. A growing body of evidence, however, challenges the primacy of concussion education as the most important predictor of underreporting, noting a lack of significant association between concussion knowledge and reporting behavior.[2,5,12,15,17,22,23] Identifying individual and social factors that influence patients' motivation to report concussion symptoms to a health care provider, coach, parent, or teammate will assist in the development of targeted interventions that aim to reduce the number of undiagnosed concussions in athletes.

To investigate these influences, Fishbein and Ajzen's reasoned action approach (often referred to as the theory of planned behavior) and identity theory formed the theoretical bases for this research.[24] Predicated on the assumption that behavioral intention predicts actual behavior, the reasoned action approach posits that attitudes, perceived norms, perceived behavioral control, and a set of underlying beliefs and background factors influence intention, which consequently increases or decreases an individual's likelihood of performing a given behavior (ie, reporting concussion symptoms). Fishbein and Ajzen[24] defined *behavioral intention* as "the subjective probability of performing a behavior." Intention may not predict behavior in all contexts, as some meta-analyses have indicated that intention-behavior correlations average between 0.43 and 0.62.[24–27] However, in health-related behaviors, significant correlations between intentions and behaviors have been identified, ranging from 0.75 to 0.96.[28] Regarding concussion reporting, Register-Mihalik et al[29] identified intention as an "appropriate proxy" for disclosure behavior in their study of American military cadets.

Identity theory complements the reasoned action approach by explaining the meanings that individuals attach to various social roles they inhabit—such as the role of athlete—and how these roles influence cognitive, emotional, and behavioral processes.[30] Specific to concussion reporting, Kroshus et al[12] found that higher athletic identity predicted underreporting in collegiate male ice hockey players. Similarly, Wayment et al[31] reported that stronger athletic identities among collegiate male football players predicted a lower likelihood to report concussion symptoms during a game or 24 hours after a game.

Applying concepts derived from the reasoned action approach and identity theory can inform a deeper understanding of reasons for nondisclosure and aid in the evidence-based design of prevention and management strategies that address the multifaceted nature of symptom reporting, thereby encouraging safer athlete behaviors.[1] The purpose of this study was to identify and quantify factors that determine college athletes' intentions to report concussion symptoms to a coach or athletic trainer (AT). To achieve this aim, we administered a cross-sectional survey to National Collegiate Athletic Association (NCAA) collegiate athletes in Pennsylvania across all sports to examine the role of attitude, perceived social pressure, perceived behavioral control, and athletic identity on athletes' intention to report concussion symptoms. Based on our theoretical reasoning, we hypothesized that each of the aforementioned variables would have a significant relationship with intention.

METHODS

We conducted a cross-sectional survey to investigate the factors that influence concussion symptom reporting among college athletes. After institutional review board review and approval, we recruited male and female NCAA student-athletes from 22 colleges and universities, and from a variety of sports, to complete an online survey via Qualtrics (Qualtrics, LLC) survey software.

Participants

We developed a diverse convenience sample of participants from 23 sports at 22 institutions by contacting ATs at NCAA institutions across Pennsylvania to ask who would be the best person at their institution to email a survey to all student-athletes. This produced an individualized recruitment strategy for each institution, with 8 ATs, 8 NCAA compliance coordinators, 4 coaches, 1 athletic mentor, and 1 athletic director distributing the survey to their student-athletes. A link to the online survey was emailed to 8769 NCAA student-athletes from Divisions I, II, and III, with 2965 athletes (mean age = 20.02 ± 1.36 years, age range = 18–25 years) completing all sections of the survey, for a completion rate of 33.81%. Respondents who did not complete all sections of the survey were omitted from analysis.

Because a disproportionately small number of respondents indicated non-US countries of origin (n = 156, 5.26%) or did not indicate country of origin (n = 160, 5.40%), only US-born student-athletes were included in the final analysis to eliminate the potential influence of cultural differences on survey responses. We categorized the remaining 2649 respondents by sport type using Rice's taxonomy for risk classification by sport.[32] Forty-six percent of respondents participated in limited/noncontact sports (baseball, cross country, golf, rowing, softball, swimming, tennis, track and field, volleyball), 37% in contact sports (acrobatics and tumbling, basketball, cheerleading, diving, field hockey, gymnastics, women's lacrosse, soccer, water polo), and 16% in collision sports (football, ice hockey, men's lacrosse, rugby, wrestling). Regarding race and ethnicity, 12.57% of participants self-identified as a racial or ethnic minority. Table 1 provides additional participant demographic information.

Measures

To measure the reasoned action constructs and their subcomponents, we adapted survey items from Register-Mihalik[33] and Kroshus et al[15] and created several novel items to measure intention, descriptive norms, and autonomy. The final Reasoned Action Model Concussion Reporting survey included 51 items.

Dependent Variable: Intention to Report Concussion Symptoms. We constructed a novel 7-item measure of intention that included situational variability, such as symptom severity, symptom duration, and type of athletic event (eg, practice versus competition). Each condition was measured on a 7-point scale from *extremely unlikely* to *extremely likely* to report. Based on factor analysis ($\lambda = 4.73$) and Cronbach α analysis ($\alpha = 0.93$) of these items, we quantified intention as a mean score across 7 different conditions: symptoms occurring during practice, symptoms occurring during regular season competition, symptoms occurring during playoff or championship competition, symptoms lasting 24 hours or less,

Table 1. Participant Characteristics

Characteristic	No. (%)
Sex	
Male	927 (34.99)
Female	1712 (64.63)
Missing	10 (0.38)
Race/ethnicity	
Minority	333 (12.57)
Nonminority	2293 (86.56)
Missing	23 (0.87)
Sport type	
Limited/noncontact	1207 (45.56)
Contact	972 (36.69)
Collision	428 (16.16)
Missing	42 (1.59)
Year in school	
Freshman	739 (27.90)
Sophomore	642 (24.24)
Junior	638 (24.08)
Senior	538 (20.31)
Fifth year	52 (1.96)
Graduate student	25 (0.94)
Missing	15 (0.57)
History of concussion	
Yes	1274 (48.09)
No	1366 (51.57)
Missing	9 (0.34)
NCAA Division	
I	36 (1.36)
II	2220 (83.81)
III	393 (14.84)

Abbreviation: NCAA, National Collegiate Athletic Association.

symptoms lasting for more than 1 week, mild symptoms, and severe symptoms.

Independent Variables: Student-Athlete Characteristics. Participant demographic information included age, race/ethnicity, sex, years in sport, category of sport (collision, contact, or limited/noncontact), previous history of concussion, and perceived concussion symptom knowledge.

Athletic identity was measured using the mean score of the 7-item Athletic Identity Measurement Scale.[34] This measure represents the degree to which an individual identifies with their role as an athlete.[34] In this sample of collegiate athletes, a single-factor model explained 85.5% of the variance across the Athletic Identity Measurement Scale items ($\lambda = 2.49$, $\alpha = 0.77$).

Attitude toward concussion symptom reporting was measured using 5 items adapted from Register-Mihalik's 7-point semantic differential scale of direct attitudes.[33] A mean score of these 5 items ($\lambda = 3.23$, $\alpha = 0.90$) quantified participants' attitudes toward reporting symptoms.

Perceived social pressure contained 2 different factors: descriptive norms ($\lambda = 3.03$, $\alpha = 0.83$) and injunctive norms ($\lambda = 1.18$, $\alpha = 0.79$). *Descriptive norms* represent what an athlete thinks important others (eg, teammates) *would* do, whereas *injunctive norms* explain an athlete's perceptions of what important others think they *should* do.[24] Descriptive normative pressure was measured using 4 novel survey items asking participants to estimate the symptom-reporting behaviors of other student-athletes. Injunctive normative pressure was measured using 8 items from Register-Mihalik that quantify a participant's belief strength and motivation to comply with the perceived beliefs of coaches, teammates, parents, and ATs.[33] This multi-item scale ranged from −21 to +21, where positive scores indicate normative pressure to report symptoms and negative scores indicate normative pressure to not report symptoms.

Perceived behavioral control also included 2 separate factors: capacity to report concussion symptoms ($\lambda = 3.38$, $\alpha = 0.94$) and autonomy ($\lambda = 0.90$, $\alpha = 0.80$). *Capacity* measures an individual's perceived ability to perform a behavior, whereas *autonomy* refers to the degree to which they have control over the behavior.[24] We quantified capacity using the mean score of 4 items developed by Kroshus et al,[15] asking about a participant's perceived ability to report a concussion under different conditions, each measured on a 7-point Likert scale. Autonomy included the mean of 2 items regarding a participant's control over their reporting behavior, also measured on a 7-point Likert scale. For the independent variables, we used a conservative approach of imputing median scores for missing values before generating mean multi-item scales for each variable.[35]

Statistical Analysis

Multi-items scales for the variables discussed above relied upon exploratory factor analysis and Cronbach α analysis to identify the factor structure and internal consistency of each variable. We used hierarchical ordinary least-squares (OLS) regression to examine the effects of (1) demographic variables, (2) athletic identity, and (3) reasoned action variables on intention to report concussion symptoms. Analysis of the OLS model revealed no issues with multicollinearity, severe outliers, or influential cases. Because slight heteroscedasticity existed, we used OLS regression with robust standard errors in the final model. Post priori investigation of interactions between independent variables did not reveal any meaningful interaction effects between variables. All statistical analyses were completed using Stata (release 13; StataCorp LP) with an a priori α of .05.

RESULTS

The final sample included in the regression analysis consisted of 2366 collegiate student-athletes. Two hundred eighty-three cases were eliminated during regression analysis due to missing data. A larger percentage of female student-athletes (64.63%) participated in the study compared with male student-athletes (34.99%). There was a relatively even distribution of student-athletes with (48.09%) and without (51.57%) a history of prior concussion. A large portion of the participants played at the NCAA Division II level (83.81%), with fewer participants from Division I (1.36%) and Division III (14.84%).

Block 1 of the hierarchical OLS regression revealed an R^2 value of 0.0392, with collision sport participation ($b = -0.059$, $P = .019$) and perceived concussion knowledge ($b = 0.171$, $P < .001$) showing statistical significance. The addition of athletic identity in block 2 produced an R^2 value of 0.0416, a modest yet statistically significant increase of 0.0024, with collision sport participation ($b = -0.058$, $P = .021$), perceived knowledge ($b = 0.176$, $P < .001$), and athletic identity ($b = -0.050$, $P = .026$) demonstrating statistical significance. Negative values for collision sports and athletic identity indicate that these variables were associated with a lower intention to report concussion symptoms.

Adding the reasoned action variables in block 3 increased the R^2 value to 0.1424, a statistically significant increase of 0.1008. An R^2 value between 0.1 and 0.3 indicates a moderate effect.[36] The only reasoned action variable that did not significantly predict intention was autonomy. The final regression

Table 2. Hierarchical OLS Regression of Concussion Symptom–Reporting Intention (N = 2366)

Predictor	*t* Statistic	*P* Value	*b*	R^2	ΔR^2
Step 1				0.0392	
Sex	1.46	.146	0.037 597 4		
Age	1.36	.174	0.033 184 6		
Minority status	−1.77	.077	−0.038 607 9		
Contact sport	−0.51	.609	−0.011 127 0		
Collision sport	−2.35	.019[a]	−0.059 229 2		
Years in sport	−1.26	.208	−0.031 185 5		
Concussion history	−1.88	.060	−0.038 255 9		
Perceived knowledge	8.62	.000[a]	0.171 146 1		
Step 2				0.0416	0.0024 ($P = .026$[a])
Sex	1.36	.175	0.035 170 6		
Age	1.15	.252	0.028 117 7		
Minority status	−1.59	.112	−0.035 032 3		
Contact sport	−0.39	.698	−0.008 441 9		
Collision sport	−2.32	.021[a]	−0.058 464 5		
Years in sport	−1.05	.292	−0.026 149 2		
Concussion history	−1.83	.068	−0.036 867 9		
Perceived knowledge	8.81	.000[a]	0.175 851 7		
Athletic identity[b]	−2.22	.026[a]	−0.049 563 3		
Step 3				0.1424	0.1008 ($P < .001$[a])
Sex	0.95	.342	0.023 266 3		
Age	1.73	.084	0.039 775 0		
Minority status	−1.70	.089	−0.037 188 5		
Contact sport	1.31	.189	0.027 145 7		
Collision sport	−0.61	.544	−0.014 271 6		
Years in sport	−0.35	.726	−0.008 266 3		
Concussion history	1.38	.167	0.025 503 8		
Perceived knowledge	−1.16	.246	−0.025 079 1		
Athletic identity	−1.76	.079	−0.036 447 2		
Attitude[b]	2.84	.005[a]	0.062 812 3		
Descriptive norms[b]	5.33	.000[a]	0.130 599 0		
Injunctive norms[b]	4.64	.000[a]	0.107 015 8		
Capacity[b]	8.38	.000[a]	0.195 834 2		
Autonomy[b]	1.20	.232	0.025 186 1		

Abbreviation: OLS, ordinary least squares.
[a] $P < .05$.
[b] Indicates when a new variable has been added to the hierarchical regression analysis.

model revealed positive effects of attitude ($b = 0.063$, $P = .005$), descriptive norms ($b = 0.131$, $P < .001$), injunctive norms ($b = 0.107$, $P < .001$), and capacity ($b = 0.196$, $P < .001$) on intention to report symptoms. However, when accounting for these reasoned action variables, athletic identity, participation in collision sports, and perceived concussion knowledge no longer produced a significant effect on intention, suggesting that any effect of these variables on symptom reporting is indirect. Although these variables did not directly affect intention to report, they likely influenced student-athletes' attitudes and perceived norms related to concussion reporting. Athletic identity and participation in collision sports had small negative indirect effects on intention, whereas perceived concussion knowledge had a small positive indirect effect. The full regression model explained 14.24% of the variance in concussion-reporting intention. Table 2 displays the full results of the hierarchical OLS regression analysis.

DISCUSSION

This cross-sectional survey study examined the influence of demographics, athletic identity, and the role of Fishbein and Ajzen's reasoned action approach in predicting collegiate student-athletes' intentions to report concussion symptoms.[24] Hierarchical OLS regression analysis revealed positive effects of attitude, descriptive norms, injunctive norms, and capacity on intention to report concussion symptoms. Athletic identity had a small negative effect on intention when operating through the reasoned action variables. Additionally, participation in collision sports had a small negative effect on intention, whereas perceived knowledge of concussion symptoms had a small positive effect, both operating through the reasoned action variables.

Athlete Demographics

Contrary to the findings of Torres et al[21] that men were less likely to report concussion symptoms than women, sex did not play a role in determining concussion symptom–reporting intention in any step of the hierarchical regression model. Although men (mean ± SD = 4.04 ± 1.72) expressed slightly lower intention to report concussion symptoms than women (mean ± SD = 4.29 ± 1.64), this difference was statistically insignificant, and controlling for additional variables negated any differences in reporting intention by sex. Other researchers[13,37] have similarly found no significant differences between males and females in concussion-reporting behavior. In a retrospective study of former collegiate athletes, Kerr et al[17] identified safer symptom-reporting behaviors among female athletes overall, but when controlling for sport, men and

women demonstrated similar reporting behaviors. Our findings are consistent with findings in the existing literature that sex does not predict concussion reporting, particularly when controlling for other variables, such as sport and normative pressure.

Participation in collision sports had a negative effect on concussion-reporting intention in the first 2 steps of the hierarchical regression; however, this effect appeared fully mediated through the reasoned action variables, because the effect became insignificant after adding reasoned action variables to the model. Limited/noncontact and contact sports did not demonstrate any statistical differences in predicting intention. Few authors to date have examined concussion-reporting intention by sport category (contact, collision, and limited/noncontact). Our results suggest that participants in collision sports may have a lower intention to report concussion symptoms compared with participants in contact and limited/noncontact sports because the specific sport environment influences attitudes, norms, and perceived control regarding symptom reporting. Based on these findings, further research is warranted to investigate the role of sport type in concussion reporting. Qualitative research among athletes from a variety of sports may guide future researchers in identifying additional characteristics that influence concussion-reporting intention.

Athletic Identity

Athletic identity demonstrated a negative effect on reporting intention, which was completely mediated by the reasoned action variables. We also identified a negative skew within this variable, indicating a stronger overall tendency toward higher athletic identities among our sample of collegiate athletes. All participants came from a background of varsity collegiate athletics, with an average of 7.74 years of experience in their current sport. At this level of competition and experience, it is not surprising that participants tended to exhibit high scores for athletic identity. The lack of adequate variability in athletic identity may explain the small effect of this variable in the second block of the regression, which was suppressed in the full regression model. Few authors to date have investigated the relationship between athletic identity and concussion-reporting intention. In a qualitative study of collegiate football players, Lininger et al[38] identified athletic identity as a major theme associated with nondisclosure of symptoms. In a study of male college ice hockey players, Kroshus et al[12] found that athletic identity weakly moderated the association between symptom-reporting norms and behavior, but the researchers did not specifically measure behavioral intention. Although athletic identity did not have a significant direct effect on intention ($P = .079$), we identified an indirect effect on symptom-reporting intention. Future research in populations with a greater degree of variability in athletic identity (eg, youth and adolescent sports) may produce clearer evidence regarding the role of athletic identity on concussion-reporting intention, especially among younger athletes whose identity roles are still developing.

Attitude, Perceived Social Pressure, and Perceived Behavioral Control

Attitude demonstrated a positive effect on intention to report ($b = 0.063$, $P = .005$), which is consistent with previous research.[13,15,29] Register-Mihalik et al[13] found that attitude had the greatest effect on intention to report a concussion compared with all other reasoned action variables. Kroshus et al[12] found no significant effect of attitude on concussion-reporting behavior; however, this study did not incorporate the full reasoned action framework, and the authors operationalized attitude differently, which may explain why the findings did not align. The current finding that attitude has a positive effect on intention is consistent with other studies with similar methods.

Previous research examining the effect of perceived social pressure (ie, social norms) on concussion-reporting intention suggests that norms play a significant role in determining intention to report.[2,12,13,15,16,29] Previous authors have measured subjective norms as a unidimensional construct; however, the current study is one of the few investigations of concussion underreporting to account for 2 distinct dimensions of perceived norms (descriptive and injunctive norms). The current findings support previous research that normative pressure from coaches, teammates, parents, and ATs influences athletes' intention to report concussion symptoms. Consistent with the meta-analysis by McEachan et al[26] on the reasoned action approach and health behaviors, both injunctive and descriptive norms were significant predictors of intention in this study. Irrespective of other variables, descriptive norms ($b = 0.131$, $P < .001$) and injunctive norms ($b = 0.107$, $P < .001$) each demonstrated a positive effect on concussion-reporting intention. Evidence-based interventions aimed at reducing concussion nondisclosure should address societal and sport-based norms associated with reporting and attempt to correct athletes' misperceptions of group norms.[16]

Few studies of concussion underreporting among athletes have accounted for perceived behavioral control.[13,15] Several authors have used a partial reasoned action approach to investigate this problem but measured only attitudes and perceived social pressure, not perceived behavioral control.[2,12,16] Those who have incorporated the full reasoned action approach have analyzed perceived behavioral control as a unidimensional measure; however, these researchers did find that perceived control significantly predicted concussion-reporting intention.[13,15,20,29] Our findings support these previous studies. Capacity had the greatest total effect on intention ($b = 0.196$, $P < .001$) compared with all other variables assessed in this study. This is consistent with findings from Wayment et al,[31] who identified behavioral control as a significant predictor of reporting behavior across various conditions among college football players. After implementing a concussion education program aimed at improving injury disclosure, Schmidt et al[20] reported concurrent increases in both self-efficacy to report and intention to report. Autonomy, conversely, did not show a statistically significant effect on concussion-reporting intention ($P = .232$). Our autonomy scale demonstrated a negative skew, indicating a high degree of perceived volitional control. Yzer[39] suggested that the reasoned action approach accounts only for behaviors that are not under complete volitional control. The mean autonomy score was particularly high in this study, and only 8.57% of participants responded negatively (*disagree* or *strongly disagree*) to questions about the degree of control they have in reporting concussion symptoms. Because autonomy varied very little at the univariate level, it did not significantly influence concussion-reporting intention. Interestingly, this finding is consistent with the results of a meta-analysis by McEachan et al,[26] who found that autonomy was the only reasoned action variable that demonstrated no statistical significance relative to health-related intentions and behaviors.

Limitations and Directions for Future Research

The cross-sectional design of this study may limit the generalizability of the results across time; however, because we asked participants about their intentions regarding *future* behaviors, we can reasonably infer time order. Geographically, we recruited all participants from universities in Pennsylvania. This sample represents a diverse sample of sports from different NCAA divisions; however, results may not be generalizable to club sports, noncollege athletes, or other geographic regions. Nonetheless, the sample size of 2649 student-athletes from 23 different sports across 22 institutions represents one of the largest and most comprehensive studies of concussion underreporting in athletes to date. Lastly, another limitation is that we measured intention to report concussion symptoms, not actual behavior. Although directly measuring behavior was not possible in this study, Ajzen and Albarracin[28] reported a range of significant correlations between health-related intentions and behaviors from 0.75 to 0.96, suggesting that intention may be an appropriate proxy for health-related behaviors when the behavior cannot be directly measured. Specific to concussion reporting, Kroshus et al[5] also support this relationship, noting that athletes with higher preseason reporting intentions had a 1.63 times greater odds of reporting concussion symptoms during the season.

The Reasoned Action Model Concussion Reporting survey instrument in this study used a novel measure of concussion symptom–reporting intention under different conditions, which produced an internally consistent scale ($\alpha = 0.93$) and has utility in future research. Previous authors have used only 1 item to measure concussion-reporting intention or did not account for situational variability or severity of symptoms.[5,13,16] The reporting intention scale developed for this study provides additional perspective surrounding an athlete's intent to disclose symptoms under various conditions.

Because the sample for this study consisted of only US-born collegiate athletes, future authors should compare these findings with non-US populations and high school athletes. Studying the antecedents to concussion reporting in a younger population and developing evidence-based interventions may establish safer reporting behaviors at an earlier age that could translate to safer behaviors over time. Although previous concussion history was not a significant predictor of intention in this study, accounting for the role of previous concussion-reporting behavior may explain additional variance in symptom-reporting intention in future studies.

The NCAA athletes who participated in this study had access to an AT at their institutions; however, we did not inquire about direct on-site availability of an AT during practices and competitions. The perceived availability of an AT and the comfort with seeking care from the AT may vary by sport and by institution. In a study of concussion-reporting behaviors in high school athletes, Wallace et al[18] found that athletes at schools without an AT had significantly lower concussion knowledge and reported fewer concussions, especially during games. Further research is warranted to determine whether access or perceived access to an AT influences symptom-reporting capacity. Future qualitative research will also improve understanding of the individual characteristics associated with concussion underreporting and help to identify important variables and inform survey design for additional quantitative studies.

Most importantly, future research on the effectiveness of evidence-based behavioral interventions will help health care providers and athletic administrators develop better strategies to improve the attitudes and norms around concussion reporting. Interventions intended to improve the culture of safety in sports and encourage athletes to seek help for a concussion require careful planning and evaluation.

CONCLUSIONS

These findings may help clinicians develop more focused interventions that address key social and individual determinants of underreporting, including attitude, perceived injunctive and descriptive norms, and capacity to report. Athletic identity, sport type, and perceived knowledge of concussion symptoms also influence reporting intention to a lesser extent. Previous research in this area has failed to address a diverse population of athletes from different sports, and relatively few authors have specifically targeted a college-age population. This study adds to the literature by combining the reasoned action approach with athletic identity to investigate concussion underreporting across various college sports.

The results of this study increase the research knowledge base in the area of concussion underreporting but also provide insight for ATs, coaches, and athletic administrators to help develop proactive and supportive programming that encourages athletes to seek appropriate care for sport-related brain injuries. This research expands upon the existing application of the reasoned action approach in the concussion-reporting literature and improves the measurement of the factors that contribute to concussion underreporting, especially in a collegiate population.

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