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Exercise addiction: A study of eating disorder symptoms, quality of life, personality traits and attachment styles

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ABSTRACT

Exercise addiction is characterized by excessive exercise patterns with potential negative consequences such as overuse injuries. The aim of this study was to compare eating disorder symptoms, quality of life, personality traits and attachments styles in exercisers with and without indications of exercise addiction. A case-control study with 121 exercisers was conducted. The exercisers were categorized into an addiction group ($n=41$) or a control group ($n=80$) on the basis of their responses to the Exercise Addiction Inventory. The participants completed the Eating Disorder Inventory 2, the Short-Form 36, the NEO Personality Inventory Revised and the Adult Attachment Scale. The addiction group scored higher on eating disorder symptoms, especially on perfectionism but not as high as eating disorder populations. The characteristic personality traits in the addiction group were high levels of excitement-seeking and achievement striving whereas scores on straightforwardness and compliance were lower than in the exercise control group. The addiction group reported more bodily pain and injuries. This study supports the hypothesis that exercise addiction is separate to an eating disorder, but shares some of the concerns of body and performance. It is driven by a striving for high goals and excitement which results in pain and injuries from overuse.

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1. Introduction

In the 1970s exercise addiction was considered a "positive addiction" because of its physiological and psychological benefits such as relaxation, euphoria and satisfaction (Glasser, 1976; Carmack and Martens, 1979). Later studies have focused on the phenomenon as harmful due to obsessively increasing exercise amounts, overuse injuries, interference with work and family, and inability to reduce exercise amounts (Seheult, 1995; Griffiths, 1997; Adams, 2009; Adams and Kirkby, 1998; Berczik et al., 2012).

Brown has developed a theoretical model of the concepts of behavioral addictions (Brown, 1993). It includes the components of *salience* (the activity becomes the most important thing in the person's life), *conflicts* (between the addicted person and others around), *mood modification* (a coping strategy to regulate emotions), *tolerance* (increasing amounts of the activity is required to achieve effect), *withdrawal symptoms* (unpleasant feelings occur when the activity is reduced), and *loss of control* (inability to limit time given to the activity) (Brown, 1997). Griffiths has applied these components to behaviors such as exercise and gambling (Griffiths, 1996; Griffiths, 1997).The Exercise Addiction Inventory (EAI) (Terry et al., 2004) is based on these components and has shown good psychometric properties (Mónok et al., 2012; Terry et al., 2004; Griffiths et al., 2005; Lichtenstein et al., 2012). The EAI has found 3% being at risk of exercise addiction in a mixed sport sample of sport science students (involved in team sports) and psychology students (participating in aerobics or gym) (Terry et al., 2004). The EAI showed an exercise addiction prevalence of 6.9% in sport science students and 3.6% among exercisers in fitness centers (Szabo and Griffiths, 2007). In a general Italian student sample 8.5% were at risk of exercise addiction (Villella et al., 2011) and 5.8% in a Danish mixed sport sample (fitness and football) (Lichtenstein et al., 2012). The prevalence of exercise addiction in the general population is 0.5% based on the EAI (Mónok et al., 2012).

In the identification of exercise addiction it is important to distinguish between exercise addiction that is secondary to an eating disorder and primary exercise addiction where the exercise is an end in itself (Veale, 1987; Veale, 1995). Veale has proposed diagnostic criteria for the condition of primary exercise addiction to make it possible to establish prevention and intervention if

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exercise is continued inspite of illness and injury. But yet exercise addiction is not accepted in the diagnostic systems (Diagnostic and Statistical Manual of Mental Disorders Fifth Edition; DSM-5) (American Psychiatric Association, 2013), and it is uncertain if exercise addiction exists in the absence of an eating disorder. Bamber and colleagues found that women with both eating disorder and secondary exercise addiction had significantly higher scores on anxiety, social dysfunction, and depression than the group with primary exercise addiction and the healthy control group (Bamber et al., 2000). Further, women with primary exercise addiction did not differ from controls on indicators of psychological morbidity. These results argue against that primary exercise addiction is a pathological syndrome. Opposite to this Blaydon et al. (2002) found a high prevalence of primary exercise addiction in competing triathletes (52%) who displayed low scores on eating disorder symptoms. Psychopathology in this group was not measured, but the athletes trained excessively (more 20 h/week) though they had a wish to do less. In a student population Zmijewski and Howard (2003) found a strong association between exercise addiction and eating disorder pathology, supporting the idea of secondary exercise addiction. But a large part of the participants had symptoms of exercise addiction without disordered eating attitudes, suggesting that primary exercise addiction does exist, but again the relationship to dysfunction or distress is unclear. We wanted to contribute to this discussion by comparing eating disorder symptoms and Body Mass Index in an exercise addiction population and an exercise control group.

Physical activity is known to enhance quality of life, but excessive exercise might lead to health problems due to negative consequences of overtraining. Therefore it is relevant to investigate if distress is related to primary exercise addiction by assessing life quality parameters such as physical, social and mental functioning. The few studies that have focused on health related quality of life in exercise addiction found no significant impact on quality of life (Antunes et al., 2006; Modolo et al., 2011). But these studies used the Negative Addiction Scale (Hailey and Bailey, 1982) which was developed to estimate running addiction and has no cut-off. This instrument was applied to 17 adventure racers (Antunes et al., 2006) and to a mixed sport sample of swimmers, body builders, basketball players etc. A generic exercise addiction tool has not been used to assess the relationship between exercise addiction and quality of life parameters. Further the pain and restrictions from overuse injuries could influence on the perceived quality of life.

To explore and explain the profiles of primary exercise addiction, personality traits have been assessed. The findings differ but traits such as perfectionism (Hagan and Hausenblas, 2003), anxiety, obsessive compulsiveness, and narcissism (Spano, 2001) are associated to exercise addiction while extraversion has shown both to be elevated in exercise addiction (Hausenblas and Giacobbi, 2004) or insignificant compared to non-addicted (Mathers and Walker, 1999). Personality traits can be described by the five-factor model (Digman, 1990). This model of personality is a trait approach to the conceptualization of personality developed from factor analysis. The model can be used to predict life behavior and thereby provide information about future outcomes in terms of diagnoses and interventions (Hartman, 2006). The five factors are: Neuroticism (sensitive/nervous vs. secure/confident), Extraversion (outgoing/energetic vs. solitary/reserved), Openness (inventive/curious vs. consistent/cautious), Agreeableness (friendly/compassionate vs. cold/unkind), and Conscientiousness (efficient/organized vs. easy-going/careless). This model has been used to describe personality types of other behavioral addictions such as compulsive buying (Mueller et al., 2010) or eating disorders (MacLaren and Best, 2009) who both display high Neuroticism scores. A study of the five factor personality profiles of pathologic gambling showed significantly decreased scores on Extraversion and Conscientiousness which was similar to obsessive compulsive disorder (Hwang et al., 2012). Knowledge of specific personality traits could be useful in the identification of risk factors for exercise addiction, but a detailed personality profile based on the five-factor model does not yet exist for exercise addiction.

Attachment patterns have been shown to influence a wide range of bio-psycho-social phenomena, including social functioning, coping and, psychological well-being, and have thus become an important aspect of health-related research (Ravitz et al., 2010). Attachment styles can be categorized as secure or insecure (preoccupied, fearful and dismissive) (Bartholomew and Horowitz, 1991). Studies of eating disorders amongst athletes find that insecure attachment styles influence athletes' eating pathology (Shanmugam et al., 2012), but attachment styles associated with primary exercise addiction have not been investigated. If exercisers with addiction display insecure attachment styles this should be taken into account in models of risk factors of exercise addiction and in treatment interventions.

The aim of this study was to assess psychological characteristics and health-related dysfunction or distress in an exercise addiction group compared to a non-addicted exercise control group, with a focus on eating disorder symptoms, quality of life, personality traits and attachment styles. We hypothesized that both groups displayed low scores on eating disorder symptoms which could indicate that exercise addiction can appear in the absence of an eating disorder Further, we expected that exercise addiction would be associated with health-related impairments due to overuse, and that specific personality and attachment traits would predict exercise addiction.

2. Method

2.1. Measures

This case-control study included an exercise addiction group and a non-addicted exercise control group. Participants answered an online survey with questions on age, height, weight, types of exercise performed on a regular basis, exercise frequency (hours of week) and sports injuries: have your exercise lead to an overload injury? Have your exercise lead to an acute injury? Have you had an injury which prevented you from working? (Answers no/yes). Exercise was defined as a physical activity which is planned, structured and repetitive. The respondents then answered five more online questionnaires, as described below. It took on average 60 min to complete the questionnaires, and the internet design prevented missing data. The participants were offered a gift card to a sport shop for participation (150 DKK). The data collection was completed between October 2011 and October 2012.

The Exercise Addiction Inventory (EAI) (Terry et al., 2004; Griffiths et al., 2005) was used to define exercise addiction and to categorize the exercisers in the addiction or control group. The EAI is a short screening tool consisting of six questions based upon six general components of addiction described by Griffiths (Griffiths, 1996; Griffiths, 1997). The responses are rated on a 5-point Likert scale. A sum-score is calculated (range 6–30 points), where a score ≥ 24 indicates exercise addiction. The Eating Disorder Inventory version 2 (EDI-2) (Garner et al., 1983; Garner, 1991) was used to screen for eating disorder symptoms. The EDI-2 is useful to identify psychological traits associated with anorexia nervosa and bulimia nervosa. The EDI-2 is valid across cultures and Danish norms exist (Clausen et al., 2009). It consists of 91 self-report items which are rated on a 6-point scale ranging from 'always' to 'never'. These responses are then transformed to values ranging from 0 to 3. The EDI comprises 11 subscales: drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, maturity fears, asceticism, impulse regulation and, social insecurity. The higher the scale score, the greater the manifestation of the trait.

The generic self-report Short-Form 36 (SF-36) (Ware and Sherbourne, 1992) was used to assess health-related quality of life. Self report of quality of life is found to be a good predictor of illness and wellbeing. Negative estimation of own health is related to an increased risk of development of illness and death. The SF-36 is used world-wide and has been translated in more than 50 countries (Kosinski et al., 2000; McHorney et al., 1993). It consists of 36 questions relating to 8 sub-scales distributed on two components: physical health (PCS) and mental health (MCS). The physical health sub-scales are: physical functioning (PF), role physical (RP),

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general health (GH) and, bodily pain (BP). The mental health sub-scales are: vitality (VT), role emotional (RE), mental health (MH) and, social functioning (SF). Higher *T*-scores indicate better functioning.

The NEO Personality Inventory Revised (NEO PI-R) (Costa and McCrae, 1992) was used to estimate personality traits based on the five-factor model (Digman, 1990). It contains 240 self-referent statements that are rated on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Each of the five factors contains six facets that are measured by eight items. Factor and facet scores were converted into *T*-scores. A *T*-score of 45–54 is considered a medium score, while a score of 55–64 is considered high and above 64 is very high. A *T*-score of 35–44 is low and below 35 is considered very low.

The Revised Adult Attachment Scale (R-AAS) (Collins and Read, 1990) was used to screen for attachment styles. The Adult Attachment Scale has shown good reliability: test-retest over 4 years 70%, internal consistency reliability, α coefficient, and retest reliability after a 2-month interval < 0.58) (Ravitz et al., 2010). The R-AAS consists of 18 items about close relationships and the answers are scored on a 5-point Likert scale. Bartholomew and Horowitz (1991) developed a four-group model of attachment styles in adulthood corresponding to this scale: *Secure attachment* (positive model of one self and others), *preoccupied attachment* (negative model of one self and positive model of others) which corresponds to the ambivalent group, *fearful attachment* (negative model of one self and others) which corresponds to the avoidant style, *dismissing attachment* (positive model of one self and negative model of others) corresponding to the detached attachment attitude. The scores were coded as dummies.

2.2. Participants

Our aim was to include both exercisers with high EAI-scores and exercisers with medium/low EAI-scores. Participants were recruited from fitness clubs and football teams at Funen in Denmark. Further sports and medicine students at the University of Southern Denmark, and employees at the police station in Odense were invited. Flyers were distributed and the study advertised for two months on the internet. A link to an online version of the questionnaires was offered to all the participants and by participating they formally gave their informed consent to scientific use of the data. We specified that participants should exercise at least 2 h/week and be 18–60 years old.

Of the 124 persons who completed all the questionnaires, three were excluded: one was < 18 years, one gender status was unclear, and one had Body Mass Index (BMI) of 40.3. High BMI could affect the responses on SF-36 because obesity is known to be associated with pronounced decrease in quality of life (Haomiao and Lubetkin, 2005). The 121 included individuals were 79 men and 42 women with an age range of 19–56 years (mean age=32, S.D.=9). The BMI ranged from 18.8 to 30.5 (mean 23.6, S.D.=2.8). The exercise range was 2–18 h a week (mean=8.4, S.D.=4.5). The mean EAI score was 19.3 (S.D.=6, range=6–30). Participants with a total EAI score 24–30 were categorized as the exercise addiction group (n=41, 32.2%) and those with a total EAI score 6–23 were categorized the non-addicted exercise control group (n=80, 67.8%) This distribution does not reflect population prevalence of exercise addiction.

2.3. Statistics

Statistical analyses were conducted using *Statistical Package for the Social Sciences* (SPSS) version 20. We used *t*-test to compare age, BMI, exercise hours/week, eating disorder symptoms, quality of life and personality traits in the exercise addiction group and control group. Chi-square analyses were used to test gender distribution, prevalence of injuries and attachment styles (and Fisher's exact test when the number of participants in cells was < 5). We used multiple logistic regressions (forward selection) to predict the odds of exercise addiction when we included the scores of EDI-2, SF-36, NEO PI-R and R-AAS in one model.

The level of significance was set to < 0.05.

3. Results

The exercise addiction group was significantly younger (mean age: 28 years versus 33 years) and exercised twice as many hours per week as the control group. The exercise addiction group also reported significantly more overload injuries, acute injuries and impairment of work. There were no differences in the gender distribution and BMI between the two groups (Table 1).

Compared to the control group, the exercise addiction group had higher mean scores on the EDI sub-scales drive for thinness, perfectionism, interoceptive awareness, ascetism and impulse regulation. The total EDI-2 score was significantly higher in the addiction group (mean EDI-2: 36) compared to the control group (mean EDI-2: 19).There were no differences between groups on the SF-36 summary scores (PCS and MCS), but the exercise addiction group had a significantly lower (worse) score on the sub-scale bodily pain (Table 2).

In terms of personality traits (NEO PI-R), the exercise addiction group had significantly higher scores on extraversion (and the facets activity and excitement seeking) and a lower score on agreeableness (and on the facets trust (p=0.05), straightforwardness, altruism, compliance and modesty) than the control group. The addiction group also had higher scores on facets hostility and achievement striving, although total scores for neuroticism, openness and conscientiousness were not significantly different in the two groups (Table 3).

No significant differences were found between the EAI groups in terms of secure and insecure (preoccupied, fearful, dismissing) attachment styles. A tendency towards dismissing attachment patterns in the addiction group was found, but was not significant (p=0.18).

In the multiple logistic regression we included the data from the four measures in one model and we controlled for age. First, we analyzed the overall factors of the instruments: EDI total score, SF-36 PCS and MCS, NEO PI-R Neuroticism, Extraversion, Openness, Agreeableness, Consciousness and the secure/not secure traits of R-AAS (Table 4). The EDI total score was divided by 10 to predict the odds of a 10-point increase of total EDI score (because a one step increase or decrease represents a little difference in this scale which in theory has a range from 0–273 and in our study 1–99). We used the SF-36 *T*-scores. The NEO PI-R factors were divided into three categories (normal *T*-score: 45–54, low *T*-score: < 45, high *T*-score: > 54). The R-AAS scores were coded as dummies. We found that a ten point increase on the total EDI score raised the odds of exercise addiction with 66%. A high score on the NEO PI-R factor Extraversion and a low score on Agreeableness significantly increased the odds of exercise addiction. The remaining overall factors and age were insignificant in this model.

Next, we analyzed the subscales of the four instruments. We found that a one point increase in the EDI subscales perfectionism and drive for thinness elevated the odds of exercise addiction with 76% and 30%, respectively. Further, a one point increase on the SF-36 sub-scale Bodily Pain protected against exercise addiction by decreasing the odds with 13%. The NEO PI-R sub-scale Assertiveness seemed to influence the odds of exercise addiction with a higher score appearing to be protective, while high scores on Activity and low scores on Deliberation increased the odds of addiction. Ideas appeared to be a risk factor both with a low and a high score. The remaining sub-scales and age showed no significant impact in the regression model (Table 4).

Table 1
Demographic and exercise characteristics of the exercise addiction group and the non-addicted exercise control group.

	Exercise addiction, n=41	Exercise control, n=80	*P* value
Age	28.3 (S.D.=7.5)	33.5 (S.D.=9.1)	0.02
BMI	23.5 (S.D.=2.5)	23.7 (S.D.=2.9)	0.77
Exercise hours/week	12.5 (S.D.=3.6)	6.3 (S.D.=3.3)	< 0.001
Gender			0.37
Males	29/79 (36.7%)	50/79 (63.3%)	
Females	12/42 (28.6%)	30/42 (71.4%)	
Injuries			
Overload injury	32/41 (78.0%)	37/80 (46.3%)	0.001
Acute injury	31/41 (75.6%)	25/80 (31.3%)	< 0.001
Affecting job	10/41 (24.4%)	4/80 (5.0%)	0.006

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Table 2
Eating disorder symptoms and quality of life in the exercise addiction group and the non-addicted exercise control group.

EDI	Exercise addiction group $n=41$, Mean score (S.D.)	Exercise control group $n=80$, Mean score (S.D.)	*P* value
Total EDI (TE)	36.37 (23.81)	19.23 (15.36)	< 0.001
Drive for Thinness (DT)	5.05 (5.87)	2.03 (3.48)	< 0.001
Bulimia (BU)	0.59 (1.14)	0.26 (1.14)	0.05
Body Dissatisfaction (BD)	5.12 (6.15)	3.33 (4.43)	0.07
Ineffectivenss (IN)	2.29 (3.19)	1.31 (2.37)	0.06
Perfectionism (PE)	5.90 (2.91)	2.24 (2.88)	< 0.001
Interpersonal Distrust (ID)	2.66 (3.29)	1.64 (2.56)	0.06
Interoceptive Awareness (IA)	2.71 (3.80)	0.96 (2.10)	< 0.001
Maturity Fears (MF)	3.54 (4.62)	2.20 (2.78)	0.05
Asceticism (AS)	3.63 (2.48)	2.29 (1.94)	< 0.001
Impulse Regulation (IR)	2.44 (3.94)	0.91 (1.63)	< 0.001
Social Insecurity (SI)	2.44 (2.88)	2.06 (2.41)	0.45
SF-36	Mean score (S.D.)	Mean score (S.D.)	
Physical Component Scale (PCS)	55.06 (5.57)	56.08 (3.74)	0.23
Physical Functioning (PF)	55.75 (2.70)	55.95 (2.29)	0.66
Role Physical (RP)	53.03 (5.90)	54.34 (4.83)	0.19
Bodily Pain (BP)	50.07 (8.56)	55.14 (5.94)	< 0.001
General Health (GH)	56.35 (6.31)	54.53 (8.04)	0.21
Mental Component Scale (MCS)	49.48 (10.11)	55.74 (4.45)	0.33
Vitality (VT)	53.08 (8.87)	55.17 (9.05)	0.23
Social Functioning (SF)	51.00 (8.91)	52.49 (6.86)	0.31
Role Emotional (RE)	50.19 (9.08)	51.41 (8.92)	0.48
Mental Health (MH)	50.42 (7.39)	52.65 (8.69)	0.16

4. Discussion

4.1. Eating disorders

The exercise addiction group demonstrated significantly higher eating disorder scores than the exercise control group, with total EDI-scores of 36 and 19 respectively. These results are consistent with the results of Grandi et al. (2011) who reported EDI scores of 41 for the exercise addiction group and 20 for the control group. Both samples consisted of both genders. We found that the elevated overall EDI score in the addiction group was explained by the sub-scales drive for thinness and perfectionism. Exercise addiction and eating disorders thus seem to share some characteristics but we were unable to distinguish between the primary and secondary nature in this study. However, when we compared the mean total EDI scores in our exercise addiction population with those of eating disordered populations, we found substantial differences. In a Danish female eating disordered group the mean total EDI score was 102 and in healthy controls 40 (Clausen et al., 2009). A sample of Norwegian eating disorder patients showed a mean EDI score of 107 for patients with excessive exercise and 84 for patients without excessive exercise (Bratland-Sanda et al., 2010). These results show that people suffering from eating disorders (with or without excessive exercise) report much more concern related to e.g. body dissatisfaction, ineffectiveness, interpersonal distrust, maturity fears and social insecurity than the exercise addiction group in our study. Further, all the participants in our study were normal weight and therefore they met not the diagnostic weight criteria of anorexia nervosa according to the DSM-IV (American Psychiatric Association, 1994).

4.2. Quality of life

The exercise addiction group scored significantly lower in the subscale for bodily pain, indicating greater physical discomfort and interference with normal activities because of pain compared to the controls. This may be due to injuries from overtraining which was significantly more reported in the addiction group. However in general we did not find evidence for decreased health related quality of life in the exercise addiction group, and their bodily pain score reached the mean score of 50 for a (US) general population. In fact, the control group had elevated scores (i.e. above 50), which could reflect positive health effects from moderate physical activity. Antunes et al. (2006) found no significant impact of exercise addiction on quality of life, but included only 17 athletes who participated in an adventure race, which is a multisport with team competitions and great variation in experiences compared to, for example, running. Generic measurement of health related quality of life may not be appropriate to detect differences between habitual exercisers and addicted exercisers, and specific instrument for this group may need to be developed. A specific instrument has been developed to asses quality of life in patients with drug dependence and it had better responsiveness compared to SF-36 (Wan et al., 2011). Further, it could be assumed that exercisers with addiction do not experience a decrease in life quality as long as they are able to maintain their exercise programs. But it is likely that life quality decreases when a serious injury occurs, which forces the exerciser to decrease or even stop exercising. This could be a relevant topic for future research.

4.3. Personality

Our results suggest that specific personality traits are associated with exercise addiction. The exercise addiction group had high scores on Extraversion and low scores on Agreeableness. These traits were also present in a study by Hausenblas and Giacobbi (2004), who used the NEO-FFI (a short 60-item version of the NEO PI-R) which gives information about the scores on the five personality domains but not the 30 facets. The same authors also found positive correlations between Neuroticism and exercise addiction, while our ANONA analysis showed that the Neuroticism facet of Hostility was significantly higher but not the domain as a whole. Two further studies found no significant relationship

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Table 3
Personality traits in the exercise addiction group and the non-addicted exercise control group.

NEO PI-R	Exercise addiction group $n=41$, Mean score (SD)	Exercise control group $n=80$, Mean score (SD)	*P* value
Neuroticism (N)	52.17 (12.17)	48.54 (12.05)	0.12
N-Anxiety	50.95 (9.79)	48.78 (12.77)	0.34
N-Hostility	54.85 (11.96)	48.78 (11.90)	0.01
N-Depression	52.02 (12.92)	48.75 (13.06)	0.19
N-Self-consciousness	52.00 (10.50)	48.90 (12.23)	0.17
N-Impulsiveness	49.29 (11.95)	46.15 (10.57)	0.14
N-Vulnerability	50.05 (12.27)	48.41 (12.67)	0.50
Extraversion (E)	55.61 (11.78)	51.35 (10.15)	0.04
E-Warmth	49.46 (13.21)	49.81 (11.19)	0.88
E-Gregariousness	50.00 (10.61)	50.08 (9.77)	0.97
E-Assertiveness	54.73 (10.11)	53.45 (10.31)	0.52
E-Activity	54.34 (7.91)	47.83 (9.01)	< 0.001
E-Excitement Seeking	58.41 (10.96)	51.74 (9.49)	< 0.001
E-Positive Emotion	54.46 (13.21)	52.33 (11.06)	0.35
Openness (O)	51.15 (9.94)	53.25 (9.91)	0.27
O-Fantasy	52.34 (11.14)	54.61 (10.03)	0.26
O-Esthetics	47.59 (10.95)	47.79 (10.88)	0.92
O-Feelings	51.54 (10.83)	52.39 (10.16)	0.67
O-Actions	51.34 (9.22)	51.54 (10.98)	0.92
O-Ideas	52.59 (12.16)	54.54 (8.93)	0.32
O-Values	48.44 (8.55)	51.05 (11.54)	0.20
Agreeableness (A)	40.05 (12.76)	47.81 (10.48)	< 0.001
A-Trust	44.17 (13.30)	49.10 (12.35)	0.05
A-Straightforwardness	42.93 (13.25)	48.33 (10.44)	0.02
A-Altruism	47.66 (12.30)	52.10 (10.79)	0.04
A-Compliance	40.78 (11.30)	48.64 (8.91)	< 0.001
A-Modesty	42.68 (9.59)	47.05 (10.29)	0.03
A-Tendermindedness	44.59 (13.16)	47.91 (11.64)	0.16
Conscientiousness (C)	52.88 (11.26)	51.48 (10.19)	0.49
C-Competence	53.80 (9.48)	54.51 (9.73)	0.70
C-Order	51.46 (10.74)	49.24 (11.36)	0.30
C-Dutifulness	49.93 (11.27)	50.33 (9.85)	0.84
C-Achievement Striving	59.83 (11.76)	49.75 (10.40)	< 0.001
C-Self-Discipline	51.15 (11.38)	50.39 (11.06)	0.72
C-Deliberation	49.51 (10.58)	52.24 (9.95)	0.17

Table 4
Odds ratio from multiple logistic regression for factors and sub-scales (forward selection).

	Odds Ratio (OR)	***p*-value**
Factor		
EDI total score	1.66	< 0.001
NEO PI-R Extraversion (Low)	0.54	0.381
NEO PI-R Extraversion (Normal) (BL)	1.00	0.052
NEO PI-R Extraversion (High)	2.49	0.076
NEO PI-R Agreeableness (Low)	2.37	0.104
NEO PI-R Agreeableness (Normal) (BL)	1.00	0.049
NEO PI-R Agreeableness (High)	0.63	0.490
Sub-scales		
EDI: perfectionism	1.76	< 0.001
EDI: drive for thinness	1.30	0.009
SF-36: bodily pain	0.87	0.011
NEO PI-R: Assertiveness (Low)	1.32	0.804
NEO PI-R: Assertiveness (Normal) (BL)	1.00	0.018
NEO PI-R: Assertiveness (High)	0.09	0.013
NEO PI-R: Activity (Low)	0.07	0.010
NEO PI-R: Activity (Normal) (BL)	1.00	< 0.001
NEO PI-R: Activity (High)	11.23	0.005
NEO PI-R: Ideas (Low)	14.07	0.023
NEO PI-R: Ideas (Normal) (BL)	1.00	0.058
NEO PI-R: Ideas (High)	5.26	0.058
NEO PI-R: Deliberation (Besindighed) (Low)	5.05	0.056
NEO PI-R: Deliberation (Besindighed) (Normal) (BL)	1.00	0.003
NEO PI-R: Deliberation (Besindighed) (High)	0.16	0.034

BL=Baseline.

between exercise addiction and Extraversion (Mathers and Walker, 1999; Kern, 2010).

High levels of activity and Excitement-seeking could explain the drive for sport and exercise. It might release a kind of 'kick'. In combination with high scores on Achievement striving and Ideas, and low scores on Deliberation, exercise addiction can be the result of a need for setting new goals, and acting out a dedicated work towards achieving exceptional performances. However, low scores on Ideas also can be associated with exercise addiction which could be explained by another type of exercisers who are limited in their exercise choices and strictly focuses on the same exercise program and system. The low scores on the Agreeableness facets give useful information about the approach to the addicted exercisers when offering treatment. Working on the interpersonal alliance would be important to gain trust and to prevent dropout due to low compliance. Narcissistic themes have been assessed in exercise and body research and are described as distrust and contempt, self-sufficiency and perfectionism (Davis et al., 1997; Spano, 2001) which are traits recognized in this study. Narcissistic personality traits are pathological when excessive patterns develop to gain self-gratification, and there is an inability to be empathic. Spano (2001) found a correlation between narcissism and amounts of physical activity.

Grandi et al. (2011) found associations between primary exercise addiction and disordered eating patterns, low self-esteem, struggle for identity, insecurity and anxiety. The exercise regimes were understood as a coping strategy to regulate emotions and self-esteem. However, this strategy eventually becomes dysfunctional and leads to distress, and therefore primary exercise addiction was considered as a clinical syndrome. According to the NEO PI-R results of our study we did not find significantly elevated scores on traits which are vulnerable for depression, anxiety or stress, and therefore we did not interpret the exercise patterns as a way of regulating negative emotions. Rather the drive for excitement and setting high goals seemed to be prototypical traits in our sample. But it is possible that different personality profiles exist for exercise addiction. There might be both a group which is characterized by negative emotions and low self esteem as found by Grandi et al. and a group which is characterized by excitement seeking and achievement striving as suggested in our study.

Other research has found several different personality types within the same disorder. On basis of factor analyses Claes et al. (2006) found three different types of personalities associated with eating disorders; one group which had no clinical elevations on the five domains of NEO, one group with high scores on Neuroticism and low on Agreeableness and Conscientiousness, and one group with high scores on Neuroticism and Conscientiousness and low on Openness. Mueller et al. (2010) found that two different personality types were associated with compulsive buying. One type had elevated scores on all five factors and was characterized as overcontrolled while the other type had high scores on Neuroticism while scores on the other factors were decreased. This type was characterized as undercontrolled and emotionally dysregulated.

The findings of these studies show a complexity in personality traits associated with different psychopathology, and this can explain the contradictory results in the field of exercise addiction. It seems unlikely that only one underlying personality profile can be detected as a risk factor. Further research is necessary to explore the potentially different personality types associated with exercise addiction and the level of impairment connected to these types.

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4.4. Attachment

Low levels of trust could be expected to be associated with insecure attachment styles but our results did not show such a relationship. If anything, a tendency towards dismissing attachment styles was found. According to Bartholomew and Horowitz (1991) this demonstrates a positive model of one-self and a negative model of others. This might be related to the low scores on agreeableness and the potential narcissistic traits. These associations are topics for further research as they could illuminate the choice of exercise over family and friends in the exercise addiction group.

4.5. Limitations of the study

Our study is based on self-report data that are vulnerable to response bias, inaccurate reporting and denial. Second, the cross sectional design only allows a description of the present characteristics and cannot detect changes over time. Future longitudinal studies could help to identify psychological predictors and developments over time in the exercise addiction. Third, clinical interviews exploring eating disorder diagnoses are necessary to obtain a more exact categorization of primary and secondary exercise addiction.

Forth, it is unclear whether exercise addiction affects the broad dimensions of health-related quality of life to such an extent that they can be identified with a generic instrument or the sample size was not large enough. Fifth, the results of the psychological profiles are presented as a group score, but individual differences were present. Finally, the internet design only registered complete rapports and therefore the number of responders leaving the questionnaires was unknown. Non-responders might differ from responders.

5. Conclusion

In conclusion, exercise addiction was associated with eating disorder traits such as concern for weight and perfectionism, but the total scores did not reach the levels seen in eating disorder patients. Injuries from excessive exercise might explain the lower (worse) score for bodily pain; however, overall there was no evidence for decreased health-related quality of life in exercise addiction. The personality traits of activity and excitement-seeking through the setting and reaching of high goals and standards were more prominent in the exercise addiction group, while interpersonal relations showed less straightforwardness, altruism, modesty and compliance. These traits are consistent with narcissistic personality traits. Attachment difficulties were not observed, however a tendency towards dismissive styles was found. These findings suggest that exercise addiction is not pathologic in terms of eating disorders but displays bodily distress in terms of pains and injuries and personality traits with similarities to narcissism. There might exist different types of personality risk profiles associated with exercise addiction, and this is important knowledge in the early identification and treatment approaches because the motives of the exercise seem to differ. Further studies to explore the potential link between exercise addiction and psychological and bodily distress are needed.

Competing interests

MBL, EC, and AE have nothing to declare. NB has within the last two years received lecture fee from Orifarm (2011 and 2012), Bristol-Myers (2012), and Eli Lilly (2011). RKS has received a lecture fee from Eli Lilly (2012), Novartis (2012), and Astra Zeneca (2010).

Contributorship

Mia Lichtenstein wrote the first draft and final version of the article. Mia Lichtenstein has conducted the data collection.

Erik Christiansen, René Klinkby Støving and Mia Beck Lichtenstein made the statistical models and analyses.

Ask Elklit, Niels Bilenberg and René K. Støving supported the study and provided guidance in the writing process.

All authors have contributed to the discussion and interpretation of the data. All authors have participated in the completion of the article.

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