Addictive Behaviors Reports 7 (2018) 58–64

Contents lists available at ScienceDirect

Addictive Behaviors Reports

journal homepage: www.elsevier.com/locate/abrep

The relationship between concussion and alcohol consumption among university athletes

Bradey Alcock[a,*], Caitlyn Gallant[a], Dawn Good[a,b]

[a] Department of Psychology, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, Ontario L2S 3A1, Canada
[b] Centre for Neuroscience, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, Ontario L2S 3A1, Canada

ARTICLE INFO

Keywords:
Concussion
Arousal
Risk taking
Alcohol consumption
Athletes

ABSTRACT

Introduction: This study investigated concussion as a potential risk factor for increased alcohol consumption in university athletes.
Methods: Using a cross-sectional design, 41 university students (37% with a history of concussion) completed self-report measures, while electrodermal activation (EDA) was recorded for each participant to capture baseline physiological arousal.
Results: As expected, concussion status significantly predicted alcohol consumption over and above athletic status, $b = 0.34$, $p = 0.034$, 95% CI [0.195, 4.832], such that those with a prior concussion history engaged in greater alcohol consumption. Importantly, concussion status also significantly predicted baseline physiological arousal, $b = -0.39$, $p = 0.014$, 95% CI [−0.979, −0.120], such that those with a history of concussion exhibited lower EDA.
Conclusions: Elevated alcohol consumption among athletes is a pronounced associate of concussion in sports and may be a behavioral reflection of disruption to the orbitofrontal cortex – an area implicated in inhibition.

1. Introduction

According to Iverson and Lange (2009), head injury severity can be classified along a continuum spanning from mild to catastrophic. Injuries on the mild end of this spectrum, such as concussions, account for the majority of all reported injuries, reflecting approximately 70–90% (Cassidy et al., 2004). Concussions – impacts to the head or torso that generate acceleration/deceleration forces sufficient to alter one's state of consciousness (e.g., feeling confused or dazed; Kay et al., 1993) – are commonly sustained in high-risk sports (Gessel, Fields, Collins, Dick, & Comstock, 2007; Noble & Hesdorffer, 2013; Zuckerman et al., 2015). Indeed, over two academic years and 25 collegiate sports, Zuckerman et al. (2015) recorded 1670 sports-related concussions – the majority of which occurred during high-risk sports competitions, such as football (36.1% of reported concussions), ice hockey (13.4%) and women's soccer (8.1%). Similar rates have been recorded in high school and university student populations (Baker & Good, 2014; Halstead & Walter, 2010) implying that the nature of play demanded by these sports may place athletes at a greater risk of sustaining a head injury (McAllister et al., 2012). For example, in a high-risk sport like competitive cheerleading, concussions account for over 30% of all injuries sustained (Currie, Fields, Patterson, & Comstock, 2015) despite the non-contact nature of competition.

Given that the ventromedial prefrontal cortex (vmPFC) is highly susceptible to disturbance in any closed-head injury (Morales, Diaz-Daza, Hlatky, & Hayman, 2007), elevated levels of impulsivity and aggression are commonly reported post-concussion (Goswami et al., 2016), and concussion severity is negatively associated with baseline levels of physiological arousal (i.e., electrodermal activation [EDA] levels; Baker & Good, 2014; van Noordt & Good, 2011). Disruption to the vmPFC and subsequent post-injury underarousal limit one's ability to anticipate negative outcomes in unpredictable/risky situations (Damasio, Tranel, & Damasio, 1990), increasing the probability that an individual will engage in impulsive, aggressive, or risk-taking behavior. In particular, according to the Somatic Marker Hypothesis (SMH; Damasio, 1994), damage to the vmPFC compromises the regulation of physiological arousal cues, resulting in dampened autonomic functioning. In turn, this puts individuals in a physiologically unprepared and uninformed state, leading to greater addiction, risk-taking and impulsive behaviors without sufficient somatic signals to inform cognition and guide behavior (Verdejo-Garcia, Pérez-García, & Bechara, 2006). Indeed, patients with severe damage to the vmPFC have been

Abbreviations: EDA, electrodermal activation; SMH, Somatic Marker Hypothesis; vmPFC, ventromedial prefrontal cortex; TBI, traumatic brain injury

* Corresponding author.
E-mail address: ba09bd@brocku.ca (B. Alcock).

https://doi.org/10.1016/j.abrep.2018.02.001
Received 5 February 2018; Accepted 5 February 2018
Available online 06 February 2018

reliably found to exhibit significant difficulties in decision-making under situations of uncertainty and greater risk-taking (Morales et al., 2005).

One risk-taking behavior that has been investigated post-injury is the increased engagement in substance use (e.g., binge drinking, cigarette smoking, etc.; McKinlay, Corrigan, Horwood, & Fergusson, 2014; Bjork & Grant, 2009). Although alcohol use tends to decrease during the first year after injury (Ponsford, Whelan-Goodinson, & Bahar-Fuchs, 2007), many studies show an increased likelihood of heavy drinking in traumatic brain injury (TBI) patients (Koponen et al., 2002) and a strong positive association between time since injury and alcohol consumption (Kreutzer, Witol, & Marwitz, 1996). Moreover, self-reported TBI has been linked to increased substance use during adolescence (Ilie et al., 2015) and, further, concussions sustained during childhood are predictive of problematic alcohol use in adolescence and early adulthood (Kennedy, Cohen, & Munafó, 2017). Given that dysregulated physiological arousal is common after concussion (Baker & Good, 2014; van Noordt & Good, 2011), it is hypothesized that attenuated arousal may play a key role in post-injury alcohol consumption. Specifically, since those with a history of concussion exhibit dampened somatic activation during the anticipatory stages of decision-making (van Noordt & Good, 2011), they may be unable to anticipate the negative consequences associated with drinking behavior and impulsively consume alcohol in excess. Alternatively, alcohol consumption may serve as a solution to chronic underarousal post-concussion and individuals may learn to consume alcohol as a means of boosting autonomic activity. In both cases, it is proposed that physiological underarousal may serve as a mechanism of increased drinking behavior after injury.

At present, the proposed relationship between concussion and alcohol consumption through physiological underarousal remains theoretical and requires further investigation. Research shows that elevated alcohol consumption increases one's risk of sustaining a brain injury (Silver, Kramer, Greenwald, & Weissman, 2001), making it difficult to determine the extent to which premorbid risk-taking and alcohol use precipitate head injury. Indeed, athletes exhibit higher levels of sensation seeking (Hartman & Rawson, 1992; Mastroleo, Scaglione, Mallett, & Turrisi, 2013; Schroth, 1995), more frequent alcohol consumption, higher rates of heavy episodic drinking, a greater number of sexual partners, and a greater engagement in unsafe sex compared to non-athletes (Wetherill & Fromme, 2007). Thus, those with riskier personalities may be more likely to seek out risky activities, such as high-risk sports and binge drinking. For instance, athletic status is associated with a greater number of problem behaviors while under the influence, such as getting in trouble with the police (Nelson & Wechsler, 2001) and sustaining an injury (Leichliter, Meilman, Presley, & Cashin, 1998). Thus, athletes who engage in behavior that is risky enough to result in a concussive injury might also be more prone to engage in other risky behaviors such as excessive substance use.

Alternatively, others have proposed that alcohol may serve as a means of coping with sports-related stressors, reinforcing athletic performance, or fostering belongingness and involvement in sports culture (see Martens & Martin, 2010). For instance, athletes who have greater involvement in their teams (i.e., team captains) drink more per week and engage in more episodic drinking than those who are less involved (i.e., second-string players; Leichliter et al., 1998); thus, it may be that the added time commitment of athletics causes greater stress and maladaptive forms of coping (Damm & Murray, 1996; Marcello, Danish, & Stolberg, 1989). Few studies, however, have found support for this idea, as athletes do not report coping as a motivation for alcohol use (Green, Uryasz, Petr, & Bray, 2001; Herring et al., 2016). Similarly, the association between alcohol consumption and social and cultural motives remains unclear since many factors influence this relationship (Martens, Dams-O'Connor, & Beck, 2006).

Taken together, the above findings highlight the need to elucidate whether elevated alcohol consumption in athletics is reflective of pre-injury personality characteristics exclusively or whether the increased prevalence of concussion in sports, and subsequent dampened physiological feedback, may contribute. The aim of this study, therefore, was to investigate the potential role of concussion as a risk factor for increased alcohol consumption in university athletes. In particular, given the established relationship among head injury, decision-making processes, and physiological arousal, the current study sought to examine EDA as a potential mechanism of the association between concussion and alcohol use. First, it was predicted that both those with a history of concussion, and those classified as athletes, would engage in greater alcohol consumption than their non-concussed and non-athlete peers. Second, based on previous findings of physiological underarousal in concussed individuals (Baker & Good, 2014), we hypothesized that those with a history of concussion would exhibit lower baseline EDA compared to those with no concussion history. Lastly, we predicted that concussion history would be associated with increased alcohol use, over and above the effects of athletic status.

2. Methods

2.1. Participants

Forty-one Brock University students (M_{age} = 20.71, SD = 3.95; 19.5% male) attended a laboratory session in the Jack and Nora Walker Lifespan Development Centre testing facilities on campus in St. Catharines, Ontario, Canada. Poster advertisements, standardized recruitment PowerPoint slides (displayed in Psychology courses offering course credit for research participation), and the Brock University Psychology Department Research Pool (SONA) were used to recruit participants. Importantly, to eliminate the potential confound of diagnosis threat (Suhr & Gunstad, 2002; Suhr & Gunstad, 2005), participants were not recruited on the basis of head injury status and were only informed of the authors' added interests in concussion during the post-study debriefing.

In line with previous investigations (Gallant, Barry, & Good, in press), the primary sport listed for current participation in university athletics was used as a means of classifying athletic status, such that 26 individuals self-identified as non-athletes (63%), 7 as low-risk athletes (17%), and 8 as high-risk athletes (20%). Of the 15 self-reported athletes, 10 (67%) currently participated in a recreational sports league and 5 (33%) participated in a competitive sports league. Table 1 contains a list of all reported sports affiliations and their associated demographic frequencies. Fifteen participants (37%) self-reported having sustained a previous concussion, while 26 had no such history (63%). Of those who endorsed a concussion history, 8 (53%) were non-athletes, while 7 (47%) were athletes (2 low-risk and 5 high-risk). Given the low number of low-risk athletes with prior concussions, athletic status was collapsed to form two athlete categories (i.e., athlete, non-athlete). The average time since injury was 91.27 months (7.61 years) and ranged from 6 to 288 months. For more details regarding the severity of concussive injuries and the associated demographic

Table 1
Self-reported sport-related activities currently played in University (n = 15).

Sport-related activity	High-risk athletes (n = 8)			Low-risk athletes (n = 7)	
	n	% of total	Sport-related activity	n	% of total
Ice Hockey	2	13.3	Basketball	1	6.7
Soccer	2	13.3	Volleyball	2	13.3
Figure skating	2	13.3	Rowing/Kayaking	1	6.7
Power/olympic Lifting	2	13.3	Dance	1	6.7
			Swimming	2	13.3