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Abstract

Context: The influence of several psychological characteristics on the willingness of athletes to report concussion behaviors has not been well explored. Therefore, the purpose of this study was to understand how athletic identity and sport passion predicted participants' willingness to report symptoms above what was explained by athlete demographics, concussion knowledge, and perceived seriousness of concussions.

Design: The study was cross-sectional

Methods: Three-hundred and twenty-two male and female high school and club sport athletes completed survey measures of concussion knowledge, athletic identity, harmonious and obsessive passion, and degree to which athletes indicated they would report concussions and concussion symptoms.

Results: Athletes scored moderately high on their knowledge of symptoms and other concussion information (M = 16.21; +/- = 2.88) and above the midpoint on their attitudes and behaviors toward reporting concussion symptoms (M = 3.64; +/- = .70). There were no differences between gender ($t(299)$ = -.78, p = .44) and previous concussion education ($t(296)$ = .1.93, p = .06) related to concussion knowledge. Results of a hierarchical regression indicated that after entering athlete demographics, concussion knowledge, and perceived seriousness of concussions, of the three psychological variables in the final stage of the model, only obsessive passion was a significant predictor of athlete's attitudes to report a concussion.

Conclusions: Perceived seriousness of concussion, perceived threat to long term health, and obsessive passion were the strongest predictors of athlete's willingness to report concussions. Athletes who did not believe concussions posed a threat to their current or future health, and those that held an obsessive passion for sport were most at risk for not reporting concussions. Future research should continue to investigate the relationship between reporting behaviors and psychological factors.

Key words: Brain injury; adolescents; sport; psychology, motivation, identity

INTRODUCTION

Sport concussion management and diagnosis is considered one of the most complicated facets of sport medicine due to the lack of objective symptoms at the time of the injury [1] and the complexity of the brain [2]. Due to these challenges, sport leagues have implemented rules for early detection and increased monitoring to detect injuries and prevent further harm from continued participation. However, even with these modifications, recent studies have indicated that as many as 18% of athletes will suffer a diagnosed concussion during each school year [3] and as many as 50% of concussions go undiagnosed in high school athletes [4] due to athletes' unwillingness to report symptoms and delayed symptom onset [5-6]. The lack of reporting of concussion symptoms may be due to lack of knowing the seriousness of the injury, lack of concussion symptom knowledge, or athletes purposely not divulging symptoms in hopes of continuing play [6-7]. Youth athletes who continue to play with a sport related concussion experience a longer recovery and neurocognitive delays [8], thus it is imperative to understand the factors impacting reporting behavior.

Researchers have investigated a number of factors that might influence an athlete's willingness to report concussion symptoms. For example, in a sample of youth adolescent athletes, over 95% indicated they should stop playing and tell someone if they sustained a concussion during a game, however, only 43% indicated that they followed the correct protocol [9]. Among these youth athletes, younger players demonstrated less knowledge regarding concussion causes and severity of concussions [9], which other researchers have hypothesized as a barrier to concussion reporting [10]. Athletes with previous concussions have negative attitudes toward concussions in general as well as toward disclosing a concussion [11]. In terms of concussion education and intention to report, research is inconclusive as Donnell et al. found a

correlation between previous concussion education and intention to report future concussion in youth athletes [12], whereas other studies have not [13]. Due to the incongruence in research findings, this relationship deserves additional study.

Although only in its infancy, several researchers have begun to investigate how personal characteristics can influence an athlete's willingness to report concussions. Specifically, research has investigated the relationship between athlete's reporting and Big 5 personality traits [14] athlete's self-efficacy [15], and athlete's intention to report [16]. Two unexplored psychological variables that might be critical to understanding willingness to report concussion symptoms are athletic identity (AI) and sport passion. Individuals with high AI place great importance on their success or failure in the athletic realm and attribute large portions of their self-worth to these accomplishments [17]. Recently, research has shown that AI has been associated with an increase in subsequent injury in a sample of youth hockey players [18] and the American Medical Society for Sports Medicine has identified AI as a potential issue that could lead to mental health concerns in athletes and a topic that deserves further study [19]. Similarly, those with high levels of passion see sport as a significant piece of their identity which might influence willingness to report concussions. Unlike AI, passion can originate in two distinct manners; harmonious and obsessive [20] with harmonious passion leading to participation in an activity without compulsion, whereas obsessive passion leads to conflict with other activities in the person's life due to the disproportionate amount of space the sport takes in the individual's life.

While unexplored in how AI and passion relate to athlete's intention to report concussions, previous studies have shown these variables are related to negative outcomes. Specifically, high AI has demonstrated negative consequences for athletes when faced with unanticipated early athletic retirement [21] and has been associated with increased depression in

injured athletes [17]. Similarly, obsessive passion has been negatively related to subjective well-being [22] and positively associated with persisting in an activity despite dangerous conditions [20, 23]. The purpose of this study was to understand causes of underreporting concussion and concussion symptoms in high school athletes. Concussion knowledge, attitudes toward concussions, athletic identity, and sport passion were measured as predictors of participants' willingness to report symptoms. As AI and obsessive passion have been related to negative outcomes in sport, we hypothesized that athletes high in the two variables would be less likely to report concussion symptoms. Further, as this study assessed concussion knowledge and past concussion history, similar to past studies [24], we hypothesized that knowledge and concussion history would positively predict intention to report concussion symptoms.

METHODS

Study Design

The study utilized a cross-sectional design that included four questionnaires assessing demographic variables, concussion attitudes and knowledge, athletic identity, and passion. The setting was various high schools and club organizations from three regions (Southeast, West, and Northwest) of the United States.

Participants and Recruitment

The study population was high school students, of any gender, participating in any sport, aged 13-18. Following Institutional Review Board approval at a large mountain west university, high school athletic directors and club directors were contacted for recruitment. Participants were recruited from high school and club teams in California, Idaho, Nevada, and Georgia.

Procedures

Assessments

Demographics. Demographic questions included sex, race**,** and ethnicity identification, age, year in school, previous concussion education, and concussion history.

Concussion Knowledge and Attitudes. Concussion knowledge and attitudes were measured using a questionnaire developed by Kurowski et al., [24] divided into three sections, knowledge-based, self-reported attitudes, and behavioral-based questions. The knowledge-based questions included 25 true-false questions about concussion symptoms, recovery, and management with a total score for correct answers calculated for each individual. The survey has demonstrated acceptable psychometric properties for use by adolescents and has been used in several studies to assess athletes' concussion knowledge and attitudes toward concussions.

The self-reported attitude and behavioral questions consisted of 11 statements such as, "I feel that getting a concussion is not a big deal and actually proves I am tough", with each question rated on a five-point Likert scale (1 = never, 5 = always). For analyses, the average of all attitude and behavioral questions was calculated for each individual.

Perceptions of Concussion Seriousness. Athlete's perceptions of seriousness of concussions were measured by two items treated individually. Athletes were asked about their general level of concern for concussions ("In general, how serious do you view concussions?") as well as their concern for long term health ("In relation to concussions, how concerned are you about your future health?") with both questions measured on a five-point Likert scale (1 = Not at all, 5 = very much so). The two questions were created by the research team and reviewed with high school athletes to ensure proper understanding of the questions before administration of the study.

Athletic Identity. Athletic identity is defined as the degree to which an individual identifies with the athlete role [17] and was measured by the Athletic Identity Measurement Scale (AIMS) [18] The AIMS has seven items measured on a 7-point Likert-scale ranging from "strongly disagree" to "strongly agree". The responses are averaged across the seven items giving a possible score of 1-7, with higher scores indicating a stronger athletic identity. In a recent study, Visek et al. [25] provided reliability and validity of the AIMS with a large sample with a cross-cultural background.

Passion. Passion is defined as "a strong inclination toward an activity that people like (or even love), that they find important, and in which they invest time and energy" p. 757 [20] Passion was measured by The Passion Scale [20] that contains 14 items across two subscales, harmonious passion and obsessive passion. Items are assessed on a 7-point Likert scales from

"do not agree at all" to "very strongly agree". The responses are averaged across each subscale giving a possible score of 1-7, with higher scores indicating higher levels of each type of passion. Although the passion scale was originally developed with a sample of collegiate athletes and non-adolescent participants [20], studies have demonstrated appropriate psychometric properties with adolescent athletes [26].

Questionnaire Administration

After permission was granted from athletic and club directors via e-mail or telephone, parents were provided informed consent forms (provided in English and Spanish) during a team meeting or via email depending on the director preference. Athletes were recruited in person after parental consent was attained. Athletes were informed of the purpose of the study and their rights as participants and gave verbal assent to participate. Questionnaires were administered in paper and pencil form. At a later date, after data collection was completed, the entire team was provided with pizza (regardless of individual participation).

Statistical Analyses

In the first phase of the analyses, we conducted descriptive analyses on all study variables and tested for differences in participant knowledge on various demographic characteristics (gender – male/female; previous experience with concussion education – yes/no; diagnosed with concussion – yes/no). Specifically, because previous research had indicated differences in concussion knowledge, we conducted independent t-tests to determine if there were differences in knowledge by gender, those who had previous experience in a class/workshop focused on concussion education, and those who had been previously diagnosed with a concussion.

To answer the primary research question, we conducted a hierarchical regression analysis predicting concussion attitudes and behaviors. In the first step, we included gender**,** age, and

concussion history**.** In the second step, we added perceptions of concussion seriousness, concern for future heath, and concussion knowledge. In the final step, we added the three psychological variables; harmonious and obsessive passion, and athletic identity. All variables in the regression analysis were treated as ordinal variables except for gender and concussion history which were both treated as nominal variables.

Ethical Considerations

At preseason meetings, a member of the research team informed players and parents of the study and they completed consent/assent forms as per the institutional IRB.

RESULTS

A total of 322 high school and club sport athletes (203 males, 119 females) participated in the study. Participants had an average age of 15.7 years (+/- = 1.34), and were recruited from seven sports (football, wrestling, hockey, lacrosse, track and field, skiing, baseball). The majority of the sample identified as Caucasian (*n* = 166), followed by Hispanic (*n* = 73), Bi-racial (*n* = 27), African American or Black (*n* = 16), Asian (*n* = 10), Multicultural (*n* = 15), and Native American (*n* = 5). Ten participants did not select a response. Just under half of participants indicated they had previously had a concussion (*n* = 138; 43%) and the number of concussions ranged from 1-7.

Descriptive statistics and bivariate correlations for all study variables are summarized in Table 1. Athletes scored moderately high on their knowledge of symptoms and other concussion information (*M* = 19.20; +/- = 2.88; Range 9-25) and above the midpoint on their attitudes and behaviors toward reporting concussion (*M* = 3.64; +/- = .70; Range 1-5). Athletes generally perceived concussions as serious (*M* = 4.11; +/- = .85) and reported they were moderately concerned that concussions might influence their future health (*M* = 3.55; +/- = 1.29). In terms

of psychological variables, the mean of harmonious passion (M = 5.55; +/- = 1.07) was higher than that of obsessive passion (M = 3.97; +/- = 1.44) and athletes held relatively high levels of athletic identity (M = 5.03; +/- = 1.13).

T-tests

The independent t-tests that assessed differences in knowledge for gender ($t(299) = -.78$, $p = .44$) and those who had taken a class/workshop for concussions ($t(296) = 1.93$, $p = .06$) were non-significant indicating that there were no differences in knowledge depending on gender or prior concussion education. The independent t-test for participants who had a diagnosed concussion was significant ($t(299) = -3.76$, $p < .001$) with those who had experienced a prior concussion having higher knowledge on than those who had not had a diagnosed concussion.

Hierarchical Regression

A hierarchical regression analysis indicated that all three sets of predictor variables were significant and explained unique aspects of the variance in concussion attitudes (see Table 2). In the first set of predictors, only gender was significant with male athletes reporting more negative concussion attitudes than female athletes. In the second set of predictors, both perceived seriousness of concussion and concern of concussion of their future health positively predicted athlete attitudes with stronger perceptions of both variables positively predicting athlete's willingness to report concussion symptoms. Surprisingly, in this step, concussion knowledge was not significantly related to concussion attitudes, indicating that the level of knowledge about concussions did not predict the willingness of an athlete to report a concussion. Finally, in the third step of the regression analysis, harmonious passion and athletic identity did not significantly predict an athlete's willingness to predict concussions. Instead, only obsessive

passion was significantly related to athlete's attitudes to report a concussion. Those athletes with higher levels of obsessive passion were less likely to report concussions.

DISCUSSION

The current study aimed to understand the causes of underreporting concussion and concussion symptoms in high school athletes with a specific focus on athletes' psychological variables. Better understanding why athletes report, or do not report, concussion symptoms can support coaches and practitioners in creating an environment that promotes more positive reporting behaviors and identify which athletes are most at risk for underreporting and suffering a significant long-term injury. Results from a hierarchical regression indicated that male athletes, those athletes that viewed concussion as serious to their current and future health, and those that had high levels of obsessive passion were least likely to report concussion and concussion symptoms. Specific results will be explored in this section.

This sample of youth athletes had a moderately high knowledge of concussion symptoms, regardless of gender and previous attendance at a workshop or class on concussion management. The lack of gender differences in knowledge is inconsistent with previous research that has shown that females have higher concussion knowledge than males [24]. As all three of these previous studies were conducted several years ago, it is possible that student-athletes are becoming more aware of the signs and symptoms of concussions regardless of gender, and further studies should continue to investigate if concussion knowledge discrepancy between male and female student-athletes is disappearing. Additionally, the lack of differences in concussion knowledge with those who had previous concussion education mirrors several previous studies [12, 24]. Specifically, a recent review [27] indicated inconsistent results in terms of how concussion knowledge changed following education with sparse evidence of long-term change in

knowledge. This relationship should continue to be investigated with an eye toward what type of education results in both short- and long-term changes in knowledge. Finally, our sample did show differences in the level of concussion knowledge depending on if athletes had previously been diagnosed with a concussion. This is inconsistent with previous research [11] and indicate that the athletes in our study who had suffered a concussion were more knowledgeable about signs, symptoms, and recovery procedures for concussions. Additional research should investigate this relationship between changes of concussion knowledge following experiencing a concussion.

Athletes viewed concussions with a high degree of seriousness in general and, to a lesser degree, as negatively influencing their future health. Counterintuitively, these two perceptions were only moderately related to each other, indicating that if an athlete believed concussions were more serious in general, it did not necessarily mean that they would view concussions as being a threat to their future health. It is possible that student-athletes believed that concussions were a serious issue, but if they were able to manage the risks and consequences of a concussion, they viewed it as non-threatening to their future health. Previous studies have shown that this age group might not be especially adept at assessing long-term health in a variety of contexts [27] and these high school student-athletes may not be able to properly judge how serious concussions can be to long-term health. Contrasting the current study, in a study of college football players, an increase in number of diagnosed concussions was associated with greater agreement of the influence of the injury on long term health consequences [28]. It is possible Baugh and colleagues found a link between experiencing concussion and long-term negative health consequences and our study did not because Baugh sampled college-aged participants while our study sampled high school student-athletes. Older athletes might see a more direct link

between concussion and long-term health compared to high school athletes and future studies should investigate how age influences how concussions are viewed in terms of both short- and long-term health.

Previous studies have found underreporting rates in high school students can be as high as 55% [27] with top reasons for not reporting a concussion a loss of playing time, not wanting to let their team down, and uncertainty of the injury severity. For athletes in our study, the strongest predictors of concussion attitudes and behaviors were how athletes viewed concussions, in terms of seriousness and impact to future health, and their levels of obsessive passion. However, even though these scores were relatively high, as the importance of the event increased (e.g., pre-season to regular season), the perceived willingness of reporting a concussion decreased. These findings indicate that even if athletes know they are supposed to report concussion symptoms, they either disregard this information or actively ignore these signals when they are involved in important events. Similarly, in a sample of 454 high school students, 50% believed that return to play following concussion should be dependent on the importance of a game or event [29]. In our study, the relationship between concussion knowledge and concussion attitudes and behaviors was nearly zero indicating that athlete knowledge of concussions was unrelated to their attitudes toward concussion, regardless of age or gender. This finding adds to the mixed literature on the relationships between knowledge and attitudes to reporting [27] Additionally, the influence of coaches and teammates, and athlete's perceived control over reporting behavior have been found to be associated with intentions to report concussion symptoms [30]. In our study, perceptions of risk were more effective in predicting their willingness to report concussions, demonstrating the importance of coaches and other

practitioners going beyond ensuring that athletes understand concussions facts and moving toward injury seriousness and future health consequences.

In terms of the psychological variables included in the final step of the regression analysis, the only significant predictor of athletes' attitudes and behaviors of concussion reporting was obsessive passion. Obsessive passion, or an overwhelming compulsion to participate in an activity [20], aligns well with some of the other specified reasons for underreporting, such as athletes not wanting to let their team down. If an athlete sees their sport as the only important aspect in their life and cannot control their urge to participate even in unsafe conditions, they might be more likely to continue playing even if they suspected injury. Similar to previous studies where athletes' obsessive passion led them to engage in dangerous behaviors [20, 21], athletes with high levels of obsessive passion were less likely to report a concussion which could lead to severe injury, second impact syndrome, and long-term consequences [31]. This finding can be important for coaches or other professionals (e.g., athletic trainers) to understand so that if their athletes display the characteristics of obsessive passion, they might need to monitor these athletes closer in terms of injury reporting and other win-at-all cost behaviors during play and throughout the injury recovery process.

Regarding the other two psychological variables of interest, it is somewhat surprising that neither of them were significant predictors of athletes' willingness to report concussions. In terms of athletic identity, someone who views themself primarily as an athlete might also be less willing to report concussions, possibly sacrificing their current and future health to continue performing, especially as the importance of the event increases. One rationale for why this variable might not have been significant in the analysis, is that obsessive passion and AI were strongly correlated to each other. Even though many of the negative aspects associated with AI

including exclusivity and negative emotions when not able to perform in their sport [17] might also be encapsulated in aspects similar to obsessive passion, previous studies have shown that AI and passion are distinctive concepts and contribute uniquely to other variables such as burnout [32]. As obsessive passion and AI were highly correlated in this study but both did not contribute to an athlete's willingness to report concussions, future scholars should investigate how these two variables may relate to each other as well as to other risky or dangerous behaviors.

Finally, harmonious passion also was not a significant predictor of an athlete's willingness to report concussion symptoms. Past studies have shown that HP can often insulate individuals from negative behaviors and outcomes [20,22,32], but this study HP was no significantly related an athlete's likelihood of reporting concussion symptoms. One possibility for the lack of significance in predicting reporting behavior is that even though the average score of harmonious passion was higher than obsessive passion, the gap between the two was not as wide as many past studies [32]. As Vallerand and colleagues indicated [33] in regards to burnout "it is not whether someone is passionate or not toward work, but rather whether someone displays a harmonious or an obsessive passion (p.309)." Although the study was done in the work context, the idea transfers to other concepts and domains, including sport. Future studies might benefit from looking at passion not only at the variable-level, but also at the individual level as some have recently done [34]. Regardless, even though harmonious passion was not significant in the overall regression analysis, creating a culture that helps athletes develop harmonious passion instead of obsessive passion should be a future practical direction for coaches and other professionals.

STRENGTHS AND LIMITATIONS

Strengths of this study include a large sample with participants from diverse racial backgrounds, including athletes from Hispanic and multi-racial backgrounds. Previous research has found that white high school athletes have demonstrated higher concussion knowledge than African-American athletes [35], and future research should continue to study concussion reporting behavior in athletes from diverse populations. Additionally, this study is not without limitations. The study relied on self-report data and athletes may have misinterpreted some questions including previous concussion education or concussion history.

CONCLUSIONS

The high school athletes in this study had moderately high knowledge of concussion symptoms and moderately high scores on attitudes towards reporting concussion symptoms. Contrasting past studies, previous concussion education and gender were not significant predictors of concussion knowledge. In terms of predicting athlete's willingness to report concussions, athletes who did not believe concussions posed a threat to their current or future health, and those that held obsessive passion were most at risk for not reporting concussions, As concussions continue to a be public health concern and athletes face health risks if they continue to play on a concussed brain, further research should continue to identify factors that influence high school athlete's concussion reporting behavior and investigate ways to ensure athletes know not only the information surrounding concussions, but also the short and long term risks to their health if not treated properly.

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Table 1. Descriptive statistics for all study variables.

	1	2	3	4	5	6	7.
1.Concussion Knowledge	--						
2. Perceived Seriousness of Concussion	.01	--					
3. Concern of Concussion to Future Health	-.10	.30**	--				
4. Harmonious Passion	.13*	.14*	.11	--			
5. Obsessive Passion	-.03	-.10	.10	.56*	--		
6. Athletic Identity	.09	-.01	.08	.54*	.69**	--	
7. Concussion Attitude and Behaviors	-.04	.41**	.21**	-.09	-.37**	-.28**	--
Mean	19.20	4.11	3.55	5.55	3.97	5.03	3.64
+/-	2.89	.85	1.29	1.07	1.44	1.13	.70
Range	9-25	1-5	1-5	2-7	1-7	2-7	1-5

Note: * = significant at p <.05; ** = significant at p <.01

Table 2 – Hierarchical Regression predicting Concussion Attitudes and Behaviors.

Predictor Variables	Step in Model	F-value (df)	R^2	Chg R^2	Beta	T value
Gender	1	6.37** (3, 269)	.07		.12*	2.19
Age	1				-.07	-1.30
Concussion Diagnosed	1				-.05	-.90
Concussion Knowledge	2	12.75** (6,266)	.22	.15**	-.01	-.21
Perceived Seriousness of Concussion	2				.32**	5.77
Concern of Concussion to Future Health	2				.13*	2.46
Harmonious Passion	3	14.74** (9,263)	.34	.12**	.07	1.04
Obsessive Passion	3				-.31**	-3.92
Athletic Identity	3				-.10	-1.31

* = significant at $p < .05$; ** = significant at $p < .01$