

Attitudes towards Concussion among Elite Irish Track Cyclists

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ABSTRACT

Concussion has become a widely discussed topic within scientific research and mainstream media in recent years due to the associated potential adverse health outcomes (McCrorry *et al.*, 2017). Within cycling, it is estimated that between one and 9% of injuries are concussions (Decock *et al.*, 2016). O'Reilly *et al.* (2020) examined behaviour towards concussion among cyclists from various disciplines, including track cycling. Their study identified a lack of knowledge as a barrier to medical attention. In the absence of exclusive research, in addition to the high-risk nature of the sport, the barriers and facilitators affecting concussion reporting among track cyclists were investigated in this study. Underpinned by a qualitative research design, semi-structured interviews were carried out with eight track cyclists competing internationally for Ireland (duration between 20 to 25 minutes). Interview questions focused on participants' experiences with and attitudes towards concussion and perceived barriers and facilitators influencing concussion reporting behaviours. Data was analysed using reflexive thematic analysis, which included an Interpretive Phenomenological Analysis approach. Four overarching themes were identified: (1) Athlete Mindset, (2) Concussion Awareness, (3) Support Systems, and (4) Screening Protocol. Practical applied recommendations include increasing access to education amongst track cyclists in addition to coaches, swannies and medical personnel. Future interventions should also seek to reduce negative perceptions towards reporting concussions and increase awareness of the dangers of concussion and the necessity of appropriate concussion protocol and management among athletes, coaches, swannies and medical personnel. Future research should seek to (1) examine coaches' perceptions of concussion and how these perceptions are communicated and expressed to athletes and (2) explore concussion management protocol compliance within track cycling.

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1. INTRODUCTION

Concussion has become a widely discussed topic within scientific research and mainstream media in recent years due to potential adverse health outcomes (Ahmed & Hall, 2017; McCrorry *et al.*, 2017). Untreated concussions can have adverse health consequences, including SIS and post-traumatic epilepsy (McCrorry *et al.*, 2013). Medical attention seeking for concussions in sports is low, leading many athletes to continue in their sport following potential concussions (Leahy *et al.*, 2020).

In the absence of exclusive research, in addition to the high-risk nature of the sport, the attitudes towards concussion and the barriers and facilitators affecting concussion reporting among track cyclists will be investigated in this study. This research aims to contribute to the growing body of literature discussing concussions and deepening the understanding of reporting behaviours among track cyclists. This literature review will examine the past and current literature on concussion and reporting behaviours.

A concussion is described as a mild traumatic brain injury resulting from rapid acceleration and deceleration of the brain, often caused by, but not exclusive to, direct trauma to the head (Bailes & Cantu, 2001). Concussions can also result from a collision in the body that transmits significant inertial



forces to the brain (Carman *et al.*, 2015). Giza *et al.* (2013, p. 2178) define concussion as a “clinical syndrome of biomechanically induced alteration of brain function typically affecting memory and orientation, which may involve loss of consciousness”.

A concussion is a heterogenous brain injury resulting in potentially significant impairments and adverse consequences affecting physical functioning (e.g., balance), cognition (e.g., confusion), and affect (e.g., emotional instability) (Carman *et al.*, 2015; Kontos *et al.*, 2015).

Before discussing concussion symptomology, it is imperative to reemphasise that a concussion can be acquired without overt symptomology (McCrorry *et al.*, 2013). Concussion typically results in neurological impairments, with usually transient symptoms. Pre (baseline and preseason) and post-injury testing has revealed numerous disturbances to cognitive functioning following concussion. These include but are not exclusive to attention/concentration deficits, executive function, memory, language function and processing speed (McInnes *et al.*, 2017).

Sports participation is associated with an increased risk of acquiring a concussion and repeated injury (O’Reilly *et al.*, 2020; Theadom *et al.*, 2014). Despite the increased awareness of the dangers of concussion and appropriate management protocol, research suggests (Hurst *et al.*, 2019) that athletes do not perceive head injuries to be significant enough to warrant medical attention seeking, which can lead to injuries and symptoms going unreported; potentially resulting in significant consequences (McCrorry *et al.*, 2012). While most SRC research reports on contact sports, particularly rugby (Baker *et al.*, 2012), cycling has received increased attention in relation to concussion risk (Hurst *et al.*, 2019; O’Reilly *et al.*, 2020). While helmets offer some protection against severe head injury (Hoye, 2018), they do not protect against the shearing and rotational forces leading to intracranial injury associated with concussion (Sone *et al.*, 2017).

Concussive forces affect vestibular, somatosensory (Riemann & Guskiewicz, 2000) and visual systems (Guskiewicz *et al.*, 2001), altering neurological signalling. This can result in significant deficits in maintaining equilibrium with significant ramifications for tracking cyclists. The inability to maintain balance while riding can increase the likelihood of subsequent crashes and consequent injuries, including secondary concussions and SIS.

Existing literature documents the gravity of symptom non-disclosure amongst athletes; despite the consequences of concussion, many concussions go unreported. Non-disclosure of concussive symptoms by riders can significantly hinder adequate concussion assessment and subsequent management, resulting in delayed recovery and an increased risk of successive concussions and the associated consequences.

The current study explores track cyclists’ attitudes towards concussion and the perceived barriers and facilitators to reporting concussion symptoms.

2. METHODOLOGY

2.1. Sample and Procedure

The qualitative approach of this research was underpinned by an inductive phenomenological research design. Inductive approaches begin with empirical observations followed by pattern identification and interpretation wherein the researcher constructs new concepts and inferences from the data (Thomas, 2003). This facilitated the participants’ subjective experiences and perceptions of concussion to be documented and explored, as concussion is a dynamic experience, not merely a singular event. The researcher obtained Ethical approval from the research institution’s Ethical Approval Board.

Eight participants completed semi-structured interviews, six female and two male ($M = 23.25$ years, $SD = 5.99$ years). At the time of data collection, participants competed internationally for Ireland. Of the eight participants, two had previously been diagnosed with a concussion, and two participants disclosed that they had acquired a concussion. However, retrospectively, it had not been diagnosed at the time. The remaining four participants had not been diagnosed with concussions or suspected undiagnosed ones. Participants were either competing or had previously competed internationally for Ireland in track cycling.

2.2. Interview Design and Procedure

Invitatory e-mails sent to potential participants included a brief outline of the research. These e-mails also included a participant information leaflet with more details and a consent form to be returned if interested in participating. Interviews were conducted via Zoom. A pilot interview was conducted before data collection to evaluate the effectiveness of the proposed interview guide and adjust as needed. Demographic measures were measured using an intake form before the interview. This was used to identify participants’ age, sex, and concussion history. The interviews aimed to explore attitudes towards concussions, and the perceived barriers and facilitators of participants to reporting concussions.

An interview guide was designed based on a study investigating concussion reporting behaviours among collegiate student-athletes (Weber-Rawlins *et al.*, 2021). Each interview lasted approximately twenty minutes. Interview recordings were transcribed using a transcription software tool (Otter.ai). In alignment with Braun and Clarke's Reflexive Thematic Analysis (RTA) (2019), data was transcribed orthographically (Byrne, 2021). To ensure transcription accuracy, the researcher listened to the audio recordings, read the transcriptions, and made any necessary changes, including adding orthographic references.

As this study was underpinned by a qualitative research design, RTA (Braun & Clarke, 2019) was employed to draw inferences from the interviews. The process of RTA involves (1) familiarisation with the data, (2) coding, (3) generating initial themes, (4) developing and reviewing themes, (5) refining, defining and naming themes, and (6) writing up.

RTA proposes that data analysis need not be a linear process, which was the reality of this research (Braun & Clarke, 2019). RTA was utilised as it facilitated the researcher to analyse the data to demonstrate the subjective nature of each participant's experiences while subsequently recognising the researcher's reflexive influence on their interpretations of the data (Byrne, 2021). Braun and Clarke's reflexive approach to thematic analysis emphasises the active role of the researcher in developing inferences from the data. The researcher used a reflexive journal to keep field notes, referencing participants' verbal and non-verbal responses, which could add to potential inferences and detail their reflections on each interview.

3. RESULTS AND DISCUSSION

This study examined the attitudes towards concussion and the perceived barriers facilitators influencing concussion reporting behaviours amongst track cyclists. Following thematic analysis, four major themes were identified by the researcher: (1) Athlete Mindset, (2) Concussion Awareness, (3) Support Systems, and (4) Screening Protocol. Table I illustrates the major themes along with subthemes and raw data themes.

TABLE I: THEMES, SUBTHEMES AND RAW-DATA THEMES

Theme	Sub-themes	Raw-data themes
Athlete mindset	Attitude	Risk-acceptance Immunity Ambivalence Achievement Pressure Automatic urge to remount Gender Athletic identity
		The nature of sport
Concussion awareness	Exposure to concussion	Personal experience Observing others' concussions
	Education	Awareness of dangers associated with concussion Lack of knowledge Access to education
	Perceptions of concussion	Helmet reliability Symptoms
Support systems		Contradictory culture Poor compliance Coach-athlete relationship
Participant perceptions of concussion screening protocol		False positive Duration of screening

3.1. The Athlete Mindset

3.1.1. Attitude

Among participants, it was identified that there was an acceptance of the risk within the sport of track cycling, “In nearly every event I am at, there is someone taken out on a stretcher, and I am just like, when is my turn?” told Participant 4. Participant 5 described it as “a risk you take, and you cannot control how you crash.” With this risk, participants demonstrated concern regarding concussion: “It would be disappointing and horrible to get,” said Participant 1. Despite the acknowledgement of risk and caution displayed towards concussion, the interviews showed that athletes maintain a particular mindset regarding sport and track cycling. This was a recurring theme among all participants. This resonates with literature suggesting that athletes appraise persevering through injury as a desirable psychological trait (Hughes & Coakley, 1991; Safai, 2003). The process of persevering through injury by athletes may reflect a culture of risk, referred to as sports ethic (Hughes & Coakley, 1991), and associated adverse implications. This culture glorifies pain and perseverance through slogans, e.g., “no pain, no gain” (Keese, 2020, p. 2). Sports ethics involves sacrificing sports, demonstrating unshakeable commitment and risk acceptance (Jessimen-Perreault & Godley, 2016). This culture socialises athletes, encouraging parallel thought processes and actions (Keese, 2020). Persevering through injury demonstrates an athlete’s conformity to the culture of risk, often met with praise (Jessimen-Perreault & Godley, 2016). System-wide change must occur to counteract this inherent culture, discouraging “no pain, no gain” ideals.

An immunity to concussion was expressed by Participant 1: “I am going to stay up on the bike and hope that my helmet is good. Moreover, that, yeah, that I do not have crashes.” This demonstrates a low perceived susceptibility to concussion, which, in agreement with the HBM (Rosenstock, 1974), reflects a reduced likelihood of reporting concussion symptoms (Gerrard et al., 1996).

The attitudes demonstrated by participants exhibit ambivalence regarding concussion reporting behaviours in favour of performance. Following a crash, Participant 6 stated: “I did not care about any pain in me. I was just kind of like, right, get back on the bike. There is just a few laps left.” Another participant extended the concept of this mindset:

“It is like praising the struggle . . . people will have like broken bones or they’ll have their skin hanging off them and like they keep riding like they’re a hero. It’s like glorifying injury almost, or like battling through something that they should not.” (Participant 4).

This ambivalence resonates with previously mentioned literature suggesting that increased knowledge and understanding of concussion does not alter athletes’ attitudes towards concussion reporting, demonstrating the paradoxical nature of attitudes and behaviours (Leahy et al., 2020; O’Reilly et al., 2020). Despite demonstrating knowledge and awareness of concussion, behaviours are not corresponding. This may be due to normative beliefs and subjective norms discussed below about support systems. Despite the evidence suggesting knowledge does not increase concussion reporting behaviours (Leahy et al., 2020; O’Reilly et al., 2020), there is some research to suggest that knowledge does positively modify athletes’ attitudes and resulting intent to report concussion (Daneshvar et al., 2021). Future research should aim to explore further the relationship between attitudes, intentions, and behaviour, investigating contributory factors and their effect sizes.

Participants also referred to a strive for achievement as a reason to continue racing without appropriate concussion screening: “I am sure there are athletes who are so determined to get the most out of themselves, like get a medal, that they do not care if they are causing damage,” told Participant 4. One participant disclosed that prospectively: “I definitely think that if I was the crash, it would, I would definitely keep going if there was a possibility of a concussion” (Participant 3).

This attitude seems to be incited by pressure elicited by athletes on themselves: “I think the only thing would be yourself and your pressure to want to do an event.” –participant 7. This concept of pressure may be initiated and exacerbated by feelings of pride regarding performance (O’Reilly et al., 2020) and prospective embarrassment following a concussion diagnosis (Chrisman et al., 2013). This adds to the concept of the sport ethic (Hughes & Coakley, 1991). Hughes and Coakley (1991, p. 3) established that “being an athlete involves striving for distinction”. Athletes inherently aim to achieve distinction, an extrinsic motivating factor. To ameliorate this pursuit, athletes should be encouraged to set intrinsic goals to offset pressure to attain extrinsic standards that may surpass their capabilities.

Many participants spoke about the automatic nature of remounting the bike following a crash, not considering concussion screening. Some participants called it an “adrenaline rush” or “race mode” (Participant 1). Similarly: “So if you crash, it is just straight back up. Get on the bike, make sure the bikes are okay, if anything is broken, you just get your spare bike and get straight back on the track” (Participant 3). This suggests that while athletes acknowledge that they should report symptoms of concussion and request screening, they simultaneously report a compulsion to perform. This concept may be suitable for explaining the ambivalence associated with symptom reporting. This highlights the role of support staff in approaching an athlete post-crash and performing concussion screening.

Gender was observed to influence an athlete's decision to report a concussion potentially, interestingly, only identified by female participants. It was suggested that males are less likely to report concussion due to the increased likelihood of men engaging in more risk-taking behaviour and the opinion that there is "no money in women's racing". Adding to previous literature (Miyashita et al., 2016; Sullivan & Molcho, 2018), this indicates a possible gender difference in track cyclists' perceptions of concussion and reporting behaviours. This gender difference may be explained by male athletes' higher engagement in risk-taking behaviour (Tamás et al., 2019). As stated previously and demonstrated in this research, males display a higher likelihood of persevering through injury to maintain athletic identity. Future research should aim to explore gender differences within concussion reporting behaviours, specifically in track cycling. Future interventions may be designed in congruence with gender differences.

3.1.2. *The Nature of Sport*

The significance of the event and the time within the season was also discussed as an influencing factor on participants' reporting behaviours. Generally, participants indicated that in the event of a significant race, they would be less likely to report concussion symptoms or request concussion screening,

"If I was to crash, say, a small race, ah, if I was to crash a small race, like, two months before the Olympic Games, I would just get off straight away. And I would get a test done, and I would make sure I was 100%. Okay. But if I was to crash at a race, and it was two weeks before the games, I would not go to do a concussion protocol." (Participant 3).

Anxieties regarding selection exacerbate the athlete mindset. Participants expressed anxiety towards withdrawal from racing and teams because of concussion and subsequent consequences to their career trajectories. Participants reported team places and race selection as a barrier to reporting concussion symptoms: *"There was like five people for sports then maybe it might prevent people from reporting it"* (Participant 7). Participant 4 suggested that some athletes *"say that they are fine, just so that they have the opportunity to be selected for a race."* Regarding achievement, event significance and selection, the above statements echo literature suggesting that athletes fail to report concussion symptoms due to the perceived prospective consequences to training and performance (Chrisman et al., 2013; O'Reilly et al., 2020). This also highlights participants' desire to preserve their athletic identity and conform to the sports ethic.

The concept that physical injuries took priority over concussion was a consistent matter discussed within the interviews. Participant 3 expressed that a physical injury would be the decisive factor contributing to withdrawal from a race:

"But I think it would be more like if I crashed so bad that it would be like a broken bone. I think that would be the only thing that would stop me from continuing. it would not be so much the concussion." (Participant 3).

Concerning recovering from a crash, participant 3 also stated that he "had a couple of days off after the crash. But that was mainly to get as the road rash recovered from my body," despite disclosing he suspected he had a concussion.

The athlete mindset appears to be a barrier to reporting concussion symptoms. Despite acknowledging concussion's dangers, participants desire to continue riding. Attitude has repeatedly been shown to influence behaviour (Ajzen, 1991). The attitudes and concomitant ambivalence towards concussion reporting demonstrated in this research may reflect athletes' efforts to maintain their athletic identity (Brewer et al., 1993) and adhere to the sports ethic (Hughes & Coakley, 1991).

3.2. *Concussion Awareness*

3.2.1. *Exposure to Concussion*

Exposure to instances of concussion was a recurring topic expressed by participants, which affected their appraisals of concussion severity. Participants' own experiences of concussions and observations of other athletes' concussions were discussed. An example of one participant's experience describes how her concussion has altered her approach to concussion reporting,

"I think when it actually happened, I was just kind of out of it. Really. I did not really know what was what was happening. I just knew after a while that I had hit my head quite bad, and I was not feeling very well in any way . . . I think that definitely changed my approach because I had concussion myself. So like I understand what people feel when they are going through." (Participant 8).

Personal experience with injury has been shown to increase perceived susceptibility (Podlog & Eklund, 2006), which, according to the HBM (Rosenstock, 1974), increases the likelihood of prospective reporting behaviours. However, Weber Rawlins et al. (2020) research suggests that increased perceived susceptibility is not enough to predict reporting behaviours.

Observing the consequences of other people's concussions sparked emotional responses in some participants: "He was kind of bedridden for a few days. So, it was scary enough looking at him sometimes" (Participant 6).

"They had crashed and continued to race, and we did not know where they were while they were still racing. So that was obviously really dangerous" (Participant 4). Participant 4 also described the impact of seeing other athletes repeatedly sustain concussions and the cumulative effects,

"It is really sad when someone has to go through the healing process of that. And I think especially after multiple because I have seen someone completely get worse . . . After every single one. So, I think there is definitely a cumulative effect, which is really, yeah, horrible to see." (Participant 4).

Vicarious experience contributes to self-efficacy, a HBM component (Bandura, 1977; Rosenstock, 1974). Observing either personal or other athletes' experiences with concussions can, therefore, influence prospective behaviours. The vicarious nature of first-hand concussion experiences and documented incidences of concussion elicited emotional responses in participants, increasing their perceived severity of concussion. Amongst participants, exposure to concussion elicited increases in the perceived severity of the concussion and perceived benefits to reporting concussion symptoms via vicarious and direct mechanisms. Observing or experiencing concussion and the associated health and performance consequences emphasised the dangers of concussion. Perceived severity and benefits of reporting are components within the HBM involved in cognitive decision-making processes and resulting behaviour (Rosenstock, 1974). High levels of these constructs suggest an increased likelihood of reporting concussion symptoms (O'Reilly et al., 2020; Rosenstock, 1974; Weber Rawlins et al., 2021).

3.2.2. Education

Participants described that receiving education regarding concussions via their governing body increased their awareness of the dangers associated with concussion, as well as the importance of reporting concussion and undergoing appropriate screening and recovery measures: "If they have an education on it, they kind of know of the long term negatives of, but like, if you don't have any bit of an education on it you would probably ignore it" (Participant 6). Another participant said: "I think it just kind of makes you aware that, like if you do hit your head, you really do need to deal with it in the right way" (Participant 7). Video demonstrations (provided as part of a concussion education workshop provided by the national governing body) of concussion proved to be very impactful on participants:

"Video of a cyclist crashing and getting back up with a concussion, he was falling all around the place and trying to get back on his bike to keep racing, and that was kind of I was kind of like geez, this is fair serious." (Participant 6).

Participant 3, who indicated that he had previously had an undiagnosed concussion, stated that the reason why he did not report his symptoms retrospectively was because he "did not really know about concussion". A lack of concussion knowledge has been cited within the literature as a barrier to reporting symptoms of concussion (Chrisman et al., 2013; O'Reilly et al., 2020; Weber Rawlins et al., 2021). Following the HBM (Rosenstock, 1974), increased knowledge increases the perceived severity of concussion, perceived behavioural control, and perceived benefits of engaging in the desired behaviour, increasing the likelihood of reporting concussion symptoms.

3.2.3. Perceptions of Concussion

Concerningly, as participants were describing their experiences with concussion, it was acknowledged by the researcher that what participants were saying about concussion did not correspond with scientific literature. Participants referred to their helmets being able to prevent concussion, suggesting an assumption that concussion cannot occur if wearing a helmet. For example, participant 3 assumed he did not have a concussion following a crash as his helmet had not been damaged: "There were no cracks on my helmet. There were no dents on my helmet. There was nothing on my helmet. So I did not suspect concussion from that". Concerning the aftermath of a crash another participant indicated that "the helmet will be damaged or it will be fairly obvious if there has been a blow to the head" (Participant 5). This belief that helmets prevent concussion has been invalidated by research suggesting that while helmets offer protection against severe head injury (Hoye, 2018), they do not protect against the shearing and rotational forces leading to intracranial injury, which are associated with concussion (Sone et al., 2017).

Also, participants assumed that concussion symptoms are always overt: "If they were concussed. It would show in some way" -participant 5, or that concussion can only occur if the head touches the ground. About a crash, Participant 4 stated: "I got up straightaway, and I did not hit my head. So, everyone just was like, she is grand. So, I just kept riding and there was not any screening." Following previously mentioned research, these perceptions contradict the scientific literature (Tator, 2013).

This observation suggests that while education regarding concussions has been received well, ensuring the correct information is being communicated to athletes is imperative. False perceptions of concussion may contribute to inaccurate misconceptions and poor reporting of symptoms.

Possible strategies to encourage reporting amongst athletes could include educational interventions to increase concussion literacy. Additionally, taking the emotional responses demonstrated by participants in response to vicarious observations, future interventions should seek to increase awareness of previous occurrences of poor concussion management.

3.2.4. Support Systems

The interviews showed that the participants' support network significantly impacted their attitudes towards concussion and reporting behaviours. Participants referred to numerous individuals within the support systems, including other athletes and teammates, medical personnel, coaching staff, and swannies.

Many participants referenced a positive culture within their support system that prioritises concussion screening post-crash: *"When you do crash, like, that is the first thing they jump to"* (Participant 8). Some participants expressed an emphasis on athlete health and well-being over performance. Regarding disclosing symptoms to a coach, one participant said: *"He would say, oh, that is grand, thanks for telling me rather than me going into the race and maybe getting sicker . . . everyone is gonna want to see you like healthy rather than do yourself dirty"* (Participant 8). However, the detriment of negligent support systems also became apparent during the interviews. Despite some participants referencing positive attitudes within their support systems, other athletes indicated that that is not always the case. The stigma associated with athletes hitting their head was expressed by Participant 7: *"There definitely is like a stigma behind if you hit your head, that there is nothing wrong to you just you just keep going."* This suggests an adjacent culture, inherently discouraging concussion reporting behaviour. Participants expressed a perceived pressure to perform inflicted by other teammates: *"If you knew you needed to be on that team for that race, like, you might feel pressure from them"* (Participant 8).

Despite evidence suggesting concussion screening immediately post-crash (Swart et al., 2020), many participants indicated this does not always occur. Following a crash and in the absence of concussion screening, Participant 7 stated: *"I continued racing, but I cannot remember. I cannot remember any of the rest of the race that I did. So, and when I came down, then the symptoms were really bad"*. While participant 7's symptoms worsened progressively over time, eventually prompting a concussion diagnosis, screening may not always occur in the absence of overt symptoms, with one participant indicating that screening would not occur *"unless it was really obvious that you were like, confused"* (Participant 4).

In some instances, races took priority over athlete well-being. About a coach, Participant 6 stated: *"he asked me how I was and stuff, but mainly it was kind of just discussing race tactics for next race."* In the foreseen event of a false positive concussion screen, Participant 3 stated: *"The athlete would like feel a lot of pressure from the coaches then because they got off because they didn't keep going."* These experiences highlight the disparity in supportive and unsupportive support systems while also inherently emphasising the prioritisation of racing and performance over athlete health and well-being.

Participants also highlighted the need for appropriate management of athletes' post-crash. When describing incidences of crashing, some participants indicated that if a member of the medical team or support team did not approach them for a concussion screen, they would not disclose their symptoms, for example: *"But being honest, it is not like the first thing that you think, oh sugar, I hit my head. But if you feel fine, and if no one is asking you those questions of like . . . I would not ask someone to ask me them [about the SCAT-5 protocol]"* (Participant 1). Participants referred to the need for *"someone to be there . . . just to say like, no, you should not go ahead. It is probably easier than making that decision for yourself"* (Participant 8). Participant 4 stated that suspected concussions would not be acknowledged *"if the athletes do not bring it up"*. These extracts highlight the need for a consistent support system for athletes.

Subjective norms, i.e., perceived societal pressures associated with performing a behaviour directly determine an individual's intention and subsequent behaviour in congruence with the TPB (Ajzen, 1991). This is illustrated in participants' responses. Like Weber Rawlins et al.'s (2021) research, an athlete's support system plays a significant factor in determining whether athletes will report symptoms of concussion and also in the likelihood of screening protocol to be carried out. O'Connor et al. (2019) reported on the significance of normative beliefs being influenced by pressure evoked by coaches and teammates, which are experiences paralleled in the participants of this study. O'Connor et al. (2019) concluded that regardless of whether an individual perceived concussion to be dangerous and should seek medical attention in suspicion of if the normative beliefs of that individual's environment contradict their values, the individual is less likely to engage in the desirable behaviour, i.e., report symptoms of concussion. Correspondingly, the construct of one's environment, supportive or unsupportive, plays a role in determining one's appraisal of behaviour in accordance with the HBM (Rosenstock, 1974). One's environment indirectly affects how individuals perceive the severity and susceptibility of concussion and determines how they appraise the benefits or barriers to reporting symptoms.

Negative consequences of close coach-athlete relationships may exacerbate subjective norms and normative beliefs. Participant 1's experience following a crash highlights the significance of coach-athlete relationships,

"...and I was like, I actually can't get up, I can't get up. But then the coach is like, helped me give me my bike, and then push me back onto the tracks." (Participant 1).

Although Participant 1 described physical injuries and possible concussions, her coach encouraged her to continue racing. The coach-athlete relationship is a fundamental and dynamic situation whereby both a coach's and athletes' cognitions, emotions and behaviours are mutually and causally interrelated (Jowett & Poczwardowski, 2007). Effective coach-athlete relationships are conceptualised by four constructs: closeness, commitment, complementarity and co-orientation (Jowett, 2005). However, extreme commitment and loyalty displayed by the athlete towards their coach can result in negative behaviours. For example, a study investigating the relationship between coach and athlete perceptions towards substance abuse demonstrated that athletes who perceived coaches' approval of substance abuse were likelier to engage in drug-taking behaviours (Seitz et al., 2014). Considering this, interventions to encourage concussion reporting behaviours should not be exclusive to athletes. Considering that a coach plays a fundamental role in an athlete's development, future research should examine coaches' perceptions of concussion and how these perceptions are communicated and expressed to athletes.

The disconnect between behavioural intention and behavioural action, demonstrated by ambivalent attitudes towards concussion, may be mitigated by screening management post-crash by support staff. While this may not increase an athlete's likelihood of reporting symptoms, it removes the responsibility from the athlete. As discussed within the theme of the athlete mindset and the nature of sports, athletes should not be responsible for requesting concussion screening protocol. Considering the nature of concussion symptoms (e.g., confusion, language function and disorientation), the significance of support staff (e.g., team doctors, physios and coaches) should be paramount.

As previously discussed, participants indicated that compliance with concussion management protocol may not be desirable. Non-compliance to concussion management protocols has also been observed in other sports. In the 2014 FIFA World Cup, concussion assessment protocols were not carried out in 63% of head colliding events (Cuisimano et al., 2017). This magnitude of non-compliance may have been done to avoid losing playing time, which resonates with the experiences and perceptions of participants in this study. Future research should consider investigating concussion management protocol compliance within track cycling.

3.2.5. Participant Perceptions of Concussion Screening Protocol

When discussing concussion screening, participants expressed a hesitancy to complete screening in case a false positive was obtained: *"It is more difficult in that sense. Because if you do pull out and you do not have concussion, then you have just pulled out for no reason"* (Participant 7). This suggests a scepticism of the viability of screening measures amongst athletes. Future interventions may aim to improve athletes' perceptions of screening measures.

Along with the fear of a false positive result, participants also highlighted the need for baseline measures to be used with screening. One participant expressed the opinion that baseline measures should be carried out more often to provide a true reflection of an individual's cognitive abilities: *"You're not going to get a good idea of what someone's like. cognitive performance is like, you know, in a normal state, if you only take, you know, one assessment every two years"* (Participant 5). These statements suggest a need for accurate screening measures and reiterating the importance of screening to athletes.

In track cycling, athletes have five laps following a crash to re-enter the race. Otherwise, they are disqualified from the race (Swart et al., 2020). Therefore, the duration of screening measures and the fast-paced nature of track racing was also a concern and a barrier for participants about reporting concussions. Some participants, including participant 3, suggested to *"make a test that was a lot shorter"*. Additionally, screening duration regarding impeding recovery was referenced: *"That is like, five, six minutes taken away from your recovery. And at the Olympic Games, you need every single second, especially when the events are run so close together"* (Participant 3).

These perceptions of concussion screening protocol measures reflect the athlete mindset previously mentioned, whereby athletes are hesitant to report concussion symptoms. The perceptions of concussion screening are a perceived barrier in reporting concussion symptoms or seeking medical attention. Perceived behavioural control, a construct within the TPB (Ajzen, 1991), relates to the individual's confidence to perform the behaviour, in this context, report symptoms of concussion, and that positive benefits will ensue from reporting their symptoms. Reporting is far less likely to happen if athletes do not appreciate the necessity of concussion protocol and subsequent recovery management.

4. CONCLUSION

This study's findings revealed that athletes' well-being is often overlooked by athletes and others in favour of performance. It is evident that the themes above are interconnected, whereby a myriad of factors influence an athlete's attitude towards concussion and the decision to report it.

This research, along with the findings of this research, can be used to inform interventions aimed at increasing concussion reporting behaviours among track cyclists. The connections previously discussed suggest that a system-wide approach should be considered to effect change. Safeguarding sustained and enduring changes necessitates a cultural shift across all involved stakeholders. Future interventions should seek to reduce negative perceptions towards reporting concussions and increase awareness of the dangers of concussion and the necessity of appropriate concussion protocol and management among athletes, coaches, swannies and medical personnel. Interventions also should be designed specifically for each stakeholder, in congruence with potential gender differences. Ideally, athletes would report their symptoms of concussion, but considering the potential symptoms to be confusion and disorientation, they may be unable to articulate their feelings. Considering this and the potential intended avoidance of symptom reporting, athletes should not be responsible for reporting concussions. While UCI's concussion management protocol includes immediate assessment of the post-injury instigating event, the results of this study suggest that this is not always the case. Therefore, governing bodies should make efforts to ensure these standards are in place.

CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interest.

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