



Can Cycling Be Addictive? A Qualitative Interview Study Among Amateur Female Cyclists

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Abstract

Exercise and healthy eating are proposed as a recommended lifestyle by the World Health Organization with several positive outcomes, including a decrease in pathologies such as diabetes and reduction in mortality rates. However, research suggests that there is the potential for exercise behaviour to become addictive among a small minority of individuals, which detrimentally impacts their lives. The risk of exercise addiction increases for endurance sports, of which cycling is considered one, given the intense physical and psychological demands, due to elevation and distance, in amateur cycling events. Understanding the risk factors specific to cycling is worthy of investigation, as it is not clear whether cycling can become an addiction. Using the ‘addiction component model’ as a framework, qualitative analysis was used to determine whether symptoms of addiction were present among a sample of eight female cyclists. Through the use of thematic analysis, the results showed that symptoms of addiction were reported by participants. Three themes were generated from research interviews comprising ‘addiction components’ (i.e. salience, conflict, mood modification, tolerance, withdrawal, and cycling despite health problems), ‘enabling infrastructure’ (i.e. supportive work, supportive family and friends), and ‘striving for excellence’ (i.e. needing to be the best, pushing too far, and having unrealistic expectation), currently measured in the ‘addiction component model’. There were also novel themes including ‘cycling above health’ where the participant continues to cycle against medical advice; ‘enabling infrastructure’ where work, family, and friends are accepting of cycling; and ‘striving for excellence’ where the participants ‘needing to be the best’ when comparing themselves to their peers, ‘pushing too far’ to achieve the goal set, and finally ‘unrealistic expectations’ resulting in negative comparison to peers. These findings suggest that addiction to cycling should be investigated further, and implications may necessitate clinical intervention to find alternative coping mechanisms when exercise is not available to an individual as there is a likelihood that individuals will continue to exercise in spite of injury and against medical advice.

Keywords Exercise · Cycling · Exercise addiction · Exercise dependence · Cycling addiction

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The World Health Organization Guidelines (2010) recommend 150 min of moderate intensity exercise weekly, and this is what individuals are encouraged to do as part of a healthy lifestyle (Nani et al., 2017). Studies have shown that 90-min moderate exercise over the course of a week in combination with a healthy diet improves bone mineral density and body composition (Chacón-Cuberos et al., 2018). Exercise is perceived as an effective intervention for psychopathology including depression, anxiety (Weinstock et al., 2017), and schizophrenia (Colledge et al., 2017) while improving self-esteem and well-being (Chacón-Cuberos et al., 2018). Exercise is also considered a means of preventing cardiovascular and metabolic diseases (Chacón-Cuberos et al., 2018; Colledge et al., 2017) and a promising adjunctive treatment for those suffering from substance abuse disorder (Weinstock, et al., 2016).

However, there is an increasing amount of research suggesting the potential for exercise to become an addictive behaviour for a minority of individuals (Terry, Szabo & Griffiths., 2004) and a coping mechanism for negative emotions, where the individual loses control over their exercising behaviour. Traditionally, addiction has been associated with substances, but behavioural addiction is now accepted. Both the latest (fifth) edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013) and the 11th revision of the *International Classification of Diseases* (ICD-11; World Health Organization, 2019) now include gambling disorder in their respective addictive disorder sections. Furthermore, internet gaming disorder is listed as a condition for further study within the DSM-5 and the ICD-11 which includes gaming disorder (American Psychiatric Association, 2013; Saunders, 2017; World Health Organization, 2019). The ‘addiction component model’ (Griffiths, 2005) posits that both behavioural and substance addictions share core commonalities all of which have to be met in order to be considered a genuine addiction. When applied to exercise, these are:

- *Salience*, where exercise becomes the single most important behaviour in the individual’s life and dominates their thoughts where they continue to think about the behaviour even when they are not engaging in it (i.e. total preoccupation)
- *Mood modification*, where the exercise results in a mood-modifying experience leading to (for example) arousal/excitement or escape/numbing
- *Tolerance*, where over time, the individual has to increase the amount and frequency of exercise they engage in to achieve the previous mood-modifying effects.
- *Withdrawal*, where the individual experiences negative side effects when they reduce or stop engaging in exercise, including psychological consequences (e.g. moodiness and irritability) and/or physical consequences (e.g. sweating, headaches)
- *Conflict*, where exercise adversely impacts personal relationships, education, and/or occupation, as well as intra-psycho conflict (e.g. the individual experiencing a subjective loss of control due to exercise)
- *Relapse*, where the individual ceases exercise for a period of time only to return to the same previous patterns of problematic exercise

Exercise addiction can be defined as when an individual continues to engage in exercise regardless of physical injury and adversely impacts other areas of their life, including personal relationships, other interests, and education/work, detrimentally impacting mental health and well-being, exercising for intrinsic rewards, and experiencing withdrawal symptoms (Juwono & Szabo, 2020; Landolfi, 2013). Exercise addiction has been described as the dark face of exercise (Cetin et al., 2017). The topic of exercise addiction has caused controversy, and despite growing research, it is still not recognised or included in the

DSM-5 (American Psychiatric Association, 2013). This may in part be due to the different definitions and measurement tools (Nogueira et al., 2018) where inconsistent prevalence rates of exercise addiction have been reported. This variation may be due to the comparison among different samples including students, athletes, heterogeneous sports, gym-based sports, endurance sports, and ultra-running, possibly based on the assumption that risk of exercise addiction is comparable across all sports. The results would suggest that this is not the case because prevalence rates for risk of exercise addiction range significantly (Egorov & Szabo, 2013). A recent meta-analysis (Trott et al., 2020) showed prevalence rates varied depending on population and was highest amongst general exercisers (8.1%) and lowest amongst amateur athletes (5.5%). However, studies were screened to exclude eating disorders which reduced the number of studies included. In contrast, another systematic review (Lodovico, 2019) reported that exercise addiction prevalence rates were highest among endurance athletes (14.2%). Exercise addiction has only ever been assessed in one nationally representative study which found that 0.3–0.5% of the Hungarian population were reported as being at risk of exercise addiction (Mónok et al., 2012).

The lack of empirical evidence of exercise as a mental health disorder (Kovacsik et al., 2018) and inconsistency in research findings means that exercise addiction has not been included in the DSM (American Psychiatric Association, 2013; Kovacsik et al., 2018; Rankin et al., 2019). This is further compounded by the positive societal position with regard to exercise as an activity that everyone should engage in (Hausenblas et al., 2017; Mayolas-Pi et al., 2017). Arguably the positive perception regarding exercise provides the situational environment to facilitate exercise addiction (Griffiths et al., 2006) because like work, it is socially acceptable and an activity that individuals are encouraged to do. This is certainly not the case for other addictions to drugs and gambling. The positive view that society has with regard to exercise addiction arguably originates from Glasser, who considered exercise as a positive addiction (Glasser, 1976), and is considered a pro-health behaviour (Berczik et al., 2012), in combination with healthier eating (Gruszczynska et al., 2018).

Another societal impact worthy of consideration is the high level of importance that Western cultures place on physical appearance (Lindsay et al., 2012), where the physical ideal is influenced by patriarchal attitude (Abate, 2010; Lirola & Chovanec, 2012), where women are visually presented as young, slim, and beautiful. This can result in some women having a resigned acceptance regardless of age that their bodies are imperfect and require fixing or improving (Lirola & Chovanec, 2012). This may reduce women to engage in unhealthy behaviours such as excessive exercise in order to achieve the ideal appearance associated with celebrity icons and females depicted in advertising. This obsession for perfection may lead to body dysmorphic disorder (BDD), associated with a desire to be perfect, affecting 0.7–2.4% of the general population, but much higher prevalence rates among those seeking aesthetic treatments (Vashi, 2016). The desire for the perfect body and its association with success may exacerbate symptoms for those suffering from BDD, as they are more likely to have poor body image and low self-esteem. This increases the risk of exercise addiction among those with BDD, because exercise is perceived as the means of improving body image rather than as a means of improving health and well-being (Corazza et al., 2019). A study of fitness club members engaging in various sports activities assessed compulsive exercise, appearance anxiety, and low self-esteem, and 11.5% of participants were considered to be at risk of exercise addiction (Corazza et al., 2019). The same study (Corazza et al., 2019) also found that females and males in this sample were at increased risk of BDD (47.2%) and (38.5%) compared to the general population, where prevalence rates range between 0.7 and 2.3%. This is significantly higher than the general population,

suggesting that engagement in exercise for both females and males is related to appearance (Corazza et al., 2019). Such findings necessitate exploration of sports activities outside of the gym because it could be that gym members are more predisposed to BDD.

When considering the neurobiological impacts, vigorous exercise has been associated with improved pre-frontal cortex cognition associated with executive functioning (Basso et al., 2015) and is considered to be a protective factor in neurological diseases (Basso & Suzuki, 2017). The neurobiological rewards of endorphins converted into opiate-like peptides may facilitate exercise dependence (Nogueira et al., 2018). The sensations of beta-endorphin functioning in the central and peripheral nervous systems, relieving pain when bound to mu-opioid receptors (Rankin et al., 2019), alter mood in a manner comparable to the effects of drugs (Nogueira et al., 2018) and provide a biological explanation as to why exercise may become an addiction because the mood-altering capacity is not dissimilar to psychoactive substance taking. Recent research by Siebers et al. (2021) examining runners and walkers suggests that it is the endocannabinoids that may contribute to the 'runner's high' rather than endorphins. Furthermore, when the activation of cognitive control regions among a sample of endurance runners were assessed using fMRI in the context of fore-going running, results were comparable to addictive populations, arguably demonstrating neurobiological evidence of exercise addiction (Martin et al., 2017).

Cycling is considered one of the most popular recreational sports and unique in that it is both a leisure activity and a method of commuting longer distances that would be impractical to run or walk. When considering the worldwide popularity of cycling, *Strava* (a sports app claiming to have the largest community of athletes) reported that cyclists using their app to record their rides cycled 5.6 billion miles in 2019 (blog.strava.com). When compared to other sports, cycling ranks fifth in the UK (4% cycling), where running is the most popular sport (15%) (Audickas, 2017).

When considering the positive health impacts of cycling, it is considered to significantly reduce all-cause mortality and endurance cycling specifically increasing cardiometabolic health (Oviedo-Caro et al., 2020). In one study, cyclists were shown to have improved psychosocial and physical outcomes regardless of volume of cycling, when compared to an inactive group, although the sample was male biased, and higher volume resulted in better body mass index and physical conditioning. This contradicts a study carried out on athletes which indicated that high intensity training led to decreased performance and a decline in psychological and mind-set of the athlete (Çetin et al., 2020). Of note here is that athletes were compared to other athletes rather than inactive groups which suggests that comparison to inactive groups may skew results (Cook et al., 2013).

Endurance sports (of which cycling can be one) are considered to have the greatest risk of causing addiction (Nogueira et al., 2018), and given the increase of amateur athletes and competitions, this is only likely to increase (Nogueira et al., 2019). Research has shown that risk of exercise addiction shows higher propensity rates in triathletes (Szabo et al., 2019) and long-distance runners (Cook et al., 2013). A study examining a group of male and female cyclists, where the sample was predominantly male, found that 17% had risk of exercise addiction which replicates prevalence rates among endurance athletes of 17–20% (Mayolas-Pi et al., 2017). Endurance sports are associated with a higher risk of exercise addiction than other forms of general exercise (Allegre et al., 2007; Rankin et al., 2019).

However, there are few studies purely examining cycling, and no previous studies have investigated whether cyclists could be at risk of cycling addiction. Another interesting finding was that quality of life (as assessed using the Quality of Life Scale (Vilagut et al., 2008)) used as a predictor of illness and well-being showed that the female cycling group who were at risk of exercise addiction was significantly worse than the female group

that had a low risk of exercise addiction (Mayolas-Pi et al., 2017). Arguably, given the study that utilised self-report, this may be due to women being more open in discussing their feelings (Juwono & Szabo, 2020). The volume of training for those at risk of exercise addiction has also been found to be significant among ‘indoor cycling’ (where advanced spinning bikes, or smart bikes, such as *Wattbike*, often used in combination with training apps such as *Zwift*), where female cyclists have demonstrated that individuals do not only have to cycle outdoors to be at risk, and those who trained more had increased levels of anxiety (Bueno-Antequera et al., 2020). Another gender difference is that women have been found to have higher levels of obsessive passion at both low and high exercise intensities, although many different sports were included in this sample (Kovacsik et al., 2018) and female cyclists had poorer sleep quality across all volumes of training compared to males (Oviedo-Caro et al., 2020). Globally, cyclists logged on the *Strava* app cycled a distance of 8.1 billion miles, climbing 400 billion feet in 2020. When considering female cycling trends, women logged 44 million cycling kilometres on the *Strava* app over a 12-month period, where 30% of all rides were recorded as social rides (Reid, 2020). This suggests that cycling is a popular form of exercise among women.

To date research into exercise addiction has predominantly used a quantitative approach using screening tools and considering heterogeneous groups of exercisers with less focus on specific sports disciplines (Bueno-Antequera et al., 2020) including cycling. This may in part explain the inconsistent prevalence rates identified to date, with regard to identification of exercise addiction (Juwono & Szabo, 2020). The scales that have been predominantly used in the literature are the Exercise Dependence Scale (Hausenblas & Downs, 2002) and the Exercise Addiction Inventory (Terry et al., 2004) although they are reported to be screening instruments rather than diagnostic tools (Berczik et al., 2012; Egorov & Szabo, 2013; Hausenblas et al., 2017). This is due to the fact that there are no formal diagnostic criteria for exercise addiction.

Cycling is under-researched when considering prevalence rates of exercise addiction compared to other sports such as running. The few studies that have been carried out with regard to exercise addiction among cyclists employ quantitative methods that fail to address the motivations that drive individuals to cycle, particularly those that have been identified at risk of exercise addiction (Cook & Luke, 2013; Gruszczynska et al., 2018; Mayolas-Pi et al., 2017; Oviedo-Caro et al., 2020). What drives addictive behaviour varies individually (Dumitru et al., 2018; Juwono & Szabo, 2020). The present study examined whether symptoms of behavioural addiction are present among female cyclists. It is proposed that risk factors are likely to be multi-layered, requiring deeper investigation to understand the aetiology of the behaviour, highlighting the suitability of a qualitative methodology.

The present study investigated whether cycling is a unique exercise addiction category or fits within endurance exercise addiction. Where an area is under-researched and where little is known, then it is appropriate to use qualitative analysis in order to have a better understanding to identify specific areas to investigate further in future research. To date exercise has been identified as a potential behavioural addiction but has not yet been included within any formal diagnostic manual (e.g. DSM-5, ICD-11). Employing a qualitative design could present valuable insight above and beyond what has been reported to date moving towards the goal of exercise addiction being accepted as a mental disorder.

The additional aims were to understand whether females have poor mental health associated with the risk of exercise addiction (Bueno-Antequera et al., 2020) compared to those not at risk of exercise addiction and what drives the motivation to cycle and determine whether cycling is a coping mechanism for managing stress and unpleasant emotions which have been associated with negative reinforcement, an indicator of exercise dependence

(Rankin et al., 2019). To the research team's knowledge, there have been no prior studies taking a qualitative approach to explore female motivations for cycling, and this is considered a novel study in which qualitative methodology is considered appropriate to support understanding in a more meaningful way.

Method

Participants

Eight female participants aged between 32 and 56 years (see Table 1 for other demographic information) were recruited from a *Facebook* cycling membership group page following a request for female participants by the first author. The sample (all from the Midlands, UK) comprised one recreational cyclist, one ex-professional, and six highly motivated amateur cyclists. All participants were employed in professional jobs and seven were mothers.

Materials, Procedure, and Ethics

The questions in the interview guide were theoretically based, following Kruger and Casey's (2015) framework where the introductory questions were more general aiming to explore the participant's general cycling behaviour. In order to assess whether symptoms of addiction were present among female cyclists, an interview guide with open-ended questions was created assessing each of the components in the addiction component model (i.e. salience, mood modification, withdrawal, relapse, tolerance, and conflict; Griffiths, 2005) to ensure that there was consistency in each interview while allowing for any topics considered to be important to the participants to be covered. Semi-structured interviews were conducted to ensure consistency across all interviews while enabling flexibility (Robson, 2002). Interviews were carried out and transcribed by the first author to support familiarisation of the dataset prior to coding. Using the framework proposed by Braun and Clarke (2006), interview transcripts were analysed by means of a thematic analysis which is a method of identifying, analysing, and reporting patterns (themes) within data. Interviews lasted between 40 and 65 min. The study was approved by the research team's University Ethics Committee prior to data collection. All participants provided written informed

Table 1 Participant demographics of the study sample ($N=8$)

Participant pseudonym	Age	Occupation	Relationship status	Number of children
Katie	49	Senior finance manager	Co-habiting	1
Helen	56	Academic	Married	2
Tracy	42	Academic	Married	1
Claire	43	Commercial finance manager	Single	2
Rita	56	Teacher	Co-habiting	2
Sonya	32	Account manager	Co-habiting	2
Katrina	50	Director	Single	4
Nancy	48	Service support manager	Co-habiting	2

consent and were provided with the opportunity to withdraw their data. De-identification of participants was used during transcription, and all participants were given pseudonyms.

Data Analysis

A critical realist approach was performed, where researchers accepted participants' accounts of their lives and experiences as real, but also recognised that those accounts were inevitably influenced by social process and context where individuals were placed (Bhaskar, 2002). Therefore, the analysis prioritised participants' perspectives and experiences, and a semantic analysis was used. A semantic approach was also chosen because it allows attainment of an overall rich thematic description of the entire dataset (where some depth and complexity are lost), rather than a more detailed description of a theme (Braun and Clarke, 2006). Although a semantic approach was used, the analytical approach involved not only a description, but also an interpretation of the data, in which the analysis attempted to reflect about its meanings and implications (Patton, 2002). Then, once the data were coded, it was grouped into meaningful themes across the entire dataset. All quotes presented a cohesive narration and contributed something significant to the research question. This resulted in some rework of themes during the analysis process. The final set of themes and chosen extracts in the report present a story that is accessible to the reader and not simply summarise what has been discussed. This was considered appropriate given that exercise addiction within cyclists is an under-researched area, as the similarities and differences of each participant could be examined in order to generate insight (Nowell et al., 2017).

In order to assess whether addiction to cycling was present in the sample, questions were generated based upon the clinical criteria as used to determine psychoactive substance addiction and proposed in the 'component model of addiction' (Griffiths, 2005). Such questions included 'Do you cycle to alleviate stress?' and 'Do you fit your work, family and social life around cycling?'. This interview framework has been used in other studies to examine other unofficially recognised addictions such as smartphone addiction.

Results and Preliminary Discussion

Through the use of thematic analysis, the results showed that symptoms of addiction were reported by participants. Three themes were generated from research interviews comprising (i) 'addiction components' (i.e. salience, conflict, mood modification, tolerance, withdrawal, and cycling despite health problems), (ii) 'enabling infrastructure' (i.e. supportive work, supportive family and friends), and (iii) 'striving for excellence' (i.e. needing to be the best, pushing too far, and having unrealistic expectation) (Table 2). These are expanded upon below alongside some preliminary discussion.

Theme 1: Addiction Components

Participants reported that behaviours were met suggesting that symptoms of addiction were present across salience, mood modification, tolerance, and conflict, but this was not the case for relapse which is why it has not been included within the results table.

Table 2 Subordinate and sub-themes

Subordinate theme	Sub-theme number	Sub-theme	Theme description	Theme results
Addiction components	1	Salience	Preoccupation of cycling thoughts	This highlights the participants pre-occupation with cycling, even when not actively cycling and how other commitments fit around cycling
Addiction components	2	Conflict	Engagement in cycling has created intra-psychic and family conflict	The participants demonstrate that their cycling has created conflict with their family relationships. Intrapyschic conflict is also identified where they continue to cycle when they know they should not
Addiction components	3	Mood modification	Engaging in cycling results in a positive change in mood	Participants reveal that cycling is used as a means of altering mood or alleviating stress and other unpleasant emotions, providing a coping mechanism
Addiction components	4	Tolerance	Participants endeavour to engage in increasingly challenging events	Participants highlight an increase in mileage and training, in some cases to achieve cycling events requiring significant training commitments
Addiction components	5	Withdrawal	The mental and physical symptoms that arise as a result of not being able to cycle	Extracts highlight both mental and physical symptoms of withdrawal, including aching muscles and a drop in mood when unable to cycle
Addiction components	6	Cycling despite health problems	Cycling when injured instead of resting and recovering	In spite of knee injuries, participants continue to cycle, demonstrating a compulsive need to continue cycling
Enabling infrastructure	1	Supportive work	Work provides the situational context for participants to be able to engage in cycling	A supportive work facilitated participant's cycling going as far as installing showers and hairdryers
Enabling infrastructure	2	Supportive family and friends	Supportive family and friend enables cycling without creating conflict	Family and friends celebrate the cycling achievements of participants and actively free up leisure time to enable participants to engage in their cycling. This is a direct contrast to other participants who did not have a supportive family resulting in conflict

Table 2 (continued)

Subordinate theme	Sub-theme number	Sub-theme	Theme description	Theme results
Striving for excellence	1	Needing to be the best		Self-imposed pressure to win and perform better than peers
	2	Pushing too far		Negative comparison of self, compared to peers, regarding cycling performance
	3	Having unrealistic expectations		Perfectionism resulting in self-imposed pressure and sickness

Sub-theme 1: Saliency

Saliency refers to an activity dominating the person's life including thinking about the activity even when they are not actively participating in it (Griffiths, 2005; Landolfi, 2012).

"From my own experience it's never far from my thoughts, you know I'm always thinking about when I'm gonna get my next ride, or how I can build it in, so in that respect there are probably parallels with addiction." (Tracy)

Tracy clearly demonstrates how cycling preoccupies her thoughts even when she is not cycling and how she plans her busy schedule around cycling, with such pre-occupation due to the behavioural delay in being able to engage with cycling and may be comparable to substance-based addictions (Berczik et al., 2012).

"I didn't go to university because I decided that it was study or ride my bike and I choose my bike...everything fits around cycling generally...I do yoga for the bike, I do running for the bike...everything else is about ensuring that the bike is optimised." (Katie)

Katie demonstrates a lifetime commitment to cycling, which has driven her life choices at an early age and dictates the other activities she undertakes. It appears that all pastimes revolve around cycling and maximising her cycling performance.

Sub-theme 2: Conflict

Conflict refers to when pursuing the activity results in a negative impact on the individual's personal, professional, and/or other recreational activities (Griffiths, 2005). It is clear from the following extracts that cycling had resulted in conflict and negatively impacted other aspects of the participant's lives. For example:

"Part of the reason me and my ex-husband separated...[was that he] wasn't into cycling. He kind of understood my exercise, but when I started cycling and going away to cycle, when I had my first trips to Mallorca and things through cycling that became an issue...the kids sometimes resent it when I'm going away to the Alps and things without them, so yeah they find it hard." (Claire)

Claire claimed that cycling was prioritised above her marital relationship, creating conflict and ultimately leading to divorce. There was a suggestion that cycling was more obsessive than the previous types of exercise she engaged in, which appeared to have been better tolerated by her ex-husband. In spite of the continued resentment her cycling creates, more recently from her children, her behaviour remains unchanged, and Claire prioritises cycling in detriment to the other roles in her life, which is indicative of addiction (Warner & Griffiths, 2006; Landolfi, 2012).

"She did resent it. She ended up complaining to grandma about it, not to me. And my mum who came to me and said Jessica's [Nancy's daughter] complaining you're always on your bike and I'm like feeling guilty as hell." (Nancy)

Nancy also reveals the resentment her daughter feels at her cycling and a sense of betrayal that her daughter spoke to her grandmother instead of her with regard to how her cycling was making her feel. Nancy highlights the dilemma that she as a mother faces with

regard to cycling and the guilt she feels at cycling instead of being with her daughter. This conflict may be driven by a compulsion to cycle due to guilt at not exercising which has been cited as an indicator of exercise addiction (Alcaraz-Ibáñez et al., 2019).

“We knew it was going to be horrendous coming home, because it was hurricane Brendan...but I kinda set my stall up for this really adventurous ride home, with all the elements being thrown at you.” (Katie)

Katie claimed that despite adverse weather conditions, this would not stop her from cycling when she planned to do so. Arguably, this parallels with substance addiction as risks are put aside in order to satisfy the need to cycle (Egorov & Szabo, 2013; Griffiths, 1997).

“I’ve got a stiff neck at the moment, but...the thought of not going on the bike was unacceptable. So, I probably made it worse...and you know, I’ve had saddle sores, and I know that you’re supposed to take time off and I’ve probably prolonged... maybe that is a sign of addiction.” (Tracy)

Tracy shows intrapsychic conflict where she continues to cycle even though she recognises that her body is indicating that it is not a good idea creating a risk of injury. She also says that this may be a sign of addiction. This highlights that cycling is a coping mechanism that the individual cannot cope without and has become an obligation that has to be done (Alcaraz-Ibáñez et al., 2019; Griffiths, 1997).

Sub-theme 3: Mood Modification

During the interviews, all participants associated cycling with a change in mood either in terms of a coping mechanism for escaping unpleasant emotions, positive euphoria (Griffiths, 2005), or a desire for stress relief (Warner & Griffiths, 2006).

“I think it just adds a lot of value...I feel like you can get a bit dependent on it...It just keeps me sane is what I reckon...When I do ride, I just end up feeling a lot better about just everything, happier, a bit more sane...It’s a good way to forget about things and lift your mood.” (Sonya)

Here Sonya reports that cycling enables her to escape and forget about unpleasant emotions and that cycling changes her moods in a positive way. However, it could also be viewed as having a numbing effect on horrible thoughts, and she suggests a reliance in terms of mental health.

“I’ve had counselling sessions where I could say it would have been better if I’d gone out on the bike...I find it alleviates stress. It takes your mind off it, stops you dwelling on things that you can’t change...It gives you another focus, something to enjoy and it does enable me to switch off.” (Katrina)

Katrina views cycling as more effective than a counselling session which again suggests that it is a better means of coping with negative emotions and acts as an anti-depressant. Cycling as a coping mechanism was explicitly mentioned by all the participants and suggests that retention of good mental health necessitates cycling. Without the option of cycling, participants would have increased levels of stress and negative mood.

The extracts here demonstrate a cyclical aspect of dysfunction where the satisfaction and stress release of engaging in cycling is shortly replaced with increasing anxiety the

longer the participant is unable to cycle (Berczik et al., 2012). The use of cycling by all participants was a coping mechanism to alter mood or alleviate stress in order to make themselves feel better (Griffiths, 2005). The concern is how participants will cope when they cannot cycle, and there is a need for health practitioners to assist ‘obsessive’ cyclists in identifying other coping mechanisms that are not associated with cycling when it is not possible to cycle.

Sub-theme 4: Tolerance

Tolerance is where individuals need to increase the amounts of the activity, in this case cycling, in order to achieve the same initial mood-modifying effects (Griffiths, 2005).

“I did a 35 [miles] with Velo Club Flintham in December and the following week I did a 50 [miles]. So, I’d kind of built up a little bit and was going great guns. I’d fallen in love with it by then... I’ve never tried to reduce it, it’s like today if someone came round and said you’ve got to reduce it...but I’ve never tried...If it’s just a temporary thing I might be a bit annoyed but I can always make up for it later.” (Nancy)

What this theme reveals is an aspiration to increase the amount of cycling with no appetite for reducing it, which arguably demonstrates tolerance. Nancy shows how her volume of cycling has progressively increased. It is suggested that with regard to cycling, tolerance is better measured by the events in which the participants engage in. Here Katie and Katrina discuss the ‘Mallorca 312’ event:

“We’re training for Mallorca 312. So that’s a lap of Mallorca, 312 Km. In my head, I’m aiming for 12 hours.” (Katie)

“I enjoy getting fitter, but it’s the endurance thing, definitely at the moment because I’m training for Majorca 312...Yeah, I’ve got nine weeks to go...The longest ride I’ve done was under 100 miles. But block wise, and the work I’m doing in the week, I’m pretty confident, that I could do it in the time constraints. It’s 14 hours, so I think it’s 22 km an hour.” (Katrina)

As Katie highlights, the event is 312 km, and Katrina’s longest ride to date has been under 100 miles. To complete this event necessitates nearly doubling her longest ride. Aside from the distance, there is 5050 m of elevation in a day; therefore, tolerance is implicit given the training commitment required to achieve such a challenge. The example of the Mallorca 312 highlights that those who engage in such events implicitly seek to increase volume and training in successfully completing such events. Therefore, it would be beneficial to consider the endurance events themselves when assessing tolerance.

Sub-theme 5: Withdrawal

Withdrawal is a theme more typically associated with drug addiction, but it is clear that the participants in the present study showed a negative response and sensations of deprivation when they are unable to cycle (Landolfi, 2012) showing symptoms of anxiety, frustration, and restlessness. This highlights a negative psychological impact, irrational feelings of loss of fitness, and physical symptoms of aching and craving the psychological effects experienced from cycling (Szabo et al., 2019).

“If I don’t do something for a couple of days, I feel like I’ve lost all fitness. It’s really out of perspective. It’s as if you’ve lost everything, it’s very bizarre...I feel physically

worse, when I don't do it...I ache more...I'm just a firm believer in your body should be doing something." (Katrina)

Katrina highlights negative reinforcement associated with lack of exercise (Rankin et al., 2019) and of what will happen when she is unable to cycle. She openly admits the irrationality of this thinking and reported physical symptoms of dependence. Clinical cases show that those who suffer with exercise addiction have lost control over their exercise habits, and it becomes an obligation (Egorov & Szabo, 2013).

"I remember getting to the end of the road and getting off and crying because I couldn't ride my bike...That was just because I couldn't ride my bike, no other reason, it wasn't the pain or anything like that, it was just the fact I thought it was better and I couldn't ride my bike." (Katie)

Katie showed the level of emotional and mental dependence she has on cycling. Her frustration and disappointment released through the physical action of crying, again highlighting the anti-depressant effect cycling has, and how her mental health suffers when not being able to engage in cycling.

"I crave the effects of it...I just feel better about myself when I've had a good ride, or longer ride...Even when I look in the mirror...if I haven't been on a ride in a couple of days I start feeling fat and you know, so in that respect that's the addictive thing...when we go on holiday for example, I used to get quite anxious, if I knew I couldn't cycle. But then I figured out that I can usually hire a bike, and it has influenced the choice of destination." (Tracy)

Tracy shows that cycling supports her self-esteem and results in a more positive body image when she has cycled. However, this was not mentioned by any other participant. Even going on holiday became a source of anxiety if she was unable to engage in cycling, which is considered a sign of withdrawal. She now avoids this situation by choosing destinations where she can hire a cycle.

"Not to be overlooked is the mental aspects of it, because one of the things I notice was I was much happier getting the exercise and getting out regularly. Conversely, when I wasn't able to get out quite so often, and I was down, it became the addiction...The addiction was more in almost telling myself I needed to do it because otherwise if I don't my mood will drop again...it's like the am I really going to be fed up because I haven't got the endorphins from it." (Nancy)

Nancy had self-knowledge in recognising the mental reliance she has on cycling and the fear of how her mood is negatively impacted when she was unable to cycle. Similar to the mood modification aspects, when considering withdrawal, it is clear that for all participants, cycling had become a coping mechanism upon which they had become dependent (Egorov & Szabo, 2013).

Sub-theme 6: Cycling Despite Health Problems

In this theme, the participants showed that they carried on cycling against medical advice. This could be considered an addictive consequence because they continued to cycle regardless of injury and pain (Rankin et al., 2019) arguably manifesting self-destructive behaviour (Griffiths, 1997; Landolfi, 2012).

“When I bust my knee in the autumn just gone, I was, you know riding probably sooner than medically I should have because I didn’t want to let it go...I was practically one-legged cycling.” (Nancy)

“Well, I had a trip to Italy, and actually broke my ACL [anterior cruciate ligament], so I needed knee surgery [laughs]. So, I had knee surgery, lost the ligament in my knee, and I was on crutches, and had a trip to Lake Garda...and I thought bugger, not going to be able to go. And I thought, no, I’m gonna go, and actually take your cycling kit just in case. And, still on crutches, that’s how bad I was. And, we got the bike.” (Claire)

Both Nancy and Claire reported knee injuries that failed to prevent them from cycling which carries the risk of aggravating injuries. In Claire’s case, even crutches did not stop her, suggesting that cycling had become an obligation rather than something that was enjoyable (Egorov & Szabo, 2013). Even though Claire and Nancy were both injured, they continued to engage in cycling, even though they should have been resting and allowing their bodies to heal and recover from injury. Injury has been associated with overtraining which may be considered an indicator for those at risk of exercise addiction (Mayolas-Pi et al., 2017). Training against medical advice is consistent with a study interviewing 24 physiotherapists, where 71% of the physiotherapists identified patients with exercise dependence as continuing to exercise despite injury and experiencing problems in gaining the compliance of clients to reduce their exercise activity (Adams and Kirkby, 1997).

Theme 2: Enabling Infrastructure

Work and the personal infrastructure including family and friends available to some of the participants could be regarded as the situational context (Griffiths et al., 2006); in that work, family and social environment enables participants to engage in cycling, minimising conflict and facilitating their cycling behaviour; indeed it may have been a deliberate choice to ensure that cycling activity is accepted. Another consideration is that the support network enables the cyclist to potentially adapt their lifestyle making them more prone to addiction regardless of the volume of training (Mayolas-Pi et al., 2017).

Sub-theme 1: Work as an Enabler

“I’m very lucky in my job and that’s why I love it so much...I like the people, the flexibility I have is fantastic. So, they’ve put me lockers in at work, they’ve put me a hairdryer in.” (Katie)

“My work is very supportive actually...and just recently they didn’t have any showers and they put one in.” (Sonya)

Both Katie and Sonya demonstrate that their employer provided the situational context which enabled them to cycle to work through the provision of showers, hairdryers, and lockers to stow work attire. Without these facilities, then cycling to work would not be an option. It also suggests in Katie’s case that being able to cycle improved her morale and motivation for her job.

Sub-theme 2: Family and Friends as Enablers

It is no coincidence that the participants who reported a supportive and accommodating family did not encounter conflict with their family with regard to their cycling.

“I have an accommodating family...everyone knows that I will want a ride at the weekend and if at all possible we work around it...Even my husband has talked about touring bikes and he’s trying to accommodate the fact that is the person I am.” (Tracy)

Tracy’s partner appears to be understanding with regard to her cycling and recognises how important cycling is to her and builds it into their future and visualises engaging in cycling with her.

“They’re all very proud of me...[They say] “I’ve got a mother who goes out and cycles and does this and that”. Or my sisters say “Wow I wished I’d stayed as fit as you”, they totally encourage it.” (Rita)

Rita demonstrates a strong sense of satisfaction and pride that her children and sister are proud of her cycling achievements, suggesting that cycling provides a positive view of self and sense of accomplishment due to the source of recognition. This may highlight a need for approval to fulfil self-esteem which is an indication that an individual may be prone to develop exercise addiction (Rankin, 2019). Given the acceptance shown by both work and social groups in which the participants find themselves, even in this small sample, may provide an explanation as to why exercise may be a hidden addiction. The participants are supported in engaging in their addiction of choice, and the participants themselves may have consciously chosen this situational context to avoid conflict or at least minimise it. Therefore, this leads to less conflict than might have been the case with other more traditional addictions.

Theme 3: Striving for Excellence

This theme highlights the extent of the self-imposed pressure to win at all costs and to be better than peers demonstrating hubristic pride in order to be superior to others (Sicilia et al., 2020). A need to achieve excellence for the self and also among peers can facilitate unrealistic expectations, fear of failure, and self-perfectionist behaviour (Mayolas-Pi et al., 2017). This was evident in the language used by the participants.

Sub-theme 1: Needing to Be the Best

“Thinking about it at the start of the racing season, I’ve got to up my game again if I want to win the world championships, so this is what I’ve got to do.” (Katie)

Here Katie shows just how important winning this amateur event is to her, and it comes across as a mandatory task, and it is questionable whether or not it is a source of enjoyment or a self-imposed duty.

Sub-theme 2: Pushing Too Far

“For me that’s why I cycle, because of the competitiveness of it...I love the fact that I will push myself to my limits... It was that absolute feeling of achievement and when I did the Etape [a cyclosportive event that enables amateur cyclists to race up moun-

tainous roads in the Pyrennes and French Alps], the emotions you feel after completing a challenge like that, it's a real mixture of emotions.” (Claire)

“Some of the sportives [competitive amateur cycling events], I've entered have been challenging for me. So, I have to follow a training plan and I have to be quite scared of them in order to commit myself because I sort of think “Oh god if I don't do something, I will not be able to complete this!” (Rita)

Rita and Claire talked about entering events as a source of challenging themselves. Once the goal is set, it needs to be attained. However, it is questionable as to whether the training and completion of the events is entirely pleasurable. It is worth highlighting that the Etape event is 151 km and 1,890 m of climbing, so it is little wonder Claire had such a complex emotional response given the physical and mental endurance required to participate.

Sub-theme 3: Having Unrealistic Expectations

This final sub-theme showed that positive reinforcement is achieved through a need to attain a goal or achieve a standing with peers which has been associated with morbid exercise behaviour (Alcaraz-Ibáñez et al., 2019).

“Sometimes [cycling] makes me feel I'm useless and hopeless...Sometimes I'm with people who are faster than me, sometimes I've done too much. I'm just knackered. Sometimes if the conditions are really crap and it's windy, you just think “Oh I can't be bothered with this, you know”...Cycle wise I still feel as though I'm a novice.” (Rita)

“I couldn't understand, I'd done a lot of miles that year...probably six and a half thousand...and I just felt like I was really sluggish and slow and out of condition and I couldn't understand why. So, I could go out on a ride and feel like I'd really struggled with it and I think “This is ridiculous”. I've done more miles than anyone else in the club, how can I be this shit?” (Nancy)

Both Rita and Nancy are critical of their cycling performance and compare themselves negatively against their peers suggesting a tendency for perfectionism and a lack of self-esteem. Low self-esteem has been associated as a risk factor for exercise addiction (Landolfi, 2012; Sicilia et al, 2020). There is also an indication of overtraining resulting in a detrimental impact to performance.

“[I] had a real nutritional problem. I don't know if it was hydration or salts, but I was very, very sick. Got to the top of Col de Glandon [1,924m high mountain pass in Savoie], I couldn't stop being sick...so I had a nightmare, I had a real nightmare and then I was just so angry with myself for not finishing...I think I had panicked myself into being sick.” (Katrina)

Katrina appeared to be her own worst critic failing to make allowances for herself despite being ill. She was more concerned by the fact that she did not achieve her goal. Again, this highlights perfectionist tendencies. Previous research considering cyclists found that they had high levels with regard to impaired limits in terms of setting goals (Rankin et al., 2019). The individual perspective of underperforming may be an indicator of overtraining (Hausenblas et al., 2017). Individuals seeking approval, recognition, and being unable to set appropriate internal limits were themes associated with being at risk of exercise behaviour where an individual feels uncomfortable pressure (Rankin et al., 2017). This certainly appears to be the case for the participants where they either need to continue

to ride at a particular level or be as good as peers. The participants demonstrated a need to prove themselves at whatever cost (Egorov & Szabo, 2013).

Discussion

The data analysis in the present study suggested that almost all of the components of the behavioural addiction model (Griffiths, 2005) were demonstrated in the participants' cycling behaviour (the exception being relapse). Mood modification was one of the strongest themes and present among all participants, suggesting that the participants were reliant on cycling for a number of different reasons (e.g. anti-depressant effects, improving mood, escaping negative emotions). It is proposed that mood modification is a stronger indicator of exercise addiction than tolerance and becomes a coping mechanism to deal with ongoing life stressors, by using exercise as a means to alleviate and cope with negative emotions, as proposed in the cognitive appraisal model (Szabo, 1995). The individual becomes reliant on exercise as a means of coping with stress, and when the exercise starts to impact on other obligations and the individual reduces the level of exercise, it results in withdrawal and exacerbates negative feelings when a lack of exercise is perceived. This results in the individual resuming the previous level of exercise (Egorov & Szabo, 2013).

This association between improved mood following exercise, defined as a single session of physical activity, is well known in the literature and can last up to 24 h (Basso & Suzuki, 2017) and offers an explanation as to why exercise has such an impact on mood. The finding in this study where the inability to cycle negatively impacts the participants mood replicates a previous cycling study where females, more vulnerable to exercise addiction, had poorer mental health outcomes than the females with a low risk of exercise addiction (Mayolas-Pi et al., 2017). This is worthy of future research to strengthen the evidence of negative mood where those suffering from exercise addiction are unable to exercise.

The physical and psychological demands of amateur road cycling events, such as the Mallorca 312, due to the distance and elevation required, necessitates frequent and high-volume training, and it has been suggested that the level of demand is greater than that required in professional cycling events (Mayolas-Pi et al., 2017). Tolerance could be more accurately assessed through the events that amateur athletes enter. The desire by cyclists to strive for excellence expresses complex emotions. On the one hand, there is authentic pride in achieving the goal and a sense of mastery. On the other hand, there is a negative comparison between the self and others. The decision point for the cyclist in terms of whether they are happy or critical of their performance is dependent on the ride itself (Alcaraz-Ibáñez et al., 2019). The participants in the present sample clearly indicated a desire for competition and striving for excellence. This arguably makes them comparable to elite athletes, who have also been considered at higher risk of exercise addiction (Çetin et al., 2020; Corazza et al., 2019).

Relapse is considered a challenging component to assess, particularly in qualitative analysis. This may be due to the positive societal perspective regarding exercise, providing less incentive for an individual to stop exercising given the reported benefits. An alternative indicator of relapse could include continuing to exercise in spite of injury and against medical advice, which was highlighted in the theme 'cycling above health'. As the present study arguably indicates, cycling is the 'drug of choice' that the individual continues to engage in, despite being injured. This supports previous findings where 71% of physiotherapists reported issues in gaining compliance from clients (Adams & Kirkby, 1997).

Further studies considering input from physiotherapists would be beneficial given that they are most likely to come into contact with those suffering from exercise addiction who will seek the help of physiotherapists in order to be able to continue training in spite of injury.

The findings in the present study suggest that symptoms of addiction were present among a small sample. Six out of the eight participants showed signs of salience, conflict, and tolerance, and all participants showed signs of mood modification and withdrawal. This would indicate a potential risk of developing exercise addiction within cycling. Participants reported enjoying the competitive element of cycling, that comes from being part of a cycling club, achieving QOMs ('queen of the mountains'), being the quickest female on a *Strava segment* (a particular road or trail section where Strava members can compare times) resulting in being at the top of *Strava* leadership boards. This highlights a need for organisations such as *British Cycling*, the organisation under which English cycling clubs are affiliated, to be aware of the risks. Further research into amateur cycling is recommended because those addicted to exercise will remain hidden because it is viewed as a positive addiction (Egorov & Szabo, 2013), where exercise is recommended by some clinicians (Freimuth et al., 2011).

In terms of diagnosis, appropriate intervention would be the development of a diagnostic assessment tool, validated by the clinical population, requiring closer engagement with physiotherapists and other medical practitioners (Berczik et al., 2012). Those most likely to be addicted to exercise are most likely to be found seeking treatment (Adams and Kirkby, 1997; Egorov & Szabo, 2013). Actual cases of exercise addiction are unlikely to be identified through surveys alone which may explain the inconsistent results in the literature because these are screening instruments rather than diagnostic tools. Previously, gambling and other recognised behavioural addictions have been assessed by practitioners in dedicated treatment centres. Exercise addiction could be assessed through overtraining injuries available from medical practitioners, which may enable a more comprehensive understanding of the real impact of exercise addiction. Given the impact to the participant's mental health when they are unable to cycle, this highlights the need for clinical intervention to identify coping mechanisms outside of exercise (Rankin et al., 2019).

Overall, the participants in the present study indicated a supportive family and social network, a situational context that enabled them to integrate cycling into their other everyday commitments. Those who did not have supportive families reported conflict particularly with regard to the relationships with their children. To the authors' knowledge, no previous studies have examined whether parents feel guilt at exercising, instead of spending time with their partners or children; therefore, the finding of guilt in this study is considered novel in the context of exercise addiction. It would be interesting for future research to investigate whether this conflict exists for fathers as well as mothers who cycle at the amateur competition level and the perspective of the non-cycling partner and family.

Only one participant indicated the need to train to not feel guilty about what she ate. This arguably concurs with the low prevalence of eating disorders (1.18%) reported among cyclists in a previous study (Cook & Luke, 2017) and consolidates previous findings that exercise can be the primary addiction (Berczik et al., 2012). Given the cycling events undertaken by some of the sample, with their associated physical demands and required endurance (such as 'Mallorca 312' event), this suggests that cycling is possibly a protective factor against eating disorders. This may indicate that exercise addiction differs by sport and that cycling may be considered a sub-type of exercise addiction as well as belonging to the umbrella of endurance sports. This provides an indication as to why prevalence rates of risk of exercise addiction may vary so widely across the literature as a 'one-size-fits-all' approach may not be the best when considering exercise addiction due to the variety

of sports that an individual can engage in. The motivation for choosing a particular sport or exercise will vary due to individual differences, the level of commitment required, and time available. Cycling may be appealing due to its flexibility because the individual may engage as part of a group or individually, as well as doing it as part of their commuting activity to and from work.

There are a number of limitations to this study including the small sample size which limits the generalisation of findings. However, this was a qualitative study, which explored the risk of addiction among cyclists and therefore generalisability was not attempted. Added to this, some participants meeting the criteria of the study did not want to allocate the time to be interviewed because it took time away from their cycling. It was also a female-only sample, and therefore it cannot be inferred that males would provide similar responses and/or exhibit the same behaviours. Although the majority of the sample practiced multiple sports making it difficult to disentangle to what extent cycling was the issue, they did identify, with the exception of one participant, that cycling was the most important activity in their life and demonstrates the challenges in researching participation in a single sport.

Conclusion

Participants appeared to report symptoms of addiction in their cycling behaviour, and the strongest themes reflecting this were ‘mood modification’, ‘withdrawal’, and ‘striving for excellence’ in terms of entering amateur events, as well as the demonstration of mastery highlighting the level of commitment and time involved. Previous research has suggested that it is difficult to gather participants at risk of exercise addiction because this takes time away from being able to exercise and because some studies have wanted them to completely stop exercising (Egorov & Szabo, 2013). The present study clearly indicated that the dangers of overtraining can cause bodily pain (Marques et al., 2018; Landolfi, 2012; Çetin et al., 2020) highlighting an unhealthy component of exercise. It is suggested that as fitness trends continue to grow, so will prevalence rates of exercise addiction among individuals and should therefore be a potential cause for concern (Marques et al., 2018) and that there is a clear need for multidisciplinary teams (Bueno-Antequera et al., 2020) in order to correctly identify and diagnose exercise addiction.

Appendix. Interview Guide

General

1. Why did you start cycling?
2. How long have you been cycling? At what age did you start?
3. Do you predominantly road ride or combine with mountain biking?
4. Do you race or enter competitive events?
5. Do you have specific goals, e.g. set annual goal target?
6. Do you mainly cycle alone or socially?
7. Is there anything that would stop you from cycling?

8. Do you ever feel that cycling is too competitive?
9. Do you feel that cycling can become an addiction for some people? How would you describe it?

Saliency

1. When you are cycling or after you have finished cycling, do you always plan your next ride?
2. Do you fit your work, family, and social life around cycling?
3. Do you think cycling has become the most dominant activity in your daily life?
4. Do you find yourself preoccupied or thinking about your previous cycling session?

Mood Modification

1. How does cycling make you feel?
2. Do you cycle as a means to alleviate stress?
3. Do you cycle as a means to temporally escape from unpleasant emotions (e.g. anxiety, guilt, helplessness)?
4. Do you cycle to get a 'buzz' or an endorphin rush?
5. Does cycling improve your mood?
6. Do you always enjoy cycling or are there times it feels like a chore?
7. Do you think that you use cycling as a coping mechanism to deal with your problems?

Tolerance

1. Have you found yourself having to increasingly cycle more miles and go further than you previously did to achieve the same results?
2. Have you found yourself increasing the number of cycling activities you do per week in order to achieve satisfaction or pleasure?
3. How much of your free time is taken up with cycling (how many hours do you cycle a week x what intensity)?
4. Do you find yourself becoming more tolerant to 'higher' amounts of cycling?
5. How does training differ between summer and winter months?

Withdrawal

1. How do you feel when you have planned a bike ride and then are unable to go? Does it impact your mood?
2. Do you feel sad, irritable, or anxious when you try to reduce your cycling activity?
3. Do you feel some physical symptoms when you try to reduce your cycling activity? (e.g. nausea, headaches)
4. How would you cope if you were unable to cycle again due to medical or other reasons?

Conflict

1. Does going cycling ever lead to conflict with your partner or family?
2. Do you, your partner, or family say that you cycle too much and regard it as 'obsessive'?
3. Does cycling stop you from doing family or social activities?
4. Do you prioritise cycling above other interests?
5. Have you ever tried to cut down the amount of cycling you do and have found yourself unable to do so?
6. Do you cycle when you do not feel very well?

Relapse

1. Did you ever stop cycling for a period of time and if so why did you return to it?
2. Did you try to reduce the amount of cycling and found yourself to be unsuccessful?

End of the Interview

1. Is there anything important that we have not spoken and that you want to mention?

Declarations

Ethics Approval All procedures performed in this study involving human participants were in accordance with the ethical standards of University's Research Ethics Board and with the 1975 Helsinki Declaration.

Informed Consent Informed consent was obtained from all participants.

Conflict of Interest The authors declare no competing interests.

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