Article

Diagnosed and Nondisclosed Sport-Related Concussion: An Exploratory Comparison Study by ADHD Status in Collegiate Athletes

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Abstract

Objective: To determine if ADHD status in collegiate athletes was associated with differences in the number of diagnosed and nondisclosed sport-related concussions, and reasons why suspected concussive injuries were not reported. **Method:** A cross-sectional survey was completed by 858 collegiate athletes (65 with ADHD; 793 without ADHD). The survey included self-report items regarding ADHD status and histories of diagnosed and nondisclosed sport-related concussions. Groups were matched for gender, age, and sport with a ratio of one participant with ADHD to four without ADHD. **Results:** Collegiate athletes with ADHD reported significantly more diagnosed sport-related concussions and were more likely to have a history of diagnosis compared to those without ADHD. There were no significant differences between groups regarding sport-related concussion nondisclosure history. **Conclusion:** Collegiate athletes with ADHD have an increased prevalence rate of diagnosed sport-related concussions compared to those without ADHD; however, this developmental disorder may not influence injury nondisclosure decisions. (*J. of Att. Dis. 2022; 26(4) 606-615*)

Keywords

sport-related concussion, ADHD, collegiate athletes

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder typically diagnosed in childhood that is marked by deficits in sustained attention, hyperactivity, and poor impulse control (Barkley, 2015). For many, these difficulties persist into adulthood with approximately 5% of young adults still displaying symptoms of this disorder (Kessler, 2006). Well-established is that children and young adults with ADHD are injured at higher rates than those without ADHD (Barkley, 2015). The reasons for this do not seem related to an inability to identify dangerous situations, but rather an under-appreciation of the negative consequences associated with a risky behavior and fewer strategies to avoid injury in hazardous situations (Farmer & Peterson, 1995).

Germane to this study, ADHD in athletes has been linked to increased risk of general sport-related injury (Clendenin et al., 2005). This is consistent with Bergandi and Witting (1988) who found that up to 60% of the variance in general injury prediction may be accounted for by behavior associated with ADHD. Children and young adults with ADHD are specifically at increased risk of head injury (DiScala et al., 1998). Defined by the 5th International Consensus Statement on Concussion in Sport as a complex pathophysiologic process affecting the brain due to biomechanical

forces (McCrory et al., 2017), sport-related concussion is experienced by athletes with ADHD at increased rates compared to athletes without ADHD (Iverson et al., 2020). In a study of high school and college athletes, Nelson et al. (2016) identified a pronounced relationship between ADHD diagnosis and concussions with the relationship becoming more prominent as the number of concussions sustained increased. Of note, athletes with ADHD were almost three times more likely than controls to have a history of three or more concussions. In another study of Division-I NCAA athletes, Alosco et al. (2014) discovered that athletes with ADHD were more likely to report a history of concussion compared to controls (50% of athletes with ADHD versus 14% of athletes without ADHD). Poor impulse control during play may be related to this increased frequency as higher self-ratings of impulsivity have distinguished college ath-

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letes with multiple concussions from those with no concussion history (Kerr et al., 2014).

Immediate identification of a sport-related concussion is necessary to provide efficient treatment and avoid negative outcomes (McCrory et al., 2017). This assertion is bolstered by findings of recent studies that have investigated the effects of delayed identification of sport-related concussion. Asken et al. (2016) studied 97 collegiate athletes that sustained a sport-related concussion by grouping the athletes as immediately removed from play or as enduring delayed removal from play, primarily because the athlete did not recognize or did not divulge the suspected concussion. These researchers found that delayed removal was related to significantly longer recovery time, even after controlling for gender, concussion history, disability status, and acute injury severity. Delayed removal was also related to an increased risk of significant injury. A follow up study of 506 college and military athletes also found that delayed removal from play was related to significantly increased symptom duration and more time missed from sport, even after controlling for recovery moderators (Asken et al., 2018). These findings underscore the importance of immediate identification of sport-related concussion, removal from play, and start of a concussion treatment protocol. However, immediate identification of sport-related concussion often requires an athlete to self-disclose the injury.

Recent findings suggest that between 25% and 50% of collegiate athletes have not reported a suspected sport-related concussion and continued to engage in sport activities while experiencing symptoms (Asken et al., 2016; Kerr et al., 2016; McAllister-Deitrick et al., 2020). These findings are concerning as a lack of disclosure may delay removal from sport, extend treatment and recovery time, and lead to further head injury complications. The relationship between ADHD status and sport-related concussion nondisclosure in collegiate athletes is currently unknown. This is troubling as White et al. (2013) warn sports medicine professionals that ADHD and concussion may have a negative interaction effect and that the presence of ADHD should be considered a "modifying factor" that may require more complex management techniques and a multidisciplinary approach to monitoring and treatment. The 5th International Consensus Statement echoes that a concussed athlete with ADHD might require more deliberate planning and treatment that extends to the educational arena (McCrory et al., 2017). Compared to peers without ADHD, college students with ADHD are known to earn significantly lower GPAs, have poorer study skills, experience greater rates of psychological disorder, and not access academic/disability services at levels one might expect (Gormley et al., 2019; Weyandt & DuPaul, 2013).

Given the importance of immediate treatment for sport-related concussion, the fact that a previous sport-related concussion is predictive of future injury, and the particular negative outcome risks that athletes with ADHD face (McCrory et al., 2017), it is important to understand reasons why athletes do not disclose suspected sport-related concussions. There are currently no investigations that have examined reasons for sport-related concussion nondisclosure in collegiate athletes with ADHD specifically, and whether these reasons differ from those of neurotypical collegiate athletes. Among athletes more broadly, Kerr et al. (2016) found that more than 70% of the former collegiate athletes who sustained a concussion across their playing career did not disclose a concussion to avoid removal from a game and also to avoid letting their team down. Further, 70% of the sample did not know they actually sustained a concussion and this uncertainty may be related to nondisclosure. Emerging literature sheds some light on factors related to nondisclosure, however. It appears that factors like age, gender, and previous concussion history are not related to nondisclosure, but sport type, namely football, is (Kuhn et al., 2017).

In light of the aforementioned literature, we posed the following research questions: (1) Do collegiate athletes with ADHD differ in the number of self-reported diagnosed sport-related concussions compared to collegiate athletes without ADHD while controlling for the effects of gender, total number of years of sport participation as an indicator of cumulative concussion risk, sport type, and acquired concussion knowledge?; (2) Do college athletes with ADHD differ in the number of self-reported, nondisclosed sport-related concussions as compared to college athletes without ADHD while controlling for the effects of gender, total number of years or sport participation as an indicator of cumulative concussion risk, sport type, and acquired concussion knowledge?; and (3) Are there differences in sport-related concussion nondisclosure reasons between collegiate athletes with ADHD and those without ADHD? We hypothesized that collegiate athletes with ADHD would be more likely to self-report a history of diagnosed and nondisclosed sport-related concussions compared to those without ADHD. We hypothesized that reasons for nondisclosure would not differ between ADHD and non-ADHD athletes. Clinically, the findings of this study will further the understanding of the moderating effect that ADHD may have on sport-related concussion occurrence and the decision-making process behind nondisclosure.

Methods

Participants

This study constituted a prospective, cross-sectional survey study of collegiate athletes recruited from six NCAA institutions (four Division-I, two Division-II) in Pennsylvania, Ohio, Michigan, and South Carolina. Male and female collegiate athletes were invited to participate in this study if

Table 1. Descriptive Statistics by Group.

	ADHD	Non-ADHD
N	65	793
Gender: male (*n*, %)	41 (63.08)	504 (63.56)
Age in years (*M, SD*)	19.55 (1.34)	19.71 (1.42)
Diagnosed SRCs (*M, SD*)	0.71 (1.10)	0.43 (0.83)
Range of SRCs	0–6	0–7
Nondisclosed SRCs (*M, SD*)	0.38 (1.06)	0.20 (0.84)
Range of nondisclosed SRCs	0–5	0–10
Concussion knowledge (*M, SD*)	41.33 (4.71)	40.80 (4.51)
Years of sport experience (*M, SD*)	10.13 (3.51)	11.31 (3.77)
Sport (*n*, %)		
Football	14 (21.54)	210 (26.48)
Lacrosse	13 (20)	89 (11.22)
Baseball/softball	7 (10.77)	86 (10.84)
Soccer	1 (1.54)	86 (10.84)
Basketball	4 (6.15)	70 (8.83)
Wrestling	4 (6.15)	48 (6.05)
Tennis	1 (1.54)	38 (4.79)
Ice hockey	2 (3.08)	35 (4.41)
Volleyball	4 (6.15)	30 (3.78)
Cross country	3 (4.62)	29 (3.66)
Water polo	3 (4.62)	29 (3.66)
Swim/Dive	2 (3.08)	18 (2.27)
Field hockey	6 (9.23)	17 (2.14)
Golf	1 (1.54)	8 (1.01)

SRC = sport-related concussions.

they were a member of an NCAA sports team at their institution. A total of 1,125 collegiate athletes initiated the survey. Individuals were excluded from participation if they were under 18 years of age (*n* = 9), had sustained a concussion within the previous 3 months (*n* = 28), or had lingering concussive symptoms from an injury that had occurred longer than 3 months ago (*n* = 17). These exclusionary criteria were used to mitigate potential response biases on survey items that may be influenced by the experience of a recent concussive injury. Additionally, 213 participants did not provide responses to survey items of interest for this investigation and were therefore not included in analyses. This resulted in a final sample of 858 collegiate athletes, 7.6% (*n* = 65) with ADHD and 92.4% without ADHD (*n* = 793). See Table 1 for complete demographic information.

Instrument

The instrument used in this investigation was a one-time, 15-minute survey. It included items related to personal and sport demographics, diagnosed sport-related concussion history, potential sport-related concussion nondisclosure, and general concussion knowledge. Regarding demographics, participants were asked to indicate their gender (male/female), age in years, NCAA sport of participation, and

number of years of sport experience. NCAA sport was further categorized into high-risk and low-risk concussion sports based upon collegiate concussion injury rates reported by Zuckerman et al. (2015). Football, soccer, wrestling, volleyball, field hockey, basketball, ice hockey, lacrosse, and softball were considered high-risk concussion sports. Low-risk concussion sports were cross country, tennis, water polo, swimming and diving, golf, and baseball. Self-reported diagnosed ADHD status was assessed by directly asking participants to indicate if they had been previously diagnosed with ADD/ADHD.

Diagnosed and nondisclosed sport-related concussion history was assessed through a series of self-reported items. Participants were first asked to indicate if they had a history of sport-related concussion(s) that were diagnosed by a healthcare provider (yes/no). If yes, they were then prompted to indicate the number of diagnosed sport-related concussions that they had sustained in the past. Similarly for sport-related concussion nondisclosure, participants were asked to report (yes/no) if they had ever sustained a possible concussion while playing sports that they did not tell anyone about (i.e., coaches, teammates, parents, medical staff) and to then list how many times that had occurred. As a follow-up, participants who indicated that they had not reported a potential sport-related concussion in the past were asked to identify all the reasons that influenced their nondisclosure decision from a list of 15 possible options (e.g., did not want to lose playing time, did not want to let my teammates down). This method of assessing concussion reporting behaviors was previously developed by McCrea et al., (2004) and adapted by Wallace et al., (2017).

Lastly, level of concussion knowledge was gauged using an assessment that was developed and validated by Register-Mihalik et al. (2013). The concussion knowledge assessment included sign and symptom recognition, complications related to returning to sport participation before full recovery is achieved, and potential repercussions associated with sustaining multiple concussions. Slight adaptations were made to the original instrument (McAllister-Deitrick et al., 2020) in order to update it to include six additional symptoms that are now commonly assessed as part of concussion management best practices (McCrory et al., 2017). This instrument also has strong psychometric properties (e.g., Cronbach alpha = .77). The maximum concussion knowledge score was 49 with higher scores representing greater knowledge. The overall survey instrument was checked for face validity by three sport-related concussion experts and then piloted on ten undergraduate college students. Minor changes were made to increase comprehension and readability, but no major item revisions were required.

General Procedures

Institutional review board approval was obtained prior to participant recruitment and data collection occurred from
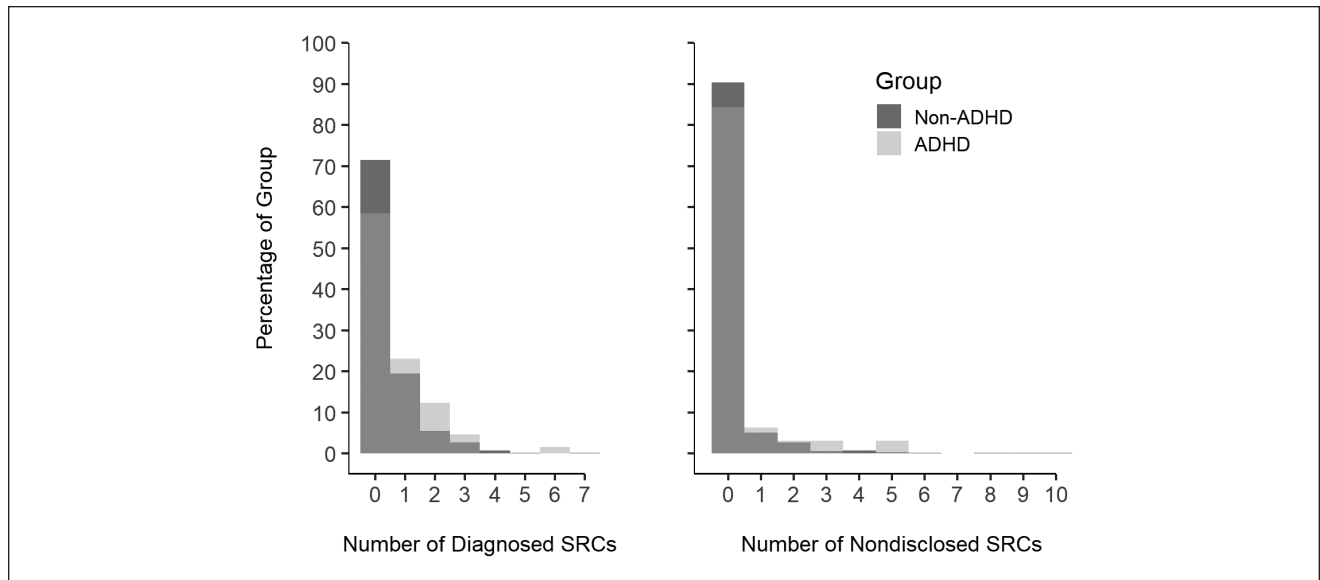
Figure 1. Distributions regarding number of diagnosed and nondisclosed sport-related concussions. Medium shade gray represents the percentage of overlap.

Fall 2017 to Spring 2018. Informative e-mails were sent to head athletic trainers at prospective institutions detailing the purpose and procedures of this study. After interest in participation was indicated, the research team collaborated with each institutions' sports medicine teams to coordinate data collection sessions with their collegiate athletes. Data collection was completed via paper and pencil or through an online Qualtrics survey (Qualtrics, Provo, UT, USA) on an iPad during pre-participation physical examinations or in conjunction with a sport team activity (e.g., practices, meetings, injury treatments). This flexibility allowed each sports medicine team to determine which data collection strategy would be the most efficient to maximize recruitment and participation at their institution. At each data collection session, participants were provided with an informed consent form and an opportunity to ask questions about the study. Informed consent was indicated when participants voluntarily initiated the survey. Completed paper and pencil surveys were entered into the Qualtrics survey platform by trained research assistants. Data were then exported from Qualtrics into a datafile for analyses.

Data Analysis Plan

Prior to performing the analyses, the two groups were matched for gender, age, and sport with a ratio of 1:4 for each data set, using the R package MatchIt (Ho et al., 2011). This was done to reduce any bias due to covariates and improve the degree of comparability between the two groups (Stuart, 2010). The "nearest matching neighbor" method was used to extract subgroups of athletes from the comparison group considering the smallest distance to each athlete who reported having received a diagnosis of ADHD one at a time.

Then, we evaluated the presence of missing data. The percentage of missing values for 26 of the 28 variables measured in the study was less than 1.50; however, the amount of missing information was larger for the number of nondisclosed sport-related concussions (NDC; $n=36$, 4.20%) and the test scores of concussion knowledge ($n=71$, 8.28%). Based on the assumption that those values were missing at random, we conducted multiple imputations by chained equations and created 20 completed data sets using the R package mice (van Buuren & Groothuis-Oudshoorn, 2011). The number of imputations was determined according to the rule of thumb in relation to the sample size and simulation studies (Graham et al., 2007; Royston & White, 2011).

Next, we examined whether athletes with ADHD had a significantly higher risk for disclosed sport-related concussion and nondisclosed sport-related concussion than the group of athletes without ADHD of comparable age and similar distributions of gender and sport type. The count nature of the two dependent variables required an approach for handling discrete and highly skewed (i.e., non-normal) distributions (see Figure 1). Therefore, negative binomial multiple regressions were used to model the effects of ADHD on the number of sport-related concussions using the R package MASS (Venables & Ripley, 2002). Two separate multiple regression models were created to determine whether such a relation would be significant while accounting for the contribution of other variables, such as gender, years of experience, sport risk level, and overall knowledge

Table 2. Negative Binomial Regression Model for Disclosed and Nondisclosed Sport-Related Concussions.

	IRR	Unstandardized beta	SE	t	p
Disclosed SRC predictors					
Intercept	−1.99	−4.80	1.25	−3.84	.00
Group (1 = ADHD)	1.65	0.50	0.23	2.20	.03
Knowledge core	1.07	0.07	0.03	2.52	.01
Gender (1 = women)	−1.28	−0.33	0.24	−1.38	.17
Risk level (1 = high)	1.77	0.57	0.28	2.04	.04
Total years of experience	1.06	0.06	0.03	1.87	.06
Nondisclosed SRC predictors					
Intercept	−1.00	−5.41	2.82	−1.92	.06
Group (1 = ADHD)	1.97	0.68	0.48	1.40	.16
Knowledge score	1.08	0.08	0.06	1.25	.22
Gender (1 = women)	−1.65	−1.05	0.50	−2.11	.04
Risk level (1 = high)	2.34	0.85	0.59	1.45	.15
Total years of experience	1.04	0.04	0.07	0.65	.52

SRC = sport-related concussions.

of concussions. The results from each imputed data set were pooled by using the Rubin's formulas (Enders, 2010).

The regression coefficients were reported along with the incidence rate ratio (IRR) which is another measure of the effect of independent variables on the dependent variable. The IRR tends to be more easily interpreted compared to beta coefficients in that the former refers to the change in the dependent variable rate expressed as a percentage of the independent variables, whereas the latter represents the change in the expected log count for each unit of the predictors.

Finally, we examined whether the two groups differed on the reasons why participants did not disclose a suspected sport-related concussion. A Fisher's exact test was performed on the association between the group membership and the reasons for not reporting. All statistical analyses were conducted in RStudio (RStudio Team, 2015).

Results

Descriptive statistics were calculated to describe the two groups in the study (see Table 1). ADHD and non-ADHD collegiate athletes did not differ by age, $t(74.78) = 0.91$, $p = .37$, or gender $\chi^2 (1, n = 858) = 0$, $p = 1.00$. However, the interaction between ADHD group membership and sport was significant ($p = .02$), meaning that collegiate athletes who reported a diagnosis of ADHD were differentially represented within sport categories. There were notably more collegiate athletes with ADHD compared to those without ADHD that played volleyball (6.15% vs. 3.78%), lacrosse (20% vs. 11.22%), and field hockey (9.23% vs. 2.14%). Therefore, we extracted matched comparison groups from each imputed data set so that the number of collegiate athletes by practiced sports was proportionally similar across the two groups.

We then designed negative binomial multiple regression models to answer the research questions. First, we tested whether ADHD status would predict sport-related concussions while accounting for the effect of the other variables (Table 2). The model confirmed our initial hypothesis that ADHD status would relate to increased sport-related concussion. Collegiate athletes with ADHD self-reported a significantly higher number of sport-related concussions ($\beta = .50$, $p = .03$) with 1.65 times the risk of reporting a diagnosed sport-related concussion compared to athletes without ADHD. Other variables included in the model were significant predictors of the sport-related concussions, such as knowledge of symptoms related to a concussive injuries ($\beta = .07$, $p = .01$) and sport risk level ($\beta = .57$, $p = .04$). Hence, if collegiate athletes were to increase their score on the knowledge test by one point, their rate for diagnosed sport-related concussions would be expected to increase by a factor of 1.07, while holding all other variables constant. Also, collegiate athletes playing high-risk sports had 1.77 times the risk of diagnosed sport-related concussions than those playing low-risk sports. Gender and years of experience in playing sport were not significant predictors of the number of diagnosed sport-related concussions.

Second, we tested whether ADHD status would predict the number of nondisclosed sport-related concussions while controlling for the same set of variables used in the previous model (see Table 2). The analysis did not confirm our hypothesis that ADHD status would be related to increased frequency of nondisclosure, revealing that collegiate athletes with ADHD were not statistically more likely to not disclose a suspected sport-related concussion ($\beta = .68$, $p = .16$). Among the set of predictors included in the model, gender was the only significant variable related to nondisclosed sport-related concussion ($\beta = −1.05$, $p = .04$); male

Table 3. Reasons for Not Reporting a Sport-Related Concussion by Group.

	ADHD, *N* (%)	Non-ADHD, *N* (%)
	11	108
I thought my coach would get mad	3 (27.27)	30 (27.78)
I did not want to go to the doctor	6 (54.55)	53 (49.07)
I thought my parents would be upset	3 (27.27)	15 (13.89)
I did not want to lose playing time	8 (72.73)	82 (75.93)
I was worried I would have to miss school and get behind on my school work	5 (45.45)	26 (24.07)
At the time I did not think it was a concussion	4 (36.36)	50 (46.30)
I thought my teammates would think I am weak	5 (45.45)	32 (29.63)
I did not think it was a serious injury	3 (27.27)	51 (47.22)
I did not have health insurance and couldn't go to the doctor	0 (0)	6 (5.56)
I did not want to let my team down	9 (81.82)	67 (62.04)
I didn't want to miss a game	9 (81.82)	81 (75.00)
My team was going to playoffs when it happened	3 (27.27)	17 (15.74)
I thought my coach would think I am weak	3 (27.27)	34 (31.48)
I had an exam or project due at school that I did not want to make up	0 (0)	7 (6.48)
I was concerned it would impact my chances of playing professional sports	2 (18.18)	11 (10.19)

collegiate athletes reported 1.65 times the risk of nondisclosure compared to women.

Finally, we examined whether the two groups differed in reasons for not disclosing a suspected sport-related concussion (see Table 3). Important to note is that this analysis was restricted to only those collegiate athletes who reported a history of sport-related concussion nondisclosure. A Fisher's exact test of independence was conducted between group membership and the 15 reasons for not reporting, and the association was not significant ($p > .05$). Therefore, collegiate athletes with and without ADHD did not differ in reasons for not disclosing a suspected sport-related concussion. The three most and least frequent reasons for not reporting were the same between the two groups. Collegiate athletes were more likely not to report a suspected sport-related concussion because they did not want to miss a game, did not want to let their team down, and/or did not want to lose playing time. By contrast, the least frequent reasons for not reporting were the presence of a due project or exam, the lack of health insurance, and/or concerns for the effects on playing professional sports in the future.

Discussion

This study sought to build upon previous literature by increasing knowledge of factors related to concussions that specifically occur during sport participation. This study found group differences regarding diagnosed sport-related concussion history between collegiate athletes with ADHD and those without ADHD, even after controlling for the effects of variables like gender, concussion knowledge (significant predictor), and concussion risk associated with the sport played (significant predictor). Collegiate athletes with

ADHD reported a significantly greater frequency of sport-related concussions compared to the control group. These findings are similar to those previously reported by Alosco et al. (2014) regarding collegiate athletes, Nelson et al. (2016) pertaining to a combined sample of high school and collegiate athletes, and Iverson et al. (2020) concerning samples of younger athletes. The present study contributes to the concussion literature in important ways. First, the current methodology exclusively pertained to sport-related concussions and not the number of lifetime concussions obtained by any cause, including non-sport causes. As a result, this is the first known study to find that collegiate athletes with ADHD are at greater risk for sport-related concussions, specifically. Furthermore, unlike existing studies on this topic, this investigation controlled for gender, concussion knowledge, and the concussion risk associated with the sport played by the participant. This is also the first study to investigate sport-related concussion nondisclosure by ADHD status although no differences were found between the study groups.

Researchers (Iverson et al., 2020; Nelson et al., 2016) previously theorized that the connection between head injuries and ADHD in athletes may be a byproduct of increased impulsivity leading to the adoption of riskier styles of play and less spatial awareness, both of which may increase risk of injury. This theory is supported by a study by Kerr et al. (2014) which found that former collegiate athletes who had sustained multiple previous concussions exhibited higher levels of impulsivity. Present findings are consistent with existing studies that suggest poor impulse control is related to increased risk of injury.

Also, with respect to the possible implications of poor impulse control, we hypothesized that a group with

increased risk of diagnosed concussive injury would also be at increased risk of possible sport-related concussion nondisclosure. This was believed to be particularly true of collegiate athletes with ADHD who may not inhibit the drive to continue playing in the face of a possible concussion, thereby manifesting in concussion nondisclosure. Findings did not support this hypothesis as collegiate athletes with ADHD were equally likely as participants without ADHD to disclose a possible sport-related concussion after controlling for the effects of gender, – though, a significant predictor with males found to be at greater risk for not disclosing – concussion knowledge, and sport played. It may actually be the case that a collegiate athletes with ADHD is unlikely to inhibit verbal and gestural (e.g., holding one's helmet) responses to concussion, even if they desire to stay in the game and continue competing. It may also be the case that the trained sideline eyes of sports medicine professionals and coaches successfully identify possible concussions, thereby not affording collegiate athletes the opportunity to not report a possible concussion. Finally, it may also be the case that with increased collegiate athletes education regarding concussion, all athletes, regardless of any special status, are equally likely to report a suspected sport-related concussion.

Although significant group differences were not present, participants within both samples did report a history of not disclosing a suspected sport-related concussion. Approximately 17% (i.e., nearly 1 in 5) of participants with ADHD admitted nondisclosure of at least one sport-related concussion and provided reasons for not reporting an injury. Collegiate athletes with ADHD are apparently given to nonreporting with some regularity. This is problematic as college students with ADHD are known to face continued academic challenges and consensus exists that concussion exacerbates the neuropsychological consequences of ADHD (McCrory et al., 2017). Future studies should focus on ways to facilitate the reporting and treatment of sport-related concussion for athletes with ADHD. This is particularly important as college students with ADHD may underutilize available university academic/disability services (Gormley et al., 2019).

The reasons for not reporting a sport-related concussion in the collegiate setting were not influenced by ADHD status in this study. A large frequency of both groups indicated concerns related to the removal from sport participation as rationale for their nondisclosure decisions. Although this is the first study to specifically address ADHD, these general findings are consistent with previous literature on this topic for collegiate athletes (e.g., Delaney et al., 2015; Lininger et al., 2017; Kerr et al., 2016; Kroshus et al, 2020). Another common reason for nondisclosure reported by those with and without ADHD was the sentiment of not wanting to let their team down. These findings replicate those of Kerr et al. (2016) who employed a similar methodology as the current study. Additionally, the importance of social identity in concussion disclosure decisions was previously highlighted by Lininger et al. (2017) in a qualitative study of eleven collegiate football athletes who voiced concerns about their team potentially losing a game due to their absence. Collectively, these findings further highlight the prioritization of sport participation and athletic/social identity over physical health regardless of ADHD status. These psychosocial considerations related to injury nondisclosure must be addressed moving forward at all levels of sport in order to positively impact injury reporting behaviors.

Implications for Practice and Research

Consensus statements have called for athletes with ADHD who sustain a sport-related concussion to be subject to deliberate planning and treatment protocols that extend to the educational arena (McCrory et al., 2017). This appears particularly necessary as ADHD and concussion may have a negative interaction effect (White et al., 2013). The need for the development and study of specialized sport-related concussion protocols for those with ADHD is further emphasized by the present findings that collegiate athletes are at increased risk for diagnosed sport-related concussions. Future research might further explore specific concussion symptoms and functional outcomes experienced by athletes with ADHD after sport-related concussion and if there are particular elements of managed recovery protocols that facilitate efficient recovery and positive outcomes.

Widely accepted is that immediate identification of a sport-related concussion is necessary to provide efficient treatment and avoid negative consequences (McCrory et al., 2017), like extended treatment and recovery times, or additional complications. Immediate treatment is potentially of great importance for athletes with ADHD to better ensure positive outcomes. Findings of this study suggest that the concussion treatment of collegiate athletes with ADHD is not delayed by their own nondisclosure any more than non-ADHD athletes. Still, as Figure 1 displays, we did document the existence of nondisclosed sport-related concussion among the collegiate athletes with ADHD. Concussion education provided to athletes should continue to emphasize the importance of immediately reporting a sport-related concussion to medical professionals.

Of interest to those that treat sport-related concussion, collegiate athletes with ADHD and those without ADHD reported similar reasons for not disclosing a suspected concussion. The top reasons including not wanting to miss a game, lose playing time, or letting the team down. It does not appear that different educational approaches need to be used with ADHD athletes in this regard, yet it may be particularly important to engage and research education approaches to reach athletes with ADHD to increase reported of possible sport-related concussions.

Study Limitations

There are several study limitations to acknowledge. First, all survey responses were self-reported in nature; therefore, we cannot confirm the accuracy of ADHD or sport-related concussion diagnoses. Future studies would be strengthened by the inclusion of medical documentation of ADHD status and a validated measurement of impulsivity. Additionally, prospective research is needed to further understand the potential causative relationship between developmental disorders and sport-related concussion occurrence. Qualitative methods could also be employed to further investigate why collegiate athletes with ADHD report concussive injuries in order to determine if this developmental disorder is a true risk factor for injury occurrence or if it is a factor related to more desirable reporting behaviors. Furthermore, the results of this study represent collegiate athletes from six NCAA institutions. A larger national sample is needed to increase the power of a future study that examines group differences in the occurrence of diagnosed and nondisclosed sport-related concussion and more comfortably generalize these findings.

Conclusions

This investigation adds to the extant literature regarding the relationship between diagnosed sport-related concussion head injury history and ADHD status in athletes. Perhaps of greater importance, this is the first study to consider a developmental disorder as a potential moderating factor in sport-related concussion nondisclosure. Findings confirmed our hypothesis that collegiate athletes with ADHD have an increased prevalence rate of diagnosed sport-related concussion compared to their peers without ADHD. Conversely, our hypothesis related to sport-related concussion nondisclosure was not supported as results did not find a significant association between ADHD status and not reporting a potential concussive injury. That is not to say that ADHD collegiate athletes in this sample were free of nondisclosed concussion, which is troubling as experts have suggested that athletes with ADHD should be provided and efficiently administered treatment protocol to avoid prolonged recovery and poor outcomes. ADHD status was not found to be related to reasons for nondisclosure decisions within our collegiate athlete sample, yet continued study of reasons why collegiate athletes do not report a possible concussion and establishing ways to counteract effectively these reasons is warranted.

Declaration of Conflicting Interests

Funding

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