

EXERCISE ADDICTION AND PERSONALITY: A TWO-DECADE SYSTEMATIC REVIEW OF THE EMPIRICAL LITERATURE (1995–2016)

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ABSTRACT

Background. It is largely unknown why among millions of exercisers a small proportion become addicted to the behaviour in a similar manner to other common addictions, such as alcohol addiction. Some scholars believe that specific personality characteristics may be involved in predisposing some individuals to exercise addiction.

Method. The objective of the current paper was to systematically review papers concerning exercise addiction over a two-decade period (1995–2016) and to establish the extent to which personality factors are related to the aetiology of exercise addiction.

Results. The results demonstrated that perfectionism and narcissism are associated with exercise addiction and that the association is stronger in the presence of obsessive-compulsiveness. It was also found that other factors (e.g., anger, hostility, anxiety, depression, and dysfunctional psychological regulation) appear to be associated with exercise addiction. In relation to the Big Five personality traits, it was found that exercise addiction could not be unequivocally associated with openness, extroversion, neuroticism, and conscientiousness. Furthermore, the diverse focus, methodologies, and samples on which the empirical research base relies make it difficult to develop a model accounting for the role of personality factors in exercise addiction.

Conclusion. The conclusion that can be drawn is that personality factors are clearly involved in exercise addiction, but the extent to which they exert their effects in the many different situations and stages of addiction requires further research using more robust methods and representative samples.

Keywords: athletes, exercise addiction, exercise dependence, physical activity, training, compulsive exercise, obligatory exercise, personality traits.

INTRODUCTION

In the addiction research field, study into behavioural addictions have received far less attention than substance addictions. However, over the past two decades, research into behavioural addictions has considerably grown, including that of exercise addiction. According to Glasser's (1976) conceptualization, exercise addiction is a positive addiction, but Morgan (1979) disagreed and determined exercise addiction to be a negative behavioural dysfunction. Exercise addiction is char-

acterized by obsessive and compulsive exercise behaviour which typically becomes exaggerated in volume and leads to negative personal and social consequences in the individual's life. Furthermore, it may trigger injuries, as well as a loss of control over exercise. Exercising at an appropriate or moderate level is healthy and recommended by health professionals. On the other hand, when a person uses exercise to escape from a psychological hardship, the behaviour may become pathological (Szabo, 2010).

In the literature, several different terms are used to describe problematic exercise behaviour, and the most popular is ‘exercise dependence’ (Cockerill & Riddington, 1996; Hausenblas & Downs, 2002a). In the present paper, the term ‘exercise addiction’ is used because it includes both compulsion and dependence (Berczik et al., 2012). Exercise addiction can be defined in its simplest terms as a behavioural process in which individuals gain pleasure or get relief from difficulties but it causes negative consequences for the individual and those around him/her. It is characterized by lack of control and maintenance despite continued negative consequences (Goodman, 1990), and described by some as comprising six main components: salience, mood modification, tolerance, withdrawal symptoms, personal conflict, and relapse (Brown, 1993; Griffiths, 2005; Szabo, 2010). Depending on its behavioural goal, exercise addiction can be classified as primary or secondary addiction. Primary exercise addiction refers to individuals that use exercise for mediating or moderating psychological distress (Szabo, 2010). Secondary exercise addiction refers to individuals who use exercise to maintain or reach an ideal body shape and/or weight and co-occurs with other comorbid psychological dysfunctions such as anorexia nervosa and bulimia nervosa (Bamber, Cockerill, & Carroll, 2000; Blaydon, Lindner, & Kerr, 2002; de Coverley Veale, 1987).

Many different research approaches exist for studying the onset, progression, and maintenance of exercise addiction. One important and relatively extensive approach focuses on personality characteristics. While the definition of personality is often debated in the literature, Allport (1937, 1961) described it as the dynamic organization of the psychophysical systems within individuals that determines their adaptation to the environment, its specific behaviour, and thinking. However, there are many further definitions of personality (Kazdin, 2000), but is beyond the remit of the present paper. In the following sections of this review, examining the extent of the association between personality and exercise addiction, personality is defined as specific persistent or long-term traits that characterize the exercising individual.

METHOD

From the perspective of exercise addiction, the review is limited to primary and/or the non-specified (undefined) version of exercise

addiction (excluding all research on secondary exercise addiction). However, studies were included if the research examined both forms of exercise addictions in relation to personality trait differences between the two types. Regarding inclusion criteria, all studies were excluded if they examined social, demographic, motivational, and/or appearance-related factors. Consequently, the present review concentrates on the primary and/or the non-specified version of exercise addiction, and its relationship with 16 different personality constructs. This includes the ‘Big Five’ traits (i.e., extraversion, conscientiousness, openness, emotional stability/neuroticism, and agreeableness), Temperament traits (persistence, novelty seeking, harm avoidance and reward dependence), Character traits (i.e., self-directedness, cooperativeness and self-transcendence), as well as the traits of perfectionism, narcissism, trait anxiety, and self-esteem.

The search was limited to empirically published refereed research papers in the English language between 1995 and 2016 and utilized four major databases: *SportDiscus*, *PubMed*, *Science Direct* and *Google Scholar*. The search terms used were: exercise dependence, exercise addiction, exercise abuse, obsessive exercise, compulsive exercise, excessive exercise, dance addiction, dance dependence, and dance abuse AND personality, trait(s), big five, extraversion, conscientiousness, openness, emotional stability/neuroticism, agreeableness, temperament, persistence, novelty seeking, harm avoidance, reward dependence, character, self-directedness, cooperativeness, self-transcendence, perfectionism, narcissism, anxiety, and self-esteem. Although the present review concentrates on primary exercise addiction, the type of addiction investigated in some studies was not clear, so these were included for evaluation. All studies specifically investigating secondary exercise addiction were excluded (although studies examining the state type or special type of anxiety [e.g. social physique anxiety] were included). Studies from non-peer reviewed outputs (e.g., book chapters, theses, etc.) were also excluded. Unfortunately, not all papers had full-text that could be accessed via the databases (or even after directly emailing the author). However, the few papers that did not have full texts had an abstract with sufficient information containing the study’s main aims, participant numbers, instruments used, and main findings. The Figure highlights in detail the search strategy.

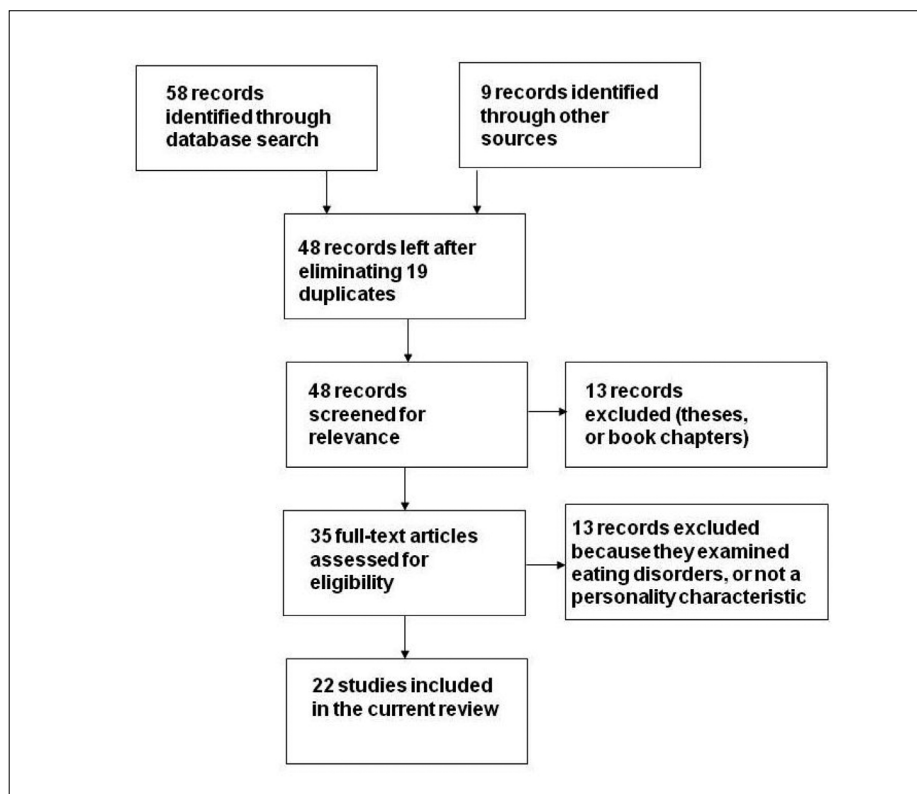


Figure. The process of selecting studies for review

RESULTS

Description of the Relevant Studies. A total of 22 studies, meeting the inclusion and exclusion criteria, were reviewed. Concerning the terminology used in describing problematic exercise, 15 studies termed the behaviour as ‘exercise dependence’, three studies termed it ‘exercise addiction’, two studies termed it ‘compulsive exercise’, and the remaining study termed it ‘obligatory exercise’ and ‘commitment to exercise’. The mean age of the populations varied between 18.9 years and 40.1 years. The frequency of exercise addiction shows great variability which may support the unstable nature of the concept and the fact that different kinds of populations are not at the same level of vulnerability and/or risk. In 14 studies, professional or amateur exerciser groups were examined or compared with non-exercisers, whereas the other eight studies comprised students as focus population or did not specify the sample recruited. The majority of the studies ($n = 20$) examined both sexes or were not specific about the gender of the participants, whereas the other two studies examined females only. The most frequently used instrument to assess the problematic behaviour was the Exercise Dependence Scale (EDS; Hausenblas & Downs, 2002b). Five of the studies utilized qualitative methodologies. Only one study

used a follow-up design. Six of the studies clearly investigated primary exercise addiction, whereas the remaining studies did not specify the type of exercise addiction, but did not examine eating disorders.

The Big Five traits and exercise addiction. As noted above, one of the most popular models in personality psychology is the Big Five (see Table 1). After many theories and changes, the final Big Five traits are extraversion, neuroticism, conscientiousness, openness to experience and agreeableness. It is generally agreed that extraversion refers to individuals being active, sociable and cheerful, while introversion refers to being reserved, solitary and sober. Neuroticism refers to an individual’s frequency of negative emotions, threatening interpretations, social withdrawal, and stress reaction to little frustration, while emotional stability is the positive opposite. Highly scrupulous individuals are goal-oriented, methodical and persevering, while non-conscientious individuals are unambitious, disorderly, and careless. Openness to experience refers to individuals being intellectual, imaginative, sensitive, and open-minded as well as being down-to-earth, intensive, and conventional. Finally, agreeableness refers to individuals who are good-natured, compliant,

Table 1. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and Big Five factors

Authors (years)	Term used+ frequency*	Sample**	Objectives	Methods***	Outcomes****
1. Hausenblas & Giacobbi Jr. (2004)	Exercise dependence	N = 173 (170 ♀, 203 ♂) non-athlete university students, age = 21.81y	To examine the relationship of primary exercise dependence symptoms with personality	Exercise Dependence Scale (Hausenblas & Downs, 2002b), NEO Five Factor Inventory (Costa & McCrae, 1992)	+ extraversion, +neuroticism, +agreeableness, -conscientiousness, -openness
2. Costa & Oliva (2012)	Exercise dependence	N = 423 (207♀, 216 ♂) voluntary gym users, age = 35.68y (females), 34.27y (males)	To investigate the association between exercise dependence and personality traits (five-factor model)	Exercise Dependence Scale (Hausenblas & Downs, 2002b), Big Five Questionnaire (Caprara, Barbaranelli & Borgogni, 1993)	+extraversion, +neuroticism, +agreeableness, +conscientiousness, +openness
3. Mathers & Walker (1999)	Exercise addiction, 3.33% (but directly selected so many)	36 Australian university students: Group1: 12 low committed to exercise (8♀, 4♂, age = 19y), Group2: 12 high committed but not addicted to exercise (9♀, 3♂, age = 20y), Group3: 12 addicted to exercise (9♀,3♂, age = 22y)	To compare exercise dependent participants with frequently exercisers and non-exercisers in the level of extraversion	Negative Addiction Scale (Hailey & Bailey, 1982), Eysenck Personality Questionnaire (Eysenck & Eysenck, 1985)	-extraversion
4. Martin, Martens, Serrao & Rocha (2008)	Exercise dependence	N = 283 (142♀, 141 ♂) university students, age = 20.12y	To explore the co-occurrence of alcohol use and exercise dependence and whether personality characteristics are responsible for this relationship	Exercise Dependence Questionnaire (Ogden, Veale, & Summers, 1997), Ten Item Personality Inventory (Gosling, Rentfrow & Swann, 2003)	partial relationship (as mediators)
5. Kern (2010), abstract	Exercise dependence	N = 806 (337♀, 469♂) participants from university (208♀, 276♂, age = 21.24y) and sport centres (129♀, 193♂, age = 30.08y), age = 24.77y	To examine the relationship between exercise dependence and personality and if there is an addictive personality type	EDS-R (Exercise Dependence Scale (Hausenblas & Downs, 2002b; Kern, 2007)	-extraversion, +neuroticism, +agreeableness, +openness

Table Abbreviations (for all tables):

*Other terms are also used (see the other tables);

** Females: Males number, type of population, age = mean age, y = years;

*** given only measurements used to assess exercise addiction and personality;

****+ an association found, –no association found.

modest, gentle, and cooperative, while non-agreeable people are irritable, ruthless, suspicious, and inflexible (Matsumoto, 2009).

In the majority of the studies, exercise addiction is positively associated with extraversion (Costa & Oliva, 2012; Hausenblas & Giacobbi Jr., 2004).

For instance, Costa and Oliva (2012) specifically examined the different dimensions of exercise addiction in the context of personality traits and found that energy/extraversion positively related to tolerance, time spent engaging in the activity, and intention effects (i.e., exercising longer or more than intended; Hausenblas & Downs, 2002b). Mathers and Walker (1999) – who examined extraversion only – found no significant difference in the level of extraversion between addicted and non-addicted exercisers. Kern (2010) also found no relationship between exercise addiction and extraversion. Neuroticism was shown to have a positive association with exercise addiction by Hausenblas and Giacobbi Jr. (2004). In line with this, in the study by Costa and Oliva (2012) reported that emotional stability was negatively associated with exercise addiction and various addiction components (i.e., withdrawal, continuance, loss of control, and reductions in engaging in other activities). In both studies, agreeableness was negatively associated with exercise addiction. Costa and Oliva (2012) also reported a negative association with continuance, reductions in engaging in other activities, time spent exercising, and intention effects.

Hausenblas and Giacobbi Jr. (2004) reported that conscientiousness had no association with exercise addiction, whereas Costa and Oliva (2012) found that it was negatively related to continuance, loss of control, reductions in engaging in other activities, and total dependence score. Hausenblas and Giacobbi Jr. (2004) reported that openness also appeared to be independent of exercise addiction, while Costa and Oliva (2012) found an association between exercise addiction and intention effects. The strongest predictors of exercise addiction were the total scores on the Leisure-Time Exercise Questionnaire (Godin & Shepard, 1985) explaining 40.8% of variance, along with neuroticism, extraversion, and agreeableness explaining an additional 8% of variance (Hausenblas & Giacobbi Jr., 2004). Demographic variables have a small contributory role in predicting exercise addiction, explaining 3% of variance. More specifically, age and BMI negatively predicted exercise addiction, whereas gender was not a significant predictor. After entering personality traits into the model, extraversion positively predicted exercise addiction, whereas conscientiousness and emotional stability were negative predictors. Age was also a significant negative predictor (Costa & Oliva, 2012).

A study by Kern (2010) reported that the strongest explanatory traits of exercise addiction were openness to experience with emotional stability or with agreeableness. Kern also posited the existence of an addictive personality type. The findings of another study supported the co-occurrence of alcohol use and abuse with exercise addiction, even after controlling for demographic and personality variables (Martin, Martens, Serrao & Rocha, 2008). Personality traits were only partially responsible for this relationship. Consciousness was associated with alcohol use, and extraversion showed an association with multiple alcohol use. Overall, neuroticism was most frequently associated with exercise addiction. This association may mean that exercise is used as a way to cope with negative emotions. Only Costa and Oliva (2012) have reported an association between exercise addiction and the Big Five traits.

Temperament, character traits and exercise addiction. A psychological model for temperament and character was developed by Cloninger, Svrakic, and Przybeck (1993). The model comprised four temperament traits: (i) novelty seeking, (ii) reward dependence, (iii) harm avoidance, and (iv) persistence, and three character traits: (i) self-directedness, (ii) cooperativeness, and (iii) self-transcendence. According to this model, the four temperament traits are independently heritable and expressed in early life. These traits reflect a response style to novel stimuli, cues of reward and punishment, aversive stimuli, and monotony (Cloninger, 1987). In the self-directedness trait, the individual identifies the self as an autonomous individual. In cooperativeness, the self is identified as an integral part of humanity, while in self-transcendence, the self is identified as the integral part of the whole universe (Cloninger, Thomas, Przybeck, & Svrakic, 1994). In research by Grandi, Clementi, Guidi, Benassi, and Tossani (2011) participants with primary exercise addiction showed higher persistence and harm avoidance, but lower self-directedness. Persistence appears to be associated with exercise addiction, and harm avoidance may be mediated via other variables (e.g., health anxiety). For individuals with lower self-directedness, it may be more important what others think about them, and exercise may be a positive way to maintain a good body image (see Table 2).

Table 2. Summary of the one study between 1995 and 2016 investigating the relationship between exercise addiction and temperament and character factors

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Grandi, Clementi, Guidi, Benassi & Tossani (2011)	Exercise dependence 29.9% primary, 36.4% among all 107 participants	N = 79 (45♀, 34♂) habitual fitness club visitors, age = 30y	To assess personality and psychological distress associated with primary exercise dependence	Exercise Dependence Questionnaire (Ogden, Veale & Summers, 1997), Temperament and Character Inventory [Cloninger et al., 1994; Conti, 2002)	+persistence, +harm avoidance, -novelty seeking, -reward dependence, +self-directedness, -cooperativeness, -self-transcendence

Perfectionism and exercise addiction.

The most frequently explored trait in exercise addiction research is perfectionism (see Table 3). Perfectionism is the trait-based tendency to have extremely high expectations of the self or others, by attaining a goal as well (Matsumoto, 2009). Hagan and Hausenblas (2003), using the Exercise Dependence Scale, found that high scoring exercise dependent participants were more perfectionist compared to less addicted ones. The high exercise addiction group also showed more exercise addiction symptoms than low scoring subjects. In other studies, the different dimensions of perfectionism have been examined. Hall, Kerr, Kozub, and Finnie (2007) showed that a combination of goal orientation, perceived ability, concern about mistakes, and high personal standards explained 31% variance in obligatory exercise. In women, the combination of high ability with elements of perfectionism explained 49% of variance in exercise addiction, while in males, the combination of achievement related over-striving (i.e., high task and ego goals) and elements of perfectionism explained 27% of variance in exercise addiction. According to a study by Hall, Hill, Appleton, and Kozub (2009) self-oriented perfectionism directly and positively influences exercise addiction. Unconditional self-acceptance was a mediator of the relationship between socially prescribed perfectionism and exercise addiction, while labile self-esteem was a mediator between unconditional self-acceptance and exercise addiction. A higher proportion of explained variance emerged by females than males in unconditional self-acceptance (34% vs. 23%) and exercise addiction (43% vs. 19%). The path coefficients values from a self-oriented perfectionism to the unconditional self-acceptance were statistically significant only in females. Labile self-esteem was a full mediator of the association

between unconditional self-acceptance and exercise addiction in males, and a partial mediator in females.

In a study by Hill, Robson, and Stamp (2015), the same dimensions of perfectionism were investigated and similar results were found. The strongest predictor of exercise addiction was self-oriented perfectionism. A self-presentational style that was pessimistic in nature was positively related to exercise addiction. After controlling for trait perfectionism, perfectionist self-presentational styles accounted for additional variance in four exercise addiction symptoms (withdrawal, loss of control, reduction, and time spent engaging in the activity). Miller and Mesagno (2014) found that exercise addiction was directly linked to self-oriented perfectionism and to socially prescribed perfectionism. Narcissism and self-orientated perfectionism jointly predicted exercise addiction even more, explaining 31% of total variance. A moderate association emerged between exercise addiction and perfectionism in both men and women. The same study also revealed that exercise addiction showed a significant relationship with specific types of perfectionism, including self-oriented and socially prescribed perfectionism, but in women only.

According to Taranis and Meyer (2010), exercise addiction showed a positive association with the 'high personal standards' dimension of perfectionism. Significant positive correlations of self-criticism with avoidance and rule-driven behaviour, weight control exercise, and exercise rigidity were also reported. After accounting for the common variance with self-criticism, the link between high 'personal standards' dimension of perfectionism and compulsive exercise was no longer statistically significant. Costa, Coppolino, and Oliva (2016) examined different models. In the first model, a path from maladaptive perfectionism to exercise addiction emerged. In

Table 3. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and perfectionism

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Hagan & Hausenblas (2003)	Exercise dependence, 50,63%	N = 79 (52♀, 27♂) university students from the USA, age = 21.78y	To examine the relationship of primary exercise-dependence symptoms with perfectionism and with exercise behaviour	Exercise Dependence Scale (Hausenblas & Downs, 2002b), Perfectionism Subscale from Eating Disorder Inventory – 2 (Garner, 1991)	+perfectionism
2. Hall, Kerr, Kozub & Finnie (2007)	Obligatory exercise	N = 246 (80♀:166♂) middle distance runners from England and Scotland, age = 34.6y	To explore the relationship between athletes' goal orientations, perfectionism, perceived ability and obligatory exercise behaviour	Obligatory Running Questionnaire (Blumenthal, O'Toole, & Chang, 1984; Pasman & Thompson, 1988), Frost Multidimensional Perfectionism Scale (Frost, Marten, Lahart & Rosenblate, 1990)	+perfectionism
3. Hall, Hill, Appleton & Kozub (2009)	Exercise dependence, 52%	N = 307 (109♀, 194♂ +4 non-respondents), middle-distance runners from recreational running clubs, age = 40.1y	To examine the psychological processes underlying the relationship between exercise dependence and perfectionism	Exercise Dependence Questionnaire (Ogden, Veale, & Summers, 1997), Multidimensional Perfectionism Scale (Hewitt & Flett, 1991)	+perfectionism, +self-oriented perfectionism, +self-esteem (as mediator), +perfectionistic self-presentational styles
4. Taranis & Meyer (2010)	Compulsive exercise	97 female exercisers from the UK, age = 21y	To explore the relationship between compulsive exercise and perfectionism dimensions (high personal standards and self-criticism), and to explore how much self-criticism accounts for the relationship of high personal standards and compulsive exercise	Compulsive Exercise Test (Taranis, Touyz, & Meyer, 2011), Frost Multidimensional Perfectionism Scale (Frost et al., 1990)	+perfectionism,
5. Miller & Mesagno (2014)	Exercise dependence	N = 90 (56♀, 34♂) regular exercisers, age = 27.41y	To examine the associations between exercise dependence, narcissism and perfectionism	Exercise Dependence Scale-Revised (Downs, Hausenblas, & Nigg, 2004), Multidimensional Perfectionism Scale (Hewitt & Flett, 1991), Narcissistic Personality Inventory (Raskin & Hall, 1979; Raskin & Terry, 1988)	+perfectionism, +self-oriented perfectionism, +socially prescribed perfectionism
6. Costa, Coppolino & Oliva (2016)	Exercise dependence, 9% AR, 68% NS, 23% NA	N = 169 (84♀, 85♂) regular adult exercisers, age = 22.76y	To explore the mediating role of basic psychological needs (Autonomy, Competence, and Relatedness) in the relationship of exercise dependence and maladaptive perfectionism, in the frame of the Self-Determination Theory	Exercise Dependence Scale-Revised (Downs et al., 2004), Frost Multidimensional Perfectionism Scale (Frost et al., 1990; Lombardo, 2008)	+maladaptive perfectionism,
7. Hill, Robson & Stamp (2015)	Exercise dependence, 9.5% AR*, 37.2% NS, 48.3% NA	N = 248 (102♀, 146♂) gym members, age = 25.74y	To investigate the relationship between exercise dependence symptoms, perfectionism and perfectionistic self-presentational styles	Exercise Dependence Scale-Revised (Downs et al., 2004), Multidimensional Perfectionism Scale (Cox, Enns, & Clara, 2002; Hewitt & Flett, 1991), Perfectionistic Self-presentational Styles (Hewitt et al., 2003)	+perfectionism, +perfectionistic self-presentational styles

Note. *AR = at risk, ND=nondependent-symptomatic, NS = nondependent-asymptomatic.

the second model, maladaptive perfectionism was inversely related to exercise addiction, emerging via the ‘needs satisfaction’ and ‘needs thwarting’. The link between maladaptive perfectionism and needs thwarting was positive, but not in the relationship between maladaptive perfectionism and needs satisfaction. Both needs satisfaction and needs thwarting positively related to exercise addiction. In a third model, after accounting for the basic psychological needs, and adding a direct path from maladaptive perfectionism to exercise addiction, the model had a less good fit index than the full mediation model. After entering needs satisfaction and needs thwarting into the model, the path between maladaptive perfectionism and exercise dependence became non-significant. The indirect impact of maladaptive perfectionism on exercise addiction through needs thwarting was statistically significant, but through needs satisfaction, it was not. Taken together, these findings suggest that perfectionism – particularly the self-oriented type – appears to be a key component in the development of exercise addiction symptoms. However, narcissism and self-esteem may modify this relationship.

Narcissism and exercise addiction. The concept of narcissism refers to extreme grandiosity

of self, and preoccupation with fantasies about success and power. Narcissistic people have an exaggerated sense of entitlement, and they approach others exploitatively (Matsumoto, 2009). Spano (2001) found that narcissism resulted in greater amount of physical activity, but not commitment to exercise. In another study, Bruno et al. (2014) found that participants with high risk for exercise addiction scored higher on self-esteem and narcissism when compared to participants with low risk for addiction. The most significant predictors of exercise frequency were: self-esteem, total narcissism, and three specific narcissism factors (i.e., authority, superiority, and exploitativeness), which explained 15.4% of the variance. Narcissism alone was a strong predictor of exercise frequency (explaining 7.9% and of variance), as well as narcissism and self-esteem together. A study by Miller and Mesagno (2014) demonstrated that exercise addiction had a positive relationship with narcissism. Its combination with self-orientated perfectionism was a predictor of higher exercise addiction scores, explaining 31% of total variance. Overall, research suggests that narcissism may be one of the key traits in exercise addiction, but its predictive value may be stronger in combination with other traits (see Table 4).

Table 4. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and narcissism

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Spano (2001)	Commitment to exercise	N = 210 (142♀, 68♂) New York residents, age = 36.54y	To explore the association of commitment to exercise with trait anxiety, with obsessive-compulsiveness and with narcissism.	Commitment to Exercise Scale (Davis, Brewer, & Ratusny, 1993), State-Trait Anxiety Inventory (Spielberger, 1983), Obsessive-Compulsive Personality Scale (Lazarre, Klerman, & Armor, 1966, 1970), Narcissistic Personality Inventory (Raskin & Hall, 1979; Raskin & Terry, 1988)	+obsessive-compulsiveness, +trait anxiety, -narcissism
2. Bruno, Quattrone, Scimeca et al. (2014)	Exercise addiction, 42.5%	N = 120 (51♀, 69♂) consecutive gym goers, age = 31.14y (counted)	To examine the risk and possible factors of exercise addiction in fitness clubs	Exercise Addiction Inventory (Terry, Szabo & Griffiths, 2004), Narcissistic Personality Inventory (Raskin & Terry, 1988; Shulman & Ferguson, 1988), Coopersmith Self-esteem Inventory (Coopersmith, 1981)	+narcissism, +self-esteem
3. Miller & Mesagno (2014)	Exercise dependence	N = 90 (56♀, 34♂) regular exercisers, age = 27.41y	To examine the associations between exercise dependence, narcissism and perfectionism	Exercise Dependence Scale-Revised, Multidimensional Perfectionism Scale (Hewitt & Flett, 1991), Narcissistic Personality Inventory (Raskin & Hall, 1979; Raskin & Terry, 1988)	+perfectionism, +self-oriented perfectionism, +socially prescribed perfectionism

Self-esteem and exercise addiction. Self-esteem refers to how individuals evaluate their body, mental processes, history, and behaviour and what their attitude towards them and opinion about them (Matsumoto, 2009). Some of the aforementioned studies investigated self-esteem, but in the context as a mediator of other traits (Bruno et al, 2014; Hall et al., 2009). However, other studies have directly examined self-esteem and related traits. A study by Groves, Biscomb, Nevill, and Matheson (2008) found an association between self-esteem and exercise addiction, but the nature of this relationship differed across the universities where the participants were recruited. According to their additional interviews, symbolic interactionist identity theory might explain such differences. The origin of self-esteem is identity reinforcement. Exercise addiction was more strongly related to self-esteem in environments where identity was linked to sport and exercise.

A study by Banbery, Groves, and Biscomb (2012) found a relationship between exercise addiction and identity formation. Maintaining a healthy body image was the main factor in exercise behaviour, as the cessation of exercising meant they could not maintain their body image, meaning they could not get their expectations of the generalized others to confirm their identity. Béres, Czeglédi and Babusa (2013) found that body-mass index and the discrepancy between self and ideal self were the lowest in the 'at risk' (AR) group, and the highest in the 'non-dependent asymptomatic (NA) group, with the 'non-dependent symptomatic' (NS) group being in the middle. The AR and NS groups evaluated their bodies as better than the NA group. The AR group exercised most frequently, and the NA group the least. Again the NS group was in the middle. More frequent exercise and less discrepancy between self and ideal self were predictors of exercise addiction, while younger age showed only a tendency in predicting exercise addiction. The model explained 39.7% of variance. Research by Liptai-Menczel et al. (2014) showed that there were differences between exercise addiction categories in wellbeing and self-esteem. According to the scores on the Exercise Addiction Inventory (Terry, Szabo, Griffiths, 2004; Griffiths, Szabo, Terry, 2005), exercise addicts had more positive impressions in their life compared to the symptomatic group, while

on the Exercise Dependence Scale (Hagan & Hausenblas, 2003), asymptomatic participants had higher self-esteem than symptomatic participants. Age, frequency of sports engagement, and self-esteem were predictors of EDS scores. These results demonstrate that self-esteem is very important factor that needs to be considered among exercise addicts. It should also be obvious from the aforementioned studies that self-esteem is also a key mediator in the association between other traits and exercise addiction. When focus becomes the body in exercising, these findings are not surprising (see Table 5).

Trait anxiety and exercise addiction. Trait anxiety refers to the general fearfulness associated with high arousal level (Matsumoto, 2009). The majority of studies in the exercise addiction field have investigated state anxiety. The present review briefly focuses on trait anxiety as part of personality (see Table 6). In the study by Spano (2001), trait anxiety had a relationship with exercise addiction. Antunes, Andersen, Tufik, and De Mello (2006) reported that exercise addiction and moderate anxiety emerged in their sample of athletes, but they did not show any indication of mood disorders. Exercise addiction itself did not generate changes in mood or in quality of life. Furthermore, there were no differences between men and women in the level of anxiety, exercise addiction, and life quality. A study by Li, Nie, and Ren (2015) showed that their exercise dependent group had a higher level of depression and state anxiety than a non-exercise dependent group, but they were not different in the level of trait anxiety. Exercise dependent participants scored lower on self-satisfaction, social behaviour, and energy in the context of wellbeing, and they also scored higher in negative mood than non-exercise dependent subjects. Groups did not differ in life satisfaction, positive mood, family satisfaction, or interpersonal relationships. Using structural equation modelling, exercise addiction had a positive influence on state anxiety, depression, and negative mood, but negatively affected self-satisfaction, social behaviour, and energy.

Weinstein, Mayan, and Weinstein (2015) found that after comparing different levels of exercise, the recreational exercising group showed the signs of mild depression, while the professional exercising group showed severe symptoms of depression. The average trait anxiety score was higher in the examined

Table 5. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and self-esteem

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Groves, Biscomb, Nevill & Matheson (2008)	Exercise dependence	quantitative data 3-times: 260 (1.) → 123 (3.) students from 3 universities in the UK (age1 = 18.90y, age2 = 19.70y, age3 = 21.47y), qualitative data: 2:2 students per universities	To examine the relationship of exercise dependence with self-esteem and identity reinforcement among three universities in the UK.	Exercise Dependence Questionnaire (Ogden, Veale, & Summers, 1997), Rosenberg Self-esteem Scale (Rosenberg, 1965), semi-structured interview	+self-esteem
2. Banbery, Groves & Biscomb (2012)	Exercise dependence	2♀, 8♂ participants from 3 universities	To investigate the association between exercise dependence and identity reinforcement in a gym-based environment in the UK	Semi-structured in-depth interview	+identity formation
3. Béres, Czeglédi & Babusa (2013)	Exercise addiction, 6.7% *AR, 62.4% NS, 30.9% NA	1231 fitness exerciser females, age = 31.3y	To examine the correlates of exercise addiction and the psychometric characteristic of the Hungarian version of Body Appreciation Scale in a sample of fitness centre user females	Exercise Addiction Inventory (Demetrovics & Kurimay, 2008; Terry, Szabo, & Griffiths, 2004), Body Appreciation Scale (Avalos, Tylka, & Wood-Barcalow, 2005)	+discrepancy between self and self-ideal
4. Liptai-Menczel et al. (2014)	exercise dependence, 2.2% (EDS)**, 7% (EAI), + 69.3% (EDS), 76.5% (EAI) ED-related symptoms	1021♀, 722♂ (eating disordered participants were removed) → 786♀, 653♂ fitness centre users from Hungary, age = 31.7y	To examine the prevalence of exercise dependence among Hungarian fitness centre users.	Exercise Dependence Scale – 21 (Downs et al., 2004; Hausenblas & Downs, 2002b), Exercise Addiction Inventory (Demetrovics & Kurimay, 2008; Terry, Szabo, & Griffiths, 2004), Rosenberg Self-esteem Scale (Rosenberg, 1965)	+self-esteem

Note. *AR = at risk, ND = nondependent-symptomatic, NS = nondependent-asymptomatic; **EDS = Exercise Dependence Scale, EAI = Exercise Addiction Inventory.

sample compared to the North American norms. Depression and trait anxiety positively correlated among the whole sample. Compulsive exercise was positively related to depression and to trait anxiety among those who regularly exercised. In the recreational group, compulsive exercising had a positive association with depression, while in the professional exercising group, compulsive exercise had a positive correlation with depression

and trait anxiety. The professional group displayed more compulsive exercise and depression than the recreational group, but in trait anxiety, there was no difference between the groups. According to the results of these studies, anxiety may have a relationship with exercise addiction. However, the findings are sometimes inconsistent regarding the type of anxiety (state or trait). It is possible that individuals' actual anxiety levels also affect the results of the trait scale.

Table 6. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and trait anxiety

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Spano (2001)	Commitment to exercise	142♀, 68♂ New York residents, age = 36.54y	To explore the association of commitment to exercise with trait anxiety, with obsessive-compulsiveness and with narcissism.	Commitment to Exercise Scale (Davis et al., 1993), State-Trait Anxiety Inventory (Spielberger, 1983), Obsessive-Compulsive Personality Scale (Lazarre et al., 1966, 1970), Narcissistic Personality Inventory (Raskin & Hall, 1979; Raskin & Terry, 1988)	+obsessive-compulsiveness, +trait anxiety, -narcissism
2. Antunes, Andersen, Tufik & De Mello (2006)	Physical exercise dependence	6♀, 11♂ adventure race athletes, age = 31.11y	To investigate exercise dependence, quality of life, and mood indicators among adventure race athletes	Exercise Dependence Scale based on Negative Addiction Scale (Hailey & Bailey, 1982, Rosa, Mello, & Souza-Formigoni, 2003), State-Trait Anxiety Inventory (Andreatini & Seabra, 1993; Spielberger, Gorsuch & Lushene, 1970)	+moderate anxiety
3. Li, Nie & Ren (2015)	Exercise dependence, 11.3%	617 ♀ 984♂ Chinese students, age = 20.5y	To examine the psychological effects of exercise dependence in a Chinese college student population	Exercise Addiction Inventory (Terry, Szabo, & Griffiths., 2004), State-Trait Anxiety Inventory (Spielberger, 1966)	+state anxiety, -trait anxiety, +depression, subjective well-being: +self-satisfaction, +social behaviour, +energy, +negative mood, -life satisfaction, -positive mood, -family satisfaction, -interpersonal relationship
4. Weinstein, Maayan & Weinstein (2015)	Compulsive exercise	32♀:39♂ recreational (51) and professional (20) exercisers, } age = 30y	To examine the association between compulsive exercise and depression and anxiety	Compulsive Exercise Scale (Tuttle, 1992), State-Trait Anxiety Inventory (Spielberger, 1983)	regularly exercisers: +trait anxiety, +depression, recreational exercisers: +depression, -trait anxiety, professional exercisers: +trait anxiety, +depression

DISCUSSION

The present review attempted to examine the extent to which an exercise addiction prone personality exists based on the empirical research carried out over a two-decade period. Taking the 22 studies as a whole, it is difficult to define a specific personality profile, but there is convergence among some studies. There is some consistency among studies examining exercise addiction and the Big Five traits. Extraversion appears to show a positive relationship with exercising (Mathers & Walker,

1999) and with exercise addiction (Costa & Oliva, 2012), but other studies show no such association (Hausenblas & Giacobbi Jr., 2004; Kern, 2010). Higher neuroticism appears to be related to exercise addiction (Costa & Oliva, 2012), although one study found no association (Hausenblas & Giacobbi Jr., 2004). Being less agreeable and conscientiousness also appears to be associated with exercise addiction (Costa & Oliva, 2012), although Hausenblas and Giacobbi Jr. (2004) found no relationship with

conscientiousness. An association was reported between exercise addiction and openness by Costa and Oliva (2012), but other studies have found no relationship (Hausenblas & Giacobbi Jr., 2004).

Personality factors may also influence the relationship between at least two different types of addiction (i.e., alcohol use and exercise addiction; Martin et al., 2008). In relation to Cloninger's traits, exercise addiction was associated with higher persistence and harm-avoidance, and with lower self-directedness and maturity (Grandi et al., 2011). Perfectionism appears to be positively associated with exercise addiction (Hagan & Hausenblas, 2003; Hall et al., 2007), mainly self-oriented perfectionism (Hall et al., 2009) or the maladaptive type of perfectionism (Costa, et al 2016). However, it is also important to take into consideration the role of self-esteem (Bruno et al., 2014; Hill et al., 2015) and self-criticism (Taranis & Meyer, 2010). Narcissism also has an association with higher physical activity (Spano, 2001) and exercise addiction (Bruno et al., 2014).

The obsessive tendencies in the personality of an exercise addict individual are obvious (Spano, 2001). The combination of narcissism with perfectionism and with obsessive-compulsiveness may be strong determinants in the onset and progression of exercise addiction (Miller & Mesagno, 2014). Because exercise is a behaviour that can improve an individual's body image, self-esteem can undoubtedly be associated with exercise addiction directly or be associated with another self-related concept (Banbery et al., 2012; Béres et al., 2013; Groves et al., 2008; Liptai-Menczel et al., 2014) or be influential as a mediator or moderator (Bruno et al., 2014; Hall et al., 2009). Self-esteem is a main feature of personality, and might have an association with almost every personality trait. As a consequence, the association between self-esteem and exercise addiction is very complex.

Many people exercise to improve mood. Several studies have investigated the association between exercise addiction and anxiety, but only few have examined trait anxiety. Most of these few studies found a positive relationship between exercise addiction and trait anxiety (Antunes et al., 2006; Spano, 2001; Weinstein et al., 2015), while others have only associated exercise addiction with state anxiety (Li et al., 2015).

CONCLUSION

There are specific limitations to the present review. Relatively few studies met the inclusion and exclusion criteria and so the empirical base used to conduct an examination of these traits was small. Even among the studies themselves, there was wide divergence in sample sizes, the representativeness of the sample, and the methodologies employed. Further research needed to systematically investigate each trait using more representative samples and more robust methodologies (such as utilizing longitudinal studies). Studies where more traits were investigated simultaneously found that the combination of traits explains a greater amount of variance than when examined separately. Personality and addiction are such complex constructs that it would be the best to examine such relationships from as many perspectives (both theoretical and methodological) as it is possible. There may well be a set of predisposing personality variables but at present, we cannot draw a specific profile of an exercise addict's personality.

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Conflicts of Interest. None to declare.

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