Do as I say: contradicting beliefs and attitudes towards sports concussion in Australia

Do as I say: Contradicting beliefs and attitudes towards sports concussion in Australia.

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Abstract

The objective of this study was to explore beliefs and attitudes of students studying exercise science in Australia towards sports concussion. A secondary objective explored differences between gender and previous experience of concussion. Three hundred and twelve participants (m = 217; f = 95) responded to a series of statements ranging across a number of areas including personal attitudes and beliefs towards concussion: if they would risk playing with a concussion; their views on elite/professional athletes who continue to play after a concussion; and attitudes towards rehabilitation. Overall, attitudes revealed that it was not safe to play with a concussion, and it was believed that those who have had repeated concussions would be likely to suffer problems later in life. However, responses also indicated that they would risk playing with a concussion, and admired elite athletes who continued to play. When controlling for gender and previous concussions, males and those who sustained a previous concussion/s were more likely to continue playing. Conversely, females were more likely to complete rehabilitation prior to returning to sport. This study demonstrates in an Australian student cohort studying for a career in exercise and sports science, disparity between beliefs and attitudes regarding sports concussion.

Introduction

Concussion is a form of traumatic brain injury following a direct force to the head. Concussion may also occur indirectly when an impulsive force to the neck or upper body is transferred to the head (Dimou & Lagopoulos, 2014; McCrory et al., 2013). Concussions may, but often do not, involve loss of consciousness, and result in a rapid onset of non-specific symptoms and impairment of neurological functions that usually resolve within 7-10 days (Broglio et al., 2014; Dimou & Lagopoulos, 2014). However, emerging evidence suggests that repeated impacts to the head may lead to increased risk of cognitive and mental health issues, and/or movement disorders later in life (McKee, Daneshvar, Alvarez, & Stein, 2014; Ozolins B, Aimers N, Parrington L, & Pearce AJ, In Press; Pearce et al., 2014; Smith, Johnson, & Stewart, 2013), and associated deterioration in brain tissue (McKee et al., 2016).

Over the last decade, this emerging evidence of both the acute effects, and the potential long-term consequences of players sustaining multiple concussions during their sporting careers, has led to increased media interest in sports-related concussion (McCrory, 2011). As a result, global public awareness about sports-related concussions has considerably increased (Raftery, 2014). However, due to colloquial speech, generally used by sports media commentators who glorify players who sustain a concussion (Cusimano, Chipman, Volpe, & Donnelly, 2009; McLellan & McKinlay, 2011), as well as the labeling of concussions by journalists using lay descriptors such as “head knock”, “ding”, or “bell rung”, can inappropriately lead to a downplay of the seriousness of concussion with the public (Broglio et al., 2014). As such, current understanding of concussion is not consistent with the currently accepted medical definition, promoting misunderstanding, and potentially affecting the reporting of concussions (Robbins et al., 2014). Consequently, previous studies,

across a range of sports and countries, have estimated over 50% of concussion injuries are not reported by players, or under-diagnosed by physicians (Baker, Devitt, Green, & McCarthy, 2013; Kerr, Register-Mihalik, Kroshus, Baugh, & Marshall, 2016; Kroshus, Daneshvar, Baugh, Nowinski, & Cantu, 2013).

Attitudes towards the reporting of, or playing on after concussion

To date, the majority of studies have sought to understand the attitudes and perceptions of concussion by investigating the issues of under-reporting in various athletic cohorts enrolled in educational institutions. For example, in high-school student athletes, McCrea, Hammeke, Olsen, Leo, and Guskiewicz (2004) and Register-Mihalik, Guskiewicz, et al. (2013) found that athletes did not disclose a concussion because they thought the injury was not serious enough to report, as well as not wanting to be removed from the match. McCrea et al (2004) also reported a lack of awareness regarding concussions, whilst Register-Mihalik et al (2013a) found that letting down teammates and coaches was a greater reason than lack of awareness for not reporting concussions. This may be due to a general increase in awareness of sports concussions through discussion in the media and wider community (Raftery, 2014).

In college/varsity cohorts, an earlier study in student-athletes (n=461) found that nearly one in five surveyed failed to report concussion symptoms to team staff while playing (Kaut, DePompei, Kerr, & Congeni, 2003). Although specific reasons were not provided in this study by the participants themselves, the authors suggested that not reporting a concussion was likely due to not wanting to be removed from the game or practice, as well as the engrained culture of playing with pain and symptoms,

even if this includes mild head injury (Kaut et al., 2003). Investigating the reporting of the history and attitudes towards concussion in a collegiate/varsity athletic population (*n*=262), Torres et al. (2013) found that 43% of those with a history of concussion reported that they had knowingly concealed concussion symptoms to allow them to continue playing in a game. Moreover, despite acknowledging they had been formally educated about the risks of concussion, 22% of the surveyed athletes indicated they would be "unlikely" or "very unlikely" to report a concussion to their coach or athletic trainer in the future. The authors note that whilst concussion education is clearly important, their findings in this college/university cohort suggested that receiving education would not motivate them to report concussion in the future (Torres et al., 2013). It has also been suggested, irrespective of whether concussion education has been received, collegiate/varsity athletes will play or train through concussion, or indeed any injury, to protect their scholarships, gain peer acceptance, as well as obtaining or maintaining coach support (Malinauskas, 2008). Likewise, Chrisman, Quitiquit, and Rivara (2013) also suggested that college/varsity athletes will hesitate reporting their injury, particularly if there was no significant pain or observable disability. A more recent study by Kroshus, Kubzansky, Goldman, and Austin (2015) examined the reporting behaviors of male collegiate ice hockey players (*n*=116), and found that the players who thought that 'most athletes' would report concussions, were themselves the *least* likely to under-report their own head injuries during the season. The authors noted that regardless of the attitude, players had a tendency to think that other athletes were less likely to report than them, with the suggestion that intervention programs should involve understanding individual perceptions of concussion reporting.

Influence of gender on continuing to play, and/or not reporting concussions

A growing body of research has investigated differences in concussion and related outcomes between males and females (Colvin et al., 2009; Covassin, Elbin III, Larson, & Kontos, 2012; Covassin, Elbin, Harris, Parker, & Kontos, 2012; Covassin, Swanik, & Sachs, 2003). As a result Corvassin and colleagues (Covassin, Elbin, et al., 2012; Covassin et al., 2003) have proposed that women are at higher risk for concussion than men. Indeed, studies have reported a higher incidence of concussions in females (Castile, Collins, McIlvain, & Comstock, 2012; Gessel, SK, Collins, Dick, & RD, 2007). Further, it has also been suggested that women may take longer to recover from a concussion than men (Colvin et al., 2009; Covassin, Schatz, & Swanik, 2007).

Research has also investigated the role of gender in relation to attitudes towards concussion reporting (intent and action) with the findings being somewhat mixed. Register-Mihalik, Linnan, et al. (2013) were not able to discern differences in attitudes between gender in high school athletes due to a small sample size. Torres et al. (2013) who used a college athlete cohort found that males had a greater *intention* to report symptoms of a concussion in the future to coaching and athletic training staff in comparison to females. Conversely, when investigating actual reporting behavior, Covassin, Elbin, et al. (2012) found gender differences in the reporting of actual symptoms in a mixed high-school (n=150)/college athlete (n=72) cohort, with female athletes reporting more symptoms than male athletes at baseline and up to 14 days post concussion. A larger study by Covassin, Elbin III, et al. (2012) involving athletes in high school (n=779) and college (n=837) observed no differences in concussion symptom reporting between genders. Similarly, Llewellyn, Burdette, Joyner, and Buckley (2014) reported no differences between gender in reporting of concussion

symptoms. However, a more recent study, also using college athletes (Kerr et al., 2016), found the prevalence of *not reporting* concussions to be higher among men than women.

Understanding previous experience of concussion on attitudes

There is also a gap in the research with regards to previous concussion experience and the relationship this has with beliefs and attitudes towards concussion. Previous studies have aimed to associate concussion knowledge with concussion attitudes, specifically with regards to those who had previous concussions. For example, Mrazik, Perra, Brooks, and Naidu (2015) explored the association between previous concussions and concussion knowledge in an adolescent Ice Hockey population (n= 183) showing no differences between players and controls (n=57) and across age and gender. Although the authors admit sampling issues (size and convenience), Mrazik et al. (2015) also suggest that there may have been a tendency in the group to provide the response expected of them. To date, only one study (Rosenbaum, 2007) has aimed to examine concussion attitudes between those who have previously experienced a concussion to those who have never been concussed. Interestingly, Rosenbaum (2007) found in high school athletes, that those who reported two or more concussions displayed attitudes that were significantly less safe than athletes with no concussion history; highlighting the need to explore the relationship between attitudes of, and experience with sustaining a concussion further.

Understanding beliefs and attitudes in an exercise and sports science cohort

It should be noted that the majority of studies regarding concussion attitudes

have, to date, been directed towards student-athletes and their coaches (Bramley, Patrick, Lehman, & Silvis, 2012; Chrisman et al., 2013; Kaut et al., 2003; Kerr et al., 2016; Kroshus et al., 2013; Kroshus et al., 2015; McCrea et al., 2004; McLeod, Schwartz, & Bay, 2007; Register-Mihalik, Guskiewicz, et al., 2013; Register-Mihalik, Linnan, et al., 2013); although club athletes (Baker et al., 2013; Braham, Finch, McIntosh, & McCrory, 2004), have also been surveyed, but to a lesser extent. Further, the majority of these studies have been completed in North America. Therefore, it was important for us to understand attitudes towards concussion in Australia.

Unlike the North American sports system, where sport is closely associated with education (Cady, 1978), sport in Australia is organized via the well-established system of community-based sports clubs (Light, 2010). As a consequence, students who enroll in courses at Australian universities are not student-athletes *per se*, who represent their university in formal sporting competition or leagues, and are not dependent upon scholarships to pay tuition fees.

To date, there have been no studies that have investigated perceptions and attitudes about concussion in non-athletic scholarship university populations. Further, and to the best of our knowledge, no study has specifically investigated a university exercise science student cohort. Exercise and sport science students undertake learning in a variety of disciplines that consequently provides them with knowledge and competencies to work with different populations. Such populations range from working with athletes at all levels and age groups, supporting roles in sport (such as athlete/coach education and welfare), education of others within the industry, through to clinical exercise rehabilitation (i.e., prescribing exercise to those with cardiovascular conditions, chronic lifestyle conditions, or neuromuscular rehabilitation). Australian universities who offer exercise and sport science courses

also require students to undertake a set amount of hours completing job placement (work experience). Generally, activities during work experience involve assisting in injury prevention and management of sporting teams, and also individual athletes during training and competition; provision of sports first-aid and follow-up rehabilitation. Further, anecdotal evidence suggests many exercise and sports science graduates from Australian universities will work in some capacity with athletes at all levels of competition (from juniors and community players through to elite professional athletes) in either an honorary or paid role (*Exercise and Sports Science Australia*, 2016; Hetherington, 2015; *Job Outlook: An Australian Government Initative*, 2016). Moreover, others who do not work specifically in exercise and sports science will complete further specialized education to become fitness instructors/personal trainers or physical education teachers (*Job Outlook: An Australian Government Initative*, 2016). Therefore, understanding student attitudes and perceptions of concussion is equally important as understanding the corresponding attitudes and perceptions of athletes and coaches.

Aim of the study

The aim of this study was to investigate the attitudes and beliefs regarding concussion in university students undertaking studies in exercise and sports science. Responses were compared across gender, and previous experience of sustaining a diagnosed concussion. We hypothesized that the attitudes of exercise science students towards concussion would correlate with responses about hypothetical situations involving a concussion (for example, “I believe that it is safe to play or train with concussion” with “would you risk playing with a concussion?”). However, we hypothesized attitudes between males and females would differ. Based on the

literature about gender to date, and the studies that showed a difference (for example Colvin et al., 2009; Covassin et al., 2007; Covassin et al., 2012a), we hypothesized that males would report that they would continue to play with a concussion, admire elite athletes who played on after a concussion, but would be less likely to complete rehabilitation. Further, we also hypothesized differences based upon previous concussion. Specifically, those reporting previous concussions would report safer attitudes towards concussion compared to those who have never been concussed.

Material and methods

Participants

The sample consisted of 312 students (male, $n = 217$; female, $n = 95$; mean age 22 ± 5.2 years), studying exercise and sports science. Students were enrolled across two Australian universities offering courses in exercise science (including exercise science, exercise physiology, exercise rehabilitation, sports science and sports coaching). Although Australian Rules football is the predominant sport watched and played, by both genders where the universities are located, students revealed they participated in a range of sports that ranged between involvement in community-club competitions to competing at elite levels (Table 1).

Table 1 here

Students were invited to participate in the anonymous survey following general announcements across research seminars, lectures, and tutorial classes. No incentive was provided to participants. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by the University Human Research Ethics committees.

Materials and Procedure

Developed by two of the investigators, the single survey consisted of 17 closed questions using a Likert-scale (see Appendix A for survey instrument). Employing previous methods (Register-Mihalik, Guskiewicz, et al., 2013) test-retest agreement of the survey was assessed with 65 university students, undertaking a variety of courses. These students completed the survey instrument at two separate times, at least 60 minutes apart, with surveys distributed with the questions in randomized order. The agreement across all attitude items used on the questionnaires ranged from 0.73 to 0.91. Mean difference between Likert-scale attitude questions was less than 0.22 (maximum score for each question = 5). Cronbach α was calculated for attitude constructs (α = 0.77) and perception constructs (α = 0.81) on the survey instrument.

For the study survey, participants were asked to complete general demographic questions such as gender, age, if they had previously sustained a concussion, and if so, how many. Using a 5-point Likert-scale that ranged from 1 ("*always*") to 5 ("*never*"), students responded to a series of statements about their personal attitudes and beliefs towards concussion. Such statements included if they would risk playing with a concussion and their attitudes towards rehabilitation, their admiration of elite athletes and the glorification of such athletes in the media; their perceptions of support from their coach, club/association administration, and family when/if they were concussed; and their perceptions of support from their club or association with providing first aid, as well as medical follow up and rehabilitation following a concussion.

Data and statistical analyses

Data from returned surveys was entered into SPSS V24 (SPSS Inc, USA) and screened for normal distribution. Shapiro-Wilk tests for normal distribution of the dependent variables found the data was not normally distributed (SW = .547 to .913; p < .001). Further transformation of the data revealed that the data was still not normally distributed (SW = .418 to .532; p < .05), therefore Spearman's rank-order correlations were used to evaluate relationships between key dependent variables. Kruskal-Wallis tests were conducted to evaluate differences between males and females, and experiences of previous concussions, in their beliefs and attitudes towards concussions. Significance was set at p < .05

Results

General descriptive data from all students surveyed are reported in Tables 1-3. Attitudes of the overall student cohort sampled, irrespective of gender or experience, showed significant positive correlations between students' attitudes towards playing with a concussion, and willing to continue playing 'with no symptoms' (r_s = .34, p = <.001); 'dizzy but feel okay' (r_s = .39, p = <.001); 'dazed but can't let team mates down' (r_s = .36, p = <.001); and 'knocked out but came to' (r_s = .34, p = <.001). Significant positive correlations were also observed between students' beliefs regarding playing with a concussion and prior experience with sustaining a concussion (r_s = .13, p =.019), but not with the number of concussions reported (r_s = -.07, p =.498).

****Tables 1-3 near here****

Gender and attitudes towards concussion

Students reported an overall belief that it was not safe to play or train with a concussion (χ^2 (1) = 13.28, p = 0.003, η^2 = 0.04); however males differed to females

in their agreement to the statement (males: M_{rank} = 145.86; females: M_{rank} = 180.79).

Students responded that they would risk playing with a concussion if their chances of being selected to compete would be affected (χ^2 (1) = 3.84, p = 0.05, η^2 = 0.01), with males (M_{rank} = 149.56) reporting that they would take a greater risk than females (M_{rank} = 170.63). Students also responded that they would be willing to play or train if they "did not feel any symptoms" (χ^2 (1) = 19.71, p = <0.001, η^2 = 0.07), with males (M_{rank} = 138.21) being more willing than females (M_{rank} = 185.42). Further, students revealed that they would be willing to play or train if they "felt dizzy but thought within themselves that they were ok" (χ^2 (1) = 15.57, p = <0.001, η^2 = 0.05), again with males (M_{rank} = 140.25) being more willing than females (M_{rank} = 182.51). When asked if they were willing to play if they "felt dazed but were afraid to let their team mates down", students agreed that they would continue (χ^2 (1) = 21.38, p = <0.001, η^2 = 0.07), with males (M_{rank} = 138.06) being more willing than females (M_{rank} = 187.60). Finally, students reported that they would be willing to play if they were "knocked out, but came to" before the end of the game (χ^2 (1) = 7.34, p = <0.01, η^2 = 0.02), with males (M_{rank} = 143.55) being more willing than females (M_{rank} = 171.39).

When asked about playing elite athletes and concussions, students admired elite athletes who continued to play when they were concussed (χ^2 (1) = 28.98, p = <0.001, η^2 = 0.09), with males (M_{rank} = 138.92) reporting greater admiration than females (M_{rank} = 196.65). However, students responded that players should be fully rehabilitated before returning to play or training after they have suffered a concussion (χ^2 (1) = 8.44, p = 0.004, η^2 = 0.03), with females (M_{rank} = 135.61) in favour of this more than males (M_{rank} = 165.65).

Males and females also differed in their perceptions for the degree of support they would receive if they were concussed from their coach (χ^2 (1) = 5.37, p = 0.02, η^2 = 0.02), with males (M_{rank} = 162.92) reporting they would perceive *less support* than females (M_{rank} = 140.03) and also from their team mates (χ^2 (1) = 5.28, p = 0.02, η^2 = 0.02), with males (M_{rank} = 163.81) reporting they would perceive *less support* than females (M_{rank} = 139.81). Gender differences were not found when asked about post-concussion support from club administration (χ^2 (1) = .657, p = 0.42,), or family (χ^2 (1) = 3.01, p = 0.08). Similarly, no gender differences were observed with regards to club administration providing first aid when concussed (χ^2 (1) = .66, p = 0.42); follow up support (χ^2 (1) = .01, p = 0.94); and rehabilitation (χ^2 (1) = .15, p = 0.69).

Previous experience sustaining a concussion

Statistically significant differences were found between students who had previously sustained a concussion (mean 2.5±1.9) and those who had not reported a concussion in their belief that it is safe to play or train with a concussion (χ^2 (1) = 5.43, p = 0.020, η^2 = 0.02). Differences were found in attitudes between those who had previously sustained a concussion/s (M_{rank} = 142.06) compared to students who did not report a concussion (M_{rank} = 163.82). Further, students overall responded that they would be willing to play or train if they did not feel any symptoms (χ^2 (1) = 6.64, p = 0.010, η^2 = 0.02) with previously concussed students (M_{rank} = 135.17) being more willing than non-previously concussed students (M_{rank} = 161.65). Similarly, students believed that they would be willing to play or train if they felt dizzy but thought within themselves that they were okay (χ^2 (1) = 4.84, p = 0.028, η^2 = 0.02) with previously concussed students (M_{rank} = 138.08) being more willing than non-

previously concussed students (M_{rank} = 160.83). Finally, students believed that they would be willing to play or train if they dazed but were afraid to let their team mates down (χ^2 (1) = 7.18, p = 0.007, η^2 = 0.02), with previously concussed students (M_{rank} = 134.81) being more willing than non-previously concussed students (M_{rank} = 162.55).

A previous experience of concussion also influenced some questions regarding perception of support. Differences were found with regards to support from the coach (χ^2 (1) = 3.99, p = 0.046, η^2 = 0.01) with previously concussed students (M_{rank} = 143.31) reporting that they would receive more support than non-previously concussed students (M_{rank} = 162.47); and support from club administration (χ^2 (1) = 5.36, p = 0.021, η^2 = 0.02) with previously concussed students (M_{rank} = 141.81) reporting that they would receive more support than non-previously concussed students (M_{rank} = 163.23). No other significant differences were found between those who had previously been concussed and those reporting no concussions (support from teammates: χ^2 (1) = .48, p = 0.487; support from family: χ^2 (1) = 1.76, p = .18; support from club administration with first aid: χ^2 (1) = .19, p = 0.663; support from club administration with follow-up: χ^2 (1) = 3.35, p = .067; support from club administration with rehabilitation: χ^2 (1) = 2.57, p = 0.109).

Discussion

With previous studies focusing on 'athlete-student' university populations about their beliefs and attitudes towards sports-related concussion (Kaut et al., 2003; McCrea et al., 2004; Register-Mihalik, Guskiewicz, et al., 2013; Torres et al., 2013), the aim of this study was to focus on 'non-athlete' students (i.e. not supported by a

scholarship to represent the university in sport; who are preparing themselves for a career in exercise, sport and/or healthcare; and who will work with individuals in a capacity of preparation, rehabilitation or education). Thus, our rationale for conducting this study was to address the gap in the literature by exploring the attitudes of students, towards concussion, who not only participate in sport, but who will be the next generation of professionals to enter the exercise and sports industry. Additionally, based on the findings of previous research, we also explored if such attitudes would differ based on gender and previous experience with sustaining a concussion.

The findings from this study revealed that our cohort of students believed that it was not safe to play with a concussion injury. Further, students responded that they believed that athletes who sustained repeated concussions were likely to develop neurological and psychological problems later in their life. Conversely, when provided with situations that tested their attitudes towards concussion, student responses contradicted their beliefs, such that they reported that they would risk playing or training with a concussion. Moreover, students responded that they admired elite athletes who continued to play after a concussion. Also unexpected was the finding that those who reported previous concussions were more likely to respond that it was not only safe to continue playing after a concussion, but also that they were willing to do so.

Gender attitude differences

Males agreed that it was safer to play with a concussion than females. Further, this gender difference was also found when asking students if they would continue to

play with increasing symptom severity of the concussion. Because we did not ask students if they would *report* their concussion, but rather, would they continue to play, it is difficult to directly compare our findings to previous research. Generally speaking however, our observations appear to support the recent findings of Kerr et al. (2016) who found, in males compared to females, a higher prevalence of not reporting concussions, and therefore continue to play with a concussion.

In the context of concussion, risk-taking behaviour in males has been previously suggested to explain higher incidence rates of concussions between males and females (McKeever & Schatz, 2003), or differences in attitudes towards concussion management and return to play guidelines (Sye, Sullivan, & McCrory, 2006). The assertions of gender and risk have been supported in a meta-analysis by Byrnes, Miller, and Schafer (1999) of 150 studies. These authors demonstrated that across a number of types of risk-taking activities, such as hypothetical choice (e.g. choice dilemma or framing); self-reported behaviour (e.g. smoking, drinking, sexual activities); or observed behaviour (e.g. driving, gambling, intellectual risk, physical activity and skills) the majority of greater risk taking behaviours were seen in males, with the greatest effect sizes found in physical activities and skills. The authors noted, however, that the gender gap appears to be reducing over time. With increased female participation in traditionally male dominated team contact sports (Hootman, Dick, & Agel, 2007), it will be important to assess females' attitudes about risk-taking and concussions in future studies.

Our data also revealed that males were more likely to participate with a concussion if team selection was at stake. Further to previous studies suggesting that removal from the current game, team-mate peer acceptance/support, and coach acceptance/support were possible reasons for why this occurs (Kaut et al., 2003;

Torres et al., 2013), the finding of attitudes towards future team selection should be another consideration contributing to under-reporting of concussion symptoms. It is not uncommon for athletes to carry injuries and continue to push for selection throughout the season (Mitten, 1993). Concussion is of particular concern because unless serious, concussion is not overtly obvious, or carries significant pain, or observable disability (Chrisman et al., 2013). Therefore, without the individual displaying clear signs of post-concussion syndrome, such as headaches and dizziness that show during, and impact on, exercise (Willer & Leddy, 2006) it appears that in our cohort, males would continue to participate following a concussion in order to be or remain selected for teams.

Previous experiences on attitudes towards concussion

The finding that those who had previously sustained a concussion agreeing that it was safe to play with a concussion, and that they would risk playing or training with increasing symptoms (unless knocked out), compared to those who had not previously suffered a concussion, was certainly unexpected. Similar to the study in high school athletes by Rosenbaum (2007), we are unsure why this attitude would prevail in those who had previously been concussed, and can only speculate on potential reasons. One such speculation relates to previous experiences influencing current attitudes (planned behaviour) as proposed by Ajzen (1991) and more recently by Kroshus, Baugh, Daneshvar, and Viswanath (2014). In the case of concussion experiences, this would suggest that participants in our study, having not suffered seriously from previous concussion/s, are shaped in their current attitudes towards concussions differently to those who have not undergone the same experience. Further exploration of concussion experiences, including quantifying the seriousness

of the injury and the recovery period following, is required to understand this paradox further.

Another possible explanation relates to the lack of knowledge by students regarding the pathophysiology of concussion injuries. In other words, students may not fully understand the potential seriousness of a mild brain injury. Previous studies in athlete and athlete-student populations have cited knowledge gaps as a reason why individuals risk playing following a concussion (Baker et al., 2013; Malinauskas, 2008; Torres et al., 2013). But as previous studies have demonstrated, education is not a key factor in changing concussion attitudes in a university population. Malinauskas (2008) and Torres et al. (2013) have both reported students who have undertaken concussion education have chosen to not disclose their own concussion injuries.

A final reason for our findings of disparate attitudes is that individuals tend to downplay their concussion experiences (McCrea et al., 2004). Compared to those who had reported not sustaining a concussion, those that did report a concussion revealed positive perceptions of support from coaches and club administration further influencing disparate attitudes. Future studies that explore beliefs and attitudes about previous concussion experiences should aim to include the severity of concussion, experience and time for recovery.

Limitations of the study, and considerations for further research

Our findings are limited by a number of factors inherent in the cohort studied and using a psychometric survey instrument. Firstly, a novel aspect of our study was to explore general students' attitudes and beliefs regarding concussions, rather than student-athletes, which makes direct comparisons potentially difficult. Further, our sampled university population was older than previous studies (e.g. Torres et al.,

2013; Kroshus et al., 2015) that have explored this issue. A reason for this is due to the age characteristics of students who are currently enrolled at universities in Australia with a mean age of 21 years, and 41% of enrolled students are between 25 and 64 years (Australian Bureau of Statistics, 2013). Therefore we caution generalising these findings to cohorts outside of Australia.

Other limitations also include not asking in-depth questions regarding their sporting experiences (i.e., exactly what sports played, and for how long have they played their sport which was beyond the scope of the research question) as well as asking the students' about their knowledge regarding concussion. Our reasoning for not including concussion knowledge was that, although many exercise science students would be working with athletes of varying levels, or in an allied health area, possibly with clinical staff, they themselves would not be working as a medical practitioner, who in Australia is the only professional allowed to diagnose concussions. If concussion is suspected, players are expected to go to hospital or their local medical practitioner for further diagnosis (Elkington & Hughes, 2016). However, quantifying respondents' concussion knowledge would be appropriate to associate with beliefs and attitudes in future studies, for example, using a modified survey previously developed by Rosenbaum and Arnett (2010) for a university level cohort. Our study was also limited by the fact that we were unable to quantify the severity of the concussion in those who had reported sustaining a concussion(s). Because the finding of less cautious attitudes in those reporting previous concussions was quite surprising to us, future studies should aim explore the effect of previous concussions on attitudes towards concussion in further depth.

Future research should continue to investigate in this population attitudes towards concussion based upon the type of sport played (for example, individual

contact sports vs team contact sports). Specifically team cohesion, and the influence of the leadership group behaviours, may be an influencing factor and playing a role in influencing and shaping behaviours of team members towards concussion (Light Shields, Gardner, Light Bredemeier, & Bostro, 1997).

Finally, the research to date, including the present study, has employed methods asking attitudes and beliefs at the individual level. Similar to the study recently reported by Kroshus et al. (2015) who found that the players who though that 'most athletes' would report concussions, were themselves the *least* likely to under-report their own head injuries during the season; the findings from this study may also involve the phenomena of what has been termed 'pluralistic ignorance' (Grant, O'neil, & Stephens, 2009). As proposed in the sociology literature, pluralistic ignorance refers to where the majority of individuals perceive that most of their peers think differently to themselves when, actually, individual attitudes are similar. However, we did not include questions with regards to what the participants thought the attitudes of their peers towards sports concussion would be. In other words, we did not ascertain if individuals in our cohort felt that others thought similarly to them. Further, given the prominence of the issue of sports concussion in recent years, examination is required to investigate if interpersonal networks and socio-technical conditions (such as social media) can combine to produce pluralistic ignorance (Grant et al., 2009) and misperceptions of students about their peers' attitudes and knowledge.

Conclusion

In conclusion, this is the first study to report attitudes of a non-athlete university student population towards concussion. Our findings show in the cohort studied, a tendency to provide the desired response regarding beliefs about concussion

safety; but presented conflicting attitudes to these beliefs when presented with hypothetical situation questions, such as admiration for elite athletes who play on following concussion, team selection, and not letting teammates down. The findings from this study are important as they reveal in a cohort who are likely to work in the industry with athletes that their attitudes are susceptible to bias based on gender and prior experiences of concussion. With increasing awareness regarding the issue of concussion, it is important to continue investigation specifically in this group studying exercise and sport science, and playing sport regularly. It is also important to understand attitudes towards concussion based upon different academic systems and student knowledge regarding concussions that can influence attitudes. Further, with difference in attitudes in gender and previous experience, data can be employed to develop specific curricular to meet these specific demands.

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Appendix A

Basic Demographics

Gender (M/F)	
Age	
Type of sport(s) played	
Have you previously sustained a concussion? If yes, please state how many if more than one.	

Attitudes and beliefs towards concussion

Please circle the number that best represents what you believe, even if you have never sustained a concussion previously.

	Always	Often	Sometimes	Rarely	Never
I believe that it is safe to play or train with concussion	1	2	3	4	5
I would risk playing or training with a concussion if I thought my chances of being selected to compete would be affected	1	2	3	4	5
Players who continue to play or train with a concussion are likely to suffer problems later in life	1	2	3	4	5
I believe that players should be fully rehabilitated before returning to play or train again after they have suffered a concussion	1	2	3	4	5
I admire elite athletes who continue to play or train when they are concussed	1	2	3	4	5
The media (television, newspapers, radio) glorify elite athletes when they continue to play with a concussion	1	2	3	4	5
I would be willing to play or train with a concussion if:					
I didn't feel any symptoms (i.e. dizzy etc.)	1	2	3	4	5
I felt dizzy but know within myself I'm okay	1	2	3	4	5
I felt dazed but can't let my team mates down	1	2	3	4	5
I was knocked out but came to before the end of the game	1	2	3	4	5

Perceptions of support when/if concussed

Even if you have not received a concussion, circle the number that best represents what you think your coach/ administrators/ teammates would provide *if* you had sustained a concussion.

	Always	Often	Sometimes	Rarely	Never
My *coach* supports me to stop playing or training when I am concussed	1	2	3	4	5
The *administration* of my club supports me to stop playing or training when I am concussed	1	2	3	4	5
My *teammates* support me to stop playing or training when I am concussed	1	2	3	4	5
My *family* (parents, siblings, spouse, children) supports me to stop playing or training when I am concussed	1	2	3	4	5

Perceptions of first aid, medical follow up, rehabilitation following concussion

Even if you have not received a concussion, circle the number that you think best represents your club would provide *if* you had sustained a concussion.

	Always	Often	Sometimes	Rarely	Never
My club provides me with *first aid* support (e.g. sports trainers) when I am concussed	1	2	3	4	5
My club provides me with *follow up medical* support (e.g. doctor to examine me after the game and the following week) when I am concussed	1	2	3	4	5
The club assists me with my *rehabilitation* when I am concussed	1	2	3	4	5

Thank you for your participation.

Table 1. Descriptive data of completed surveys

Characteristic (# reporting)	Frequency (%)[a]
Gender (n=312)	
Male	217 (69.6)
Female	95 (30.4)
Primary sport played (n=312)	
Team sport	245 (78.5)
Individual sport	49 (15.7)
No competitive sport (e.g. weights, recreational running/cycling/swimming)	18 (5.8)
Highest level of sport played (n=312)	
Competitive Elite (national/international level)	33 (10.6)
Competitive non-elite	103 (33.0)
Recreational non-competitive[b]	158 (50.6)
No competitive sport	18 (5.8)
Self-reporting concussion (n=312)	
Yes	105 (33.7)
No	207 (66.3)

[a] Some percentages are rounded. [b] Recreational non-competitive may include participation in club sport days/evenings, but not represent that club in a league or pennant competition.

Table 2. Percentages of agreement towards attitudinal statements.

Student attitude item	Agreement with item
Rate these statements on a scale of 1 ("Always") to 5 ("Never").	
I believe that it is safe to play or train with a concussion	1.6%
I would risk playing or training with a concussion if I thought my chances of being selected to compete would be affected	21.8%
Players who continue to play or train with a concussion are likely to suffer problems later in life	45.8%
I believe that players should be fully rehabilitated before returning to play or train again after they have suffered a concussion	75.6%
I admire elite athletes who continue to play or train when they are concussed	20.8%
The media glorify elite athletes when they continue to play with a concussion	43.6%
Rate on a scale of 1 ("Always") to 5 ("Never"). I am willing to play or train with a concussion if:	
I didn't feel any symptoms	53.5%
I felt symptoms but know within myself I'm okay	27.5%
I felt symptoms but can't let my team mates down	26.9%
I was knocked out but came to before the end of the game	12.5%

Table 3. Percentages of agreement towards perception statements.

Student perception item	Agreement with item
Rate these statements on a scale of 1 ("Always") to 5 ("Never").	
My *coach* supports me to stop playing or training when I am concussed	82.7%
The *administration* of my club supports me to stop playing or training when I am concussed	86.2%
My *teammates* support me to stop playing or training when I am concussed	73.1%
My *family* (parents, siblings, spouse, children) supports me to stop playing or training when I am concussed	88.8%
My club/association provides me with *first aid* support (e.g. sports trainers) when I am concussed	89.4%
My club/association provides me with *follow up medical* support (e.g. doctor to examine me after the game and the following week) when I am concussed	60.2%
My club/association assists me with my *rehabilitation* when I am concussed	60.3%