DET PSYKOLOGISKE FAKULTET

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Prevalence and Correlates of Exercise Addiction in Norway: A Large-Scale Cross-Sectional Study

HOVEDOPPGAVE

profesjonsstudiet i psykologi

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Forord

Denne hovedoppgaven ble utført ved Universitetet i Bergen, Det psykologiske fakultet i perioden januar til mai 2021.

Vi vil gjerne takke vår veileder, Dominic Sagoe, for tilgang på et robust datamateriale, grundige tilbakemeldinger, og for å ha vært tilgjengelig for spørsmål og veiledning gjennom hele prosessen. Takk for at din zoom alltid har vært åpen, og for din tålmodighet under utførelsen av analysen i SPSS. Denne oppgaven hadde ikke blitt til uten din hjelp.

Rebecca, Nina og Mari

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Abstract

To our knowledge, no previous large-scale study has been conducted on exercise addiction in Norway. Thus, the present study examines the prevalence and correlates of exercise addiction in Norway. Participants were 15,654 (females = 6,151) persons. Their ages ranged from 16 to 91 (M = 33.65 ± 12.27) years. Data was collected through an exploratory online survey including questions on demographics, sports participation and exercise, anxiety and depression symptoms, personality, and the Exercise Addiction Inventory. The estimated prevalence of exercise addiction was 0.8% (females 0.9% vs. males 0.7%, p = .318). Persons who exercise more than once daily had the highest prevalence of exercise addiction (7.2%). Results of multiple regression analysis found the following factors as associated with higher risk of exercise addiction: being female, participation in running, exercise frequencies of three days per week or higher, sports competition at the low, middle or top national level, higher symptoms of anxiety and depression, and higher levels of neuroticism and narcissism. Conversely, factors associated with lower risk of exercise addiction were: being 40 years or older, higher BMI, exercising often, sometimes or never at a gymnasium, intellect/imagination, and agreeableness. Our findings elucidate the prevalence of exercise addiction in Norway as well as associated risk and protective factors. Implications of findings for practice and future research are discussed.

Keywords: correlates, exercise addiction, exercise dependence, personality, physical activity, prevalence

Sammendrag

Så vidt vi vet er det er utført en større studie om treningsavhengighet i Norge. Dermed undersøker denne studien forekomsten, og sammenhengen mellom treningsavhengighet og ulike variabler i Norge. Deltakerne var 15 654 (kvinner = 6 151) personer. Deltakernes alder varierte fra 16 til 91 (M = 33,65 ± 12,27) år. Data ble samlet inn gjennom en internettbasert spørreundersøkelse, som inkluderte spørsmål om demografi, sport- og treningsvaner, angst- og depresjonssymptomer, personlighet og spørreskjemaet Exercise Addiction Inventory. Den estimerte forekomsten av treningsavhengighet var 0,8% (kvinner 0,9% mot menn 0,7%, p = 0,318). Personer som trener mer enn én gang daglig, hadde høyest forekomst av treningsavhengighet (7,2%). Det ble gjennomført en multippel regresjonsanalyse som avdekket at følgende faktorer var forbundet med høyere risiko for treningsavhengighet: å være kvinne, treningsfrekvens på tre dager eller høyere, å drive med løping, deltakelse i konkurransesport på et nasjonalt nivå, høyere angst- og depresjon symptomer, og høyere nivåer av nevrotisisme og narsissisme. Motsatt var følgende faktorer forbundet med lavere risiko for treningsavhengighet: å være 40 år eller eldre, høyere BMI, å trene ofte, noen ganger eller aldri på et treningssenter og høyere nivåer av intellekt/åpenhet og medmenneskelighet. Våre funn belyser forekomsten av treningsavhengighet i Norge, samt tilhørende risiko- og beskyttende faktorer. Implikasjoner av funn for praksis og fremtidig forskning blir diskutert.

Nøkkelord: korrelater, treningsavhengighet, personlighet, fysisk aktivitet, forekomst

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Exercise

Exercise refers to planned, structured, motivated, and repetitive physical activity often performed in leisure time for improved health and fitness (Garber et al., 2011; World Health Organization [WHO], 2018). Popular forms of exercise include running, gym training, team sports and yoga. In recent years, there has been a growing interest in the health benefits of exercise. Empirical research shows that regular exercise is associated with positive physical and mental health outcomes including enhanced cardiovascular fitness (Helsedirektoratet, 2008; Wilson et al., 2015) and lower stress and anxiety levels (Helsedirektoratet, 2014; Mikkelsen et al., 2017). Research also suggests that regular exercise acts as an important component in the prevention of noncommunicable diseases such as cardiovascular disease, type 2 diabetes, and cancer (Reiner et al., 2013; WHO, 2018). In addition, several studies indicate that numerous emotional, as well as social benefits, may be derived from regular exercise (Atkins et al., 2019; Bernstein & McNally, 2018; Mills et al., 2019), such as preventing (Mammen & Faulkner, 2013) and treating (Morres et al., 2019) mood disorders including depression and reducing the development of Alzheimer's disease and dementia (Chang et al., 2010; Reiner et al., 2013; Rovio et al., 2005).

Despite the growing body of evidence advocating the importance of exercise and an active lifestyle, structural changes in society during the last 40-50 years, such as automated jobs, modern transportation and increased time spent watching television, has resulted in reduced daily physical activity in the Norwegian population, and thereby increasing the prevalence of being overweight and obese (Anderssen et al., 2007; Folkehelseinstituttet, 2017). Physical inactiveness is commonly regarded as one of the biggest threats to global health in the 21st century (Blair, 2009), and the fourth biggest risk factor of global death

(WHO, 2010). In response, several health authorities have taken measures to promote and maintain public health through reduced prevalence of physical inactivity. For example, in their newly updated action plan, Norwegian health authorities recommend a minimum of 150 minutes daily exercise with an intensity similar to fast walking, or minimum 75 minutes of high intensity training per week (Departementene, 2020.). Measures have also been taken on an international level. The World Health Organization's (2018) "More Active People for a Healthier World global action plan" targets a 15% reduction in the global prevalence of physical inactivity by 2030.

However, governmental policies are not the only avenue for promoting the importance of exercise. Some studies have focused on how social media can facilitate many of the social influences known to influence exercise and health behaviors (Centola, 2013; Johnston & Davis, 2019), such as receiving social support and being exposed to health-related content through social interactions (Smith & Christakis, 2008). Health-related content such as images and texts aiming to inspire people to exercise more and eat healthy are often called "fitspiration". A #fitspiration search on Instagram (March 11, 2015) returned 5.2 million pictures (Holland & Tiggemann, 2016), whereas our recent replication of the search (January 27, 2021) returned 19 million pictures. The growing body of #fitspiration content on Instagram illustrates the growing interest in exercise.

Addiction

The concept of addiction has long been understood to include the use of a drug (Walker, 1989). However, research on behaviors such as gambling, sex and shopping indicates that the term addiction could be used much broader than only referring to substance use (Shaffer et al., 2004). Research within the field of addictive behaviors has led to a differentiation between 'chemical addiction' and 'behavioral addiction'. A chemical addiction can be explained as a neurological state characterized by alteration in chemical signals (or

their receptors) transmitted in the central nervous system, produced by the substance abused, leading to positive reinforcement, and motivating the individual to continue to use the substance (D'Souza, 2015; Marlatt et al., 1988). Examples of chemicals one can become addicted to is alcohol, opioids, and benzodiazepines (Helsedirektoratet, 2016). Opioids are most often prescribed to treat pain (Helsedirektoratet, 2015), while benzodiazepines are most often used to treat anxiety and sleep disorders (Helsedirektoratet, 2016).

A behavioral addiction, on the other hand, can be described as repeated behaviors with short term rewards, characterized by the "loss of control", and continued despite attempts to moderate the behavioural pattern. The addictive behaviour also tends to increase in frequency and amount over time and is correlated with an increased risk of adverse consequences, such as disease and/or problems on a personal and/or social level, with an additional high relapse-rate (Marlatt, et al., 1988; Walker, 1989). Examples of behavioural addictions are gambling disorder (Mann et al., 2016), sexual addiction (Short et al., 2016) and exercise addiction (Griffiths, 2005), all though gambling disorder is the only recognized behavioural addiction in The Diagnostic and Statistical Manual of Mental Disorders (5th ed., DSM–5: American Psychiatric Association [APA], 2013). Research within behavioral addictions demonstrates that addiction is not restricted to drug-abuse, but a multifaceted concept best understood through an interdisciplinary framework. This might have implications for clinical interventions and further research within the field of excessive exercise (Griffiths, 2005).

Excessive Exercise and Exercise Addiction

The increased focus on the benefits of exercise has shown to yield results. Studies have found an increase in time spent on regular exercise in Norway from 1985 to 2011 (Breivik & Rafoss, 2017). Despite the numerous positive health outcomes related to regular exercise, research also suggests that for a subset of people, exercise can become obsessive and excessive and thus lead to negative physical and mental health outcomes, as well as several

adverse emotional and social consequences (Lukács et al., 2019; Maceri et al., 2019; Trott et al., 2020a). Indeed, exercising despite experiencing fatigue increases the risk of irreversible physical injuries (Lukács et al., 2019). Excessive exercise may therefore interfere with normal daily functioning (Szabo et al., 2015).

Several terms such as exercise dependence (Cockerill & Riddington, 1996; Hausenblas & Symons Downs, 2002a), compulsive exercise (Dalle et al., 2008) and obligatory exercise (Pasman & Thomposon, 1988) have been used to describe excessive exercise. Despite different connotations used for the phenomenon, there has been a growing use of the term "exercise addiction" (Berczik et al., 2012). Research indicates that "exercise addiction" can be described as an addiction in line with the most common characteristics of addictions (Berczeik et al., 2012; Griffiths, 1996).

Exercise addiction can be understood as a dysfunctional behavioral pattern where an individual experiences reduced control over his or her exercise routine, thereby exercising excessively, showing signs of dependence, and encounters adverse health effects, in addition to reduced social and professional functioning (Szabo et al., 2015). However, consensus on how to best describe the phenomenon is yet to be reached among researchers (Symons Downs et al., 2019; Trott et al., 2020a). Despite the lack of consensus on how to define excessive exercise, recent research suggests that excessive exercise could be classified as a behavioural addiction, alongside gambling disorder (Szabo et al., 2015). However, although gambling disorder is listed as a disorder in DSM-5 (APA, 2013), exercise addiction to this day is not (APA, 2013; Szabo et al., 2015). This might be due to the lack of consensus on whether excessive exercise should be considered secondary to other psychiatric disorders, such as eating disorders, or if excessive exercise can also manifest as a primary symptom and hence in itself be considered pathological (Lukács et al. 2019; Freimuth et al., 2011). Studies

indicate that exercise dependence does occur as a primary symptom of exercise addiction, but more research is needed on this issue (Trott et al., 2020a).

Theories of Exercise Addiction

Some theories have been proposed and adapted to highlight the phenomenon of exercise addiction. These theories include the components model of addiction, the interactional model of exercise addiction and the five-factor model of personality. In relation to the development of the interactional model, the sympathetic arousal hypothesis, the four-phase model, the biopsychosocial model, and the cognitive appraisal hypothesis will also be presented. The theories present biological, psychosocial, and cognitive perspectives that altogether elucidate exercise addiction. A description of these theories is presented below.

The Components Model of Addiction

The components model of addiction (Griffiths, 1996, 1997, 2005) encompasses six key facets of addiction that are applicable to behavioral addictions, such as exercise addiction. The six components are salience, mood modification, tolerance, withdrawal, conflict, and relapse. Salience can be defined on cognitive, emotional, and behavioural levels. Salience is described as fixations and distortions (cognitive level), urges (emotional level) and reduced social engagement (behaviour level), making the addictive behaviour the number one priority in the individual's life (Griffiths, 1996; 1997; 2005). Mood modification is described as the subjective feeling an individual gets when performing the activity (Szabo, 2010) such as running (Sancho & Ruiz-Juan, 2011). The subjective feeling may be characterized as “buzz” or a “high” (Griffiths, 2015), or when applied to running: “extreme pleasure" or “euphoria” (Sancho & Ruiz-Juan, 2011). Additionally, mood modification can involve different mood-modifying effects depending on the condition of the individual. Applicably, exercise might be anxiety-reducing and have calming effects on the individual when the individual is stressed (Helsedirektoratet, 2008). Similarly, exercise may enhance feelings of energy in the

individual (Helsedirektoratet, 2014). This mood-alternating effect is a psychological "expectation effect" (Griffiths, 2005).

Moreover, tolerance can be described as the process where an individual needs to increase the time they spend on a specific activity to experience the same effect as before (Symons Downs et al., 2019). In the case of exercise addiction, a person might have to exercise with higher intensity or higher frequency to experience the previously stated "buzz" or "high" as the person develops higher tolerance with increased amounts of exercise (Freimuth et al., 2011). Withdrawal symptoms can furthermore be explained as the negative psychological- or physiological symptoms the individual experiences when the activity is stopped or abruptly decreased. Examples of this include mood swings and stress induced reactions such as sleeplessness. The withdrawal effects that are seen in behavioural addictions are comparable to those seen in substance dependence (Griffiths, 2005).

Furthermore, conflict refers to the inter- and/or intrapersonal conflict the individual experiences because of their preoccupation with the certain activity. Interpersonal conflict can be described as the conflict experienced between the person who is engaging in the addictive behavior and their relationships, and their occupational and social life. Intrapersonal conflict, on the other hand, refers to conflict within the individual, and may manifest as an inability to stop the behavior, leading to the loss of control (Griffiths, 2005). Finally, relapse describes the likelihood that the individual at risk of addictive behavior will resume engaging in the specific activity after abstaining from the activity for a certain time (Griffiths, 1996).

The Interactional Model of Exercise Addiction

The interactional model of exercise addiction (Egorov & Szabo, 2013) has been propounded to explain how exercise addiction is triggered, developed, and maintained. In developing the interactional model of exercise addiction, Egorov and Szabo (2013) account

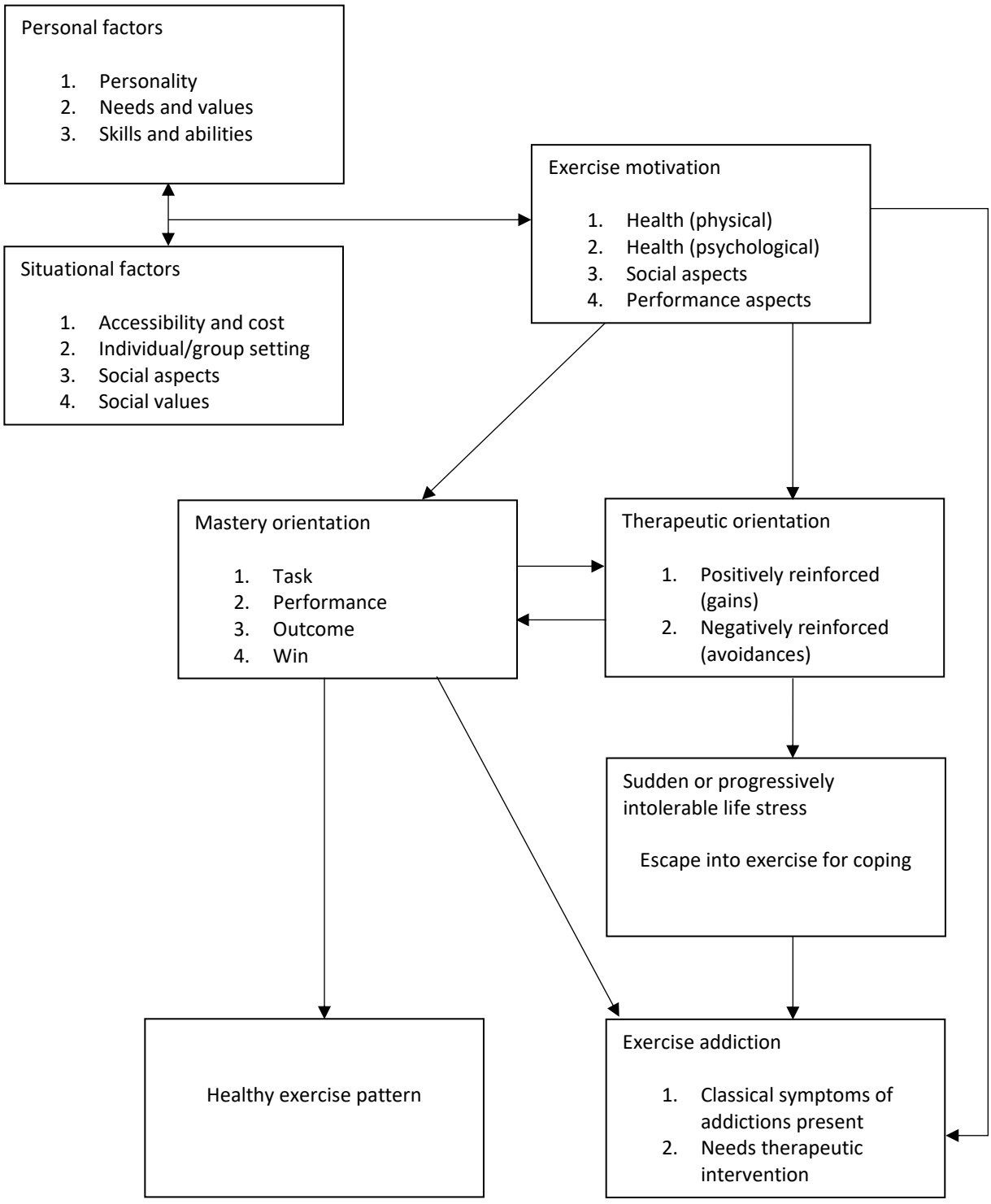
for inconsistencies in previous suggested models of exercise addiction, such as the sympathetic arousal hypothesis, the "four phase" model, the biopsychosocial model and the cognitive appraisal hypothesis. The sympathetic arousal hypothesis (Thompson & Blanton, 1987) proposes that exercise leads to a gradually higher baseline activity level, which further requires the individual to increase the amount of exercise to experience an optimal level of sympathetic arousal, and hence cause an exercise addiction over time. Furthermore, the "four phase" model (Freimuth et al., 2011) posits that exercise leads to mood-modifying effects, which for some individuals is the sole method for coping with stress. This can lead to several negative consequences, such as prioritization of exercise over other commitments, which over time can result in symptoms of addiction. Egorov and Szabo (2013) argue that the sympathetic arousal hypothesis and the four-phase model does not account for why some people get addicted to exercise whereas others do not.

In response, the biopsychosocial model (McNamara & McCabe, 2012) suggests that exercise addiction is triggered by biological factors, such as a person's body mass index (BMI) and psychosocial factors (e.g., peer pressure and self-esteem). However, Egorov and Szabo (2013) highlight evidence that addictions often emanate from attempts to cope with difficult situations (Korolenko, 1991, cited in Egorov and Szabo, 2013), thereby questioning the suggestion of a biological origin of exercise addiction. The cognitive appraisal hypothesis (Szabo, 1995) explains exercise addiction as a coping strategy to reduce stress. The absence of exercise results in withdrawal symptoms which increases the likelihood of stress and therefore the need for exercise. According to Egorov and Szabo (2013), the cognitive appraisal hypothesis model explains how exercise addiction is maintained, but not how it develops. Additionally, previous models do not account for why exercise is chosen as the means for coping with stress.

The interactional model (Figure 1) is a version of the cognitive appraisal hypothesis and includes a set of variables thought to be related to the development of exercise addiction (Egorov & Szabo, 2013). The interactional model assumes that a person's motive for exercise is the result of an interaction between personal and situational variables. Thus, a person may develop either a mastery orientation, in which they exercise for the purpose of productivity or performance, e.g., becoming stronger, or a therapeutic motivation in which the motive for exercise is based on desirable health-gains, e.g., running to feel better. The variable, "Sudden or progressively intolerable life stress", is suggested to trigger the need for coping. Studies show that individuals addicted to exercise more often were motivated to exercise because of the mood-modifying effect, thus having a therapeutic orientation, than individuals who are not addicted (Serier et al. 2018; Trott et al., 2002). Thus, exercise addiction could develop because of an attempt to deal with mental health problems such as anxiety and depression, which further could be interpreted as unexpected or increasingly unbearable life stress (Trott et al., 2002b). Previous studies have found that individuals with higher anxiety (Spano, 2001) and depression (Lichtenstein, Nielsen, et al., 2018) symptoms have higher exercise addiction scores. It is therefore hypothesized that individuals suffering from anxiety and depression are more likely to be addicted to exercise than individuals without these mental health challenges.

Figure 1

The interactional model of exercise addiction (Egorov & Szabo, 2013).



The Five-Factor Model of Personality

Personality can be defined as a collection of organized, internal structures and psychological traits, that have an impact on an individual's reaction and responses to the internal and external environment (Larsen et al., 2017). Personality traits are stable cognitive, emotional, and behavioral characteristics that establish individual identity and illustrate how individuals are distinct from one another (Holt et al., 2015; Matthews et al., 2009). Central to the concept of personality traits is the idea that individual differences in behaviour patterns reflects a person's disposition (Buss & Craik, 1980). The conceptualization of personality has been a subject of great debate, and multiple models have been proposed. One distinct difference between the models are the nature and number of constructs, or factors, needed to organize personality structure. Based on several studies, researchers from various disciplines have come to agree that the five-factor model adequately captures most of the individual differences in personality traits (Costa & McCrae, 1992; Digman, 1990; McCrae & John, 1992).

The five-factor model consists of five personality factors/traits: neuroticism, extraversion, intellect/imagination, agreeableness, and conscientiousness (Costa & McCrae, 1992). Persons with high scores on neuroticism tend to experience emotional instability and negative affect, while extraversion describes people with high levels of activity and sociability (McCrae & John, 1992). Openness to experience, also referred to as intellect/imagination (Donnellan et al., 2006) refers to being imaginative, intellectually curious, enjoying variation and valuing the influence of emotions (Costa & McCrae, 1992). Agreeableness refers to a person’s degree of compassion and trustworthiness, where people with low levels tend to appear insensitive to others and might be described as mistrusting and competitive. People with high levels of conscientiousness can be described as structured,

reliable, and ambitious. The five-factor model has shown high internal consistency, retest reliability and validity (Costa & McCrae, 1992).

The five-factor model has shown to predict health related behaviour and habits (Booth-Kewley & Vickers, 1990), and has been used to account for and explore exercise addiction. It has been found that persons with higher scores on neuroticism, extraversion, and conscientiousness, as well as lower scores on agreeableness, are at higher risks of experiencing exercise addiction (Andreassen et al., 2013; Hausenblas & Giacobbi, 2004; Lichtenstein, Christiansen, et al., 2014). Neuroticism is thought to be a personality trait that increases the susceptibility of developing psychopathology (Winter & Kuiper, 1997). Facets that underlie neuroticism include anxiety and depression, which describes the tendency to worry, and feeling guilt, frustration, and sadness (Costa & McCrae, 1992).

In line with the interactional model, it is reasonable that exercise functions as a coping strategy to modify these mood states. It is also suggested that neuroticism is the personality trait that is most associated with health-related complaints (Costa & McCrae, 1985). This could mean that individuals with high neuroticism scores exercise to reduce worries about their physical health (Hausenblas & Giacobbi, 2004). Extraversion, on the other hand, could be related to exercise addiction due to the active and energetic nature individuals with high levels of this personality trait tend to have (Hausenblas & Giacobbi, 2004). One study found that intellect/imagination is related to exercise addiction (Kern, 2009). However, several studies have not found a significant correlation (Andreassen et al., 2013; Hausenblas & Giacobbi, 2004; Lichtenstein, Christiansen, et al., 2014). The difference in findings is plausibly due to issues with the internal consistency and replicability of the trait, (John et al., 2008), which makes it difficult to form assumptions about the findings in our study regarding this personality trait. Furthermore, the negative association between agreeableness and exercise addiction could be explained by the fact that individuals with low scores on

agreeableness find it difficult tolerating the relational conflict that often follows an addiction (Andreassen et al., 2013; Graziano & Tobin, 2009).

It has also been suggested that the tendency to enjoy competition could underlie the development of exercise addiction (Hausenblas & Giacobbi, 2004). Accordingly, the positive relationship between conscientiousness and exercise addiction can be explained by the fact that people with high scores of this personality trait often set high goals for themselves and work systematically over time to reach them (Costa & McCrae, 1992). A personality trait which is not included in the model as a factor of its own, but has shown to correlate with exercise addiction, is narcissism (Bruno, 2014). Narcissistic personality can be defined as a set of traits and actions that describe high levels of preoccupation with oneself, and an overestimation of one's own self-worth (APA, 2020). This could lead to a greater emphasis on one's own appearance and fitness skills, increasing the vulnerability for developing an addiction to exercise (Miller & Mesagno, 2014). Narcissism has also shown to correlate positively with extraversion and negatively with agreeableness (Hyatt et al., 2018).

Assessment of Exercise Addiction

A variety of tools have been used to measure exercise addiction (Marques et al., 2019), including the Exercise Dependence questionnaire (EDQ: Ogden et al, 1997), the Exercise Dependence Scale (EDS: Hausenblas & Symons Downs, 2002b) and the Exercise Addiction Inventory (EAI: Griffiths et al., 2005). The measurement methods vary in the way they are developed. The EDQ is developed by using factor analysis on statements collected from individuals who think of themselves as addicted to exercise (Ogden et al, 1997). The EDS is developed on the theoretical basis of the seven criteria for substance dependence in DSM-4 (Hausenblas & Symons Downs 2002b): tolerance, withdrawal, intention effects, lack of control, time, reduction in other activities, and continuance (APA, 1994). EDQ is a self-report questionnaire consisting of 29 items (e.g., "My pattern of exercise interferes with my social

life"), scored on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree), or 0 (not applicable). The 29 items are furthermore encompassed by eight factors: interference with social/family/work life (F1), positive reward (F2), withdrawal symptoms (F3), exercise for weight control (F4), insight into problem (F5), exercise for social reason (F6), exercise for health reasons (F7), and stereotyped behavior (F8). The EDQ has been shown to have good internal consistency ($\alpha = 0.84$) (Ogden et al., 1997).

Similar to the EDQ, the EDS (Hausenblas & Symons Downs, 2002b) is a self-report questionnaire used to assess symptoms of exercise dependence. The EDS is also a 29-item questionnaire with eight subscales similar to the EDQ's eight factors: interference with social/family life (1), positive reward (2), withdrawal symptoms (3), exercise for weight control (4), insight into problem (5), exercise for social reasons (6), exercise for health reasons (7), and stereotyped behavior (8). However, EDS has improved psychometric properties compared to the EDQ with high internal consistency ($\alpha = 0.94$) (Hausenblas & Symons Downs, 2002b). When responding to the EDS, participants report on their current beliefs and behaviors over the past three months on a 5-point Likert scale ranging from 1 (never) to 5 (always). Unlike the EDQ, the EDS differentiates among at-risk (e.g., 5–6 on a 6–point Likert scale), nondependent-symptomatic (e.g., 3–4 on a 6-point Likert scale), and nondependent-asymptomatic individuals (1–2 on a 6-point Likert scale).

Furthermore, the EAI (Griffiths et al., 2005; Terry et al., 2004) was developed in response to a growing need for a more applicable screening-tool to identify people at risk of- or affected by excessive exercise termed "exercise addiction". While the EDQ (Ogden et al., 1997) and EDS (Hausenblas & Symons Downs, 2002a, 2002b) are based on factor analysis and the seven clinical criteria of addiction in DSM-5 (APA, 1994), the EAI is based on the components model of addiction (Griffiths, 1996; Terry et al., 2004) comprising: salience, mood modification, tolerance, withdrawal, conflict, and relapse (Griffiths, 1996, 1997, 2005).

Each statement is scored on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The EAI has been reported to be less time-consuming compared to for example EDS, and thus a more practical instrument for health practitioners to use in their day-to-day work (Griffiths et al., 2005). The EAI has also been shown to have high ($\alpha = 0.84$) internal consistency (Griffiths et al., 2005). In a systematic review (Marques el al., 2019), the EDS (Hausenblas & Symons Downs, 2002a, 2002b) and the EAI (Griffiths et al., 2005; Terry et al., 2004) were found to be the most common tools for exercise addiction measurement. In this study we will use EAI to measure exercise addiction.

Prevalence and Correlates of Exercise Addiction

Due to the lack of consensus regarding standardized definitions and methods of measurement of exercise addiction, it has been difficult to compare studies and be certain about the prevalence (Hausenblas & Symons Downs, 2002a; Nogueira et al., 2018). However, a recent systematic review of 34 studies with prevalences ranging between 0.3% and 42% (Marques et al., 2019) and estimated the overall prevalence of exercise addiction for the general population as ranging between 0.3% and 6.4%. A study conducted on the general male population in Norway 0.4% were classified as being at risk of exercise addiction (Trana, 2013). Additionally, the prevalence of exercise addiction among high school students ranged between 8.5% and 13% whereas prevalence for sports shop customers was 29.6%. Moreover, the prevalence of exercise addiction ranged between 3% and 7% for recreational athletes and university students, and between 6% and 9% for elite athletes (Marques et al., 2019). Inferably, the variation in exercise addiction prevalence can be explained by the different populations included in the studies. Majority of the studies sampled regular exercisers, while fewer studies have been conducted with the general population (Marques et al., 2019).

One study conducted based on the general population in Hungary (Mónok et al., 2012) estimated a prevalence of 0.5%, whereas the prevalence of exercise addiction in a general population study in the US was 6.4% (Cunningham et al., 2016).

Some studies on exercise addiction have focused on specific exercise types with running being the most studied (Hausenblas & Symons Downs, 2002a). The prevalence of exercise addiction among this group is found to be 8.6% (Lukács et al., 2019). Studies have also been done on weightlifters (Hale et al., 2013), and individuals exercising at the gym (Lichtenstein, Griffiths, et al., 2018), finding prevalences of 13.5% and 8.7% respectively. This shows that the prevalence of exercise addiction amongst runners, weightlifters and gym-goers are higher than the results found in the general population, where the prevalence is estimated to be between 0.3 and 6.4% (Marques et al., 2019). The prevalence of exercise addiction is positively associated with the amount of time used training (Lukács et al., 2019), and there are indications that younger people are at a higher risk of exercise addiction (Edmunds et al., 2006). Additionally, individuals who participate in competitions also show a higher association with exercise addiction compared to regular exercisers (Smith et al., 2010).

The Present Study

It can be inferred from the literature reviewed above that evidence on the prevalence of exercise addiction is mixed depending on the sample size, method of measurement and characteristics of the participants. Although previous studies have examined the prevalence and characteristics of exercise addiction as reviewed above, we are not aware of any population-wide study that has examined the prevalence of exercise addiction across various correlates in Norway. Hence, the overarching aim of the present study is to examine the prevalence and correlates of exercise addiction in Norway.

Additionally, previous international studies have found positive associations between exercise addiction and the following variables: high exercise frequency (Lukács et al., 2019),

running (Lukács et al., 2019), weightlifting (Hale et al., 2013), training at the gym (Lichtenstein, Griffiths, et al., 2018), participation in high-performance sports (Smith, et al., 2010), symptoms of anxiety (Spano, 2001), and depression (Lichtenstein, Nielsen et al., 2018), high scores on extraversion (Andreassen et al., 2013; Hausenblas & Giacobbi, 2004; Lichtenstein, Christiansen, et al., 2014), neuroticism (Andreassen et al., 2013; Hausenblas & Giacobbi, 2004), conscientiousness (Andreassen et al., 2013), and narcissism (Bruno, 2014), and low scores on agreeableness (Andreassen et al., 2013; Hausenblas & Giacobbi, 2004; Lichtenstein, Christiansen, et al., 2014).

Based on the theories and empirical studies reviewed above, we expected to find that higher risk of exercise addiction would be associated with: younger age, higher exercise frequency, participation in weightlifting and running, gymnasium exercise, participation in high-performance sport, higher symptoms of anxiety and depression, higher levels of neuroticism, conscientiousness, and narcissism, as well as lower agreeableness.

Methods

Participants and Procedure

Participants were 15,654 (females = 6,151) persons with mean age 33.65 (range: 16–91, *SD* = 12.27) years. Other sample characteristics are presented in Table 1. They were recruited through invitations in an article on exercise addiction published on a Norwegian newspaper's website. The article provided a link directing the participants to a digital questionnaire hosted through the online survey tool SurveyXact. An incentive for participation was that respondents received immediate feedback on their risk of exercise addiction at the end of the survey. Data was collected for approximately one month. As no personally identifying data was collected from participants, the study required no formal ethical approval in line with regulations of the Norwegian Act on Medical and Health Research.

Measures

Demographics

The survey assessed various demographic information, such as age, sex, body mass index (BMI), and relationship/marital status.

Exercise Frequency

The following question was used to assess exercise frequency: "On average, how often do you exercise?" with 9 response options: 1 (never or less than once a week), 2 (once a week), 3 (2 days a week), 4 (3 days a week), 5 (4 days a week), 6 (5 days a week), 7 (6 days a week), 8 (daily), and 9 (several times daily).

Running

Respondents indicated whether they participated in running by selecting one of the following response options: 0 (no) and 1 (yes).

Weightlifting

Respondents indicated if they participated in weightlifting by selecting one of the following response options: 0 (no) and 1 (yes).

Gym Exercise

Participants indicated how often they exercised at the gym with the following response options: 1 (yes, every time I exercise), 2 (yes, often when I exercise), 3 (yes, sometimes when I exercise) or 4 (no).

Participation in High-Performance Sport

Information on whether respondents participated in high-performance (elite and competitive) sport was indicated by choosing one of the five response-options: 1 (yes, international level), 2 (yes, top national level), 3 (yes, moderate national level), 4 (yes, low

national level) or 5 (no). The participants were asked to choose one of the five response-options.

Anxiety and Depression Symptoms

The Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983) was used for assessing symptoms of anxiety and depression. The HADS contains two seven-item subscales, one for anxiety (e.g., "I get sudden feelings of panic") and one for depression (e.g., "I feel cheerful"). Both scales are answered on a four-point scale scored from 0 (not at all) to 3 (very often). A sum-score is then calculated for anxiety (ranging from 0 to 21) and for depression (ranging from 0 to 21). In line with previous categorization (Pallesen et al., 2006; Sagoe et al., 2015), a score higher than 7 on either subscale indicates the presence of anxiety or depression symptoms. In the present study, Cronbach's alphas were 0.82 for anxiety and 0.73 for depression.

Big Five Personality Traits

The Big Five personality traits were assessed using the Mini-International Personality Item Pool-Five-Factor Model (Mini-IPIP: Donnellan et al., 2006). The Mini-IPIP consists of 20-items and is a shorter version of the 50-item International Personality Item Pool-Five Factor Model (Goldberg, 1999). Example items are: "I am relaxed most of the time" (neuroticism), "I talk a lot to different people at parties" (extraversion), "I am not interested in abstract ideas" (intellect/imagination), "I feel others' emotions" (agreeableness) and "I like order" (conscientiousness). The participants answered the question on a five-point scale, ranging from 1 (very inaccurate) to 5 (very accurate), resulting in an index score summing the responses for each personality trait. In the present study, Cronbach's alphas were 0.73 for neuroticism, 0.81 for extraversion, 0.67 for intellect/imagination, 0.76 for agreeableness, and 0.70 for conscientiousness.

Narcissism

Narcissism was assessed using an adapted version of the Narcissistic Personality Inventory (NPI-16; Ames et al., 2006). The scale is a shorter version of the 40-item original NPI (Raskin & Terry, 1988). In NPI-16, items are answered in a forced-choice format: 0 (e.g., I am an extraordinary person) indicates a narcissistic response, and 1 (e.g., I am much like everyone else) indicates the non-narcissistic. In the present study, we used a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). Thus, the index score ranges from 16 to 80. Higher scores indicate higher symptoms of narcissism. In the present study, Cronbach's alpha was 0.88.

Exercise Addiction

The Exercise Addiction Inventory (EAI: Griffiths et al., 2005; Terry et al. 2004) was used to assess the risk of being addicted to exercise. EAI consists of six statements with each representing an addiction component. Example items are "Exercise is the most important thing in my life" (salience), "Conflict have arisen between me and my family and/or my partner about the amount of exercise I do" (conflict), "I use exercise as a way of changing my mood (e.g. to get a buzz, to escape, etc.) (mood modification), "Over time I have increased the amount of exercise I do in a day" (tolerance), "If I have to miss an exercise session I feel moody and irritable" (withdrawal), and "If I cut down the amount of exercise I do, and then start again, I always end up exercising as often as I did before" (relapse). Participants were asked to answer each statement on a 5-point Likert scale ranging from 1 (strongly disagree), to 5 (strongly agree) (Griffiths et al., 2005). An index score was calculated by summing responses across all items (range 6-30). A total score of 24 or higher indicates being at risk for exercise addiction (Griffiths et al., 2005; Lichtenstein, Larsen, et al., 2014). Research has shown that EAI has good test-retest reliability (r = 0.85), as well as good internal consistency (α = 0.84) (Griffiths et al., 2005). Cronbach's alpha for EAI in this study was 0.83.

Statistical Analysis

Characteristics of the sample was determined in terms of descriptive statistics as means and standard deviations for interval and ratio level variables, and by percentages for nominal level variables. Bivariate (crude) and multivariate (adjusted) linear regression analysis were then conducted to examine the correlates of being at risk of exercise addiction. Here, index exercise addiction was used as the dependent variable. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity. For post hoc power analysis, setting f^2 to 0.7 (large), alpha to .001, sample size to 15,654, and 32 predictors, the achieved power is 1.0 indicating that the multivariate regression analysis has more than adequate power. SPSS version 26 (IBM Corp.) was used for the data analysis. The power analysis was conducted using G*Power version 3.1 (Faul et al., 2009).

Results

Prevalence of Exercise Addiction

The estimated prevalence of being at risk for exercise addiction was 0.8% (95% CI: 0.6–1.0). There was no significant difference ($x^2 = 1.00$, $p = .318$) in exercise addiction prevalence between females (0.9%, 95% CI: 0.7–1.0) and males (0.7%, 95% CI: 0.5–1.0). The highest prevalence of exercise addiction was among persons who exercise more than once daily (7.2%). Other prevalence estimates are presented in table 1.

Table 1.

Prevalence of Exercise Addiction (N = 15,654)

		Exercise addiction *n* (%)	
Variable	*N* (%)	At risk	Not at risk
Sex			
Male	6399 (51)	27 (0.7)	3834 (99.3)
Female	6151 (49)	37 (0.9)	4080 (99.1)
Age (years)			
≤ 19	1310 (10.5)	19 (2.5)	734 (97.5)
20–29	4358 (34.8)	20 (0.7)	2802 (99.3)
30–39	2809 (22.4)	13 (0.7)	1776 (99.3)
40–49	2575 (20.6)	9 (0.5)	1659 (99.5)
≥ 50	1473 (11.8)	3 (0.3)	943 (99.7)
Married/cohabitation/in a relationship			
No	7810 (62.3)	31 (0.6)	4951 (99.4)
Yes	4728 (37.7)	33 (1.1)	2963 (98.9)
Weightlifting/strength training			
No	7193 (45.9)	19 (0.9)	2179 (99.1)
Yes	8461 (54.1)	45 (0.8)	5735 (99.2)
Running			
No	7808 (49.9)	14 (0.5)	2667 (99.5)
Yes	7847 (50.1)	50 (0.9)	5247 (99.1)
Exercise frequency			
≤ 2 days a week	1275 (10.5)	3 (0.4)	752 (99.6)
3–4 days a week	4813 (39.8)	2 (0.1)	3103 (99.9)
5–6 days a week	4321 (35.7)	15 (0.5)	2952 (99.5)
Daily	1229 (10.2)	21 (2.5)	809 (97.5)
> daily	468 (3.9)	23 (7.2)	298 (92.8)

Gymnasium exercise			
Always	2746 (22.7)	24 (1.3)	1805 (98.7)
Often	3944 (32.6)	15 (0.6)	2659 (99.4)
Sometimes	2314 (19.1)	11 (0.7)	1487 (99.3)
No	3093 (25.6)	14 (0.7)	1963 (99.3)
High-performance sport			
International level	117 (1.0)	3 (4.2)	69 (95.8)
Top national level	265 (2.2)	3 (1.7)	172 (98.3)
Medium national level	862 (7.2)	15 (2.6)	552 (97.4)
Low national level	1213 (10.2)	6 (0.7)	803 (99.3)
No	9444 (79.4)	37 (0.6)	6318 (99.4)
Anxiety			
HADS < 7	5961 (61.3)	16 (0.3)	4844 (99.7)
HADS ≥ 7	3771 (38.7)	48 (1.5)	3070 (98.5)
Depression			
HADS < 7	8667 (89.0)	29 (0.4)	7072 (99.6)
HADS ≥ 7	1067 (11.0)	35 (4.0)	842 (96.0)
	Range	*M* (*SD*)	*M* (*SD*)
BMI (kg/m^2)	11.1–76.5	23.4 (12.9)	24.1 (3.7)

HADS: Hospital Anxiety and Depression Scale.
Figures may not add up due to missing values.

Significant Bivariate (Crude) Correlates of Exercise Addiction

Table 2 shows the results from the bivariate (crude) linear regression analysis for being at risk of exercise addiction. From Table 2, factors associated with higher risk of exercise addiction are being female (vs. being male), ages 20–29 and 30–39 (vs. age 19 or younger), being married, in cohabitation or a relationship (vs. not), participation in weightlifting (vs. no weightlifting) or running (vs. no running), and exercising five to six days, daily or more than once a day (vs. two days or less per week). Other factors associated with higher risk of exercise addiction are exercising often at a gymnasium (vs. always), sports competition at an international level, top national level, middle national level or low national level (vs. not competing), higher symptoms of anxiety (vs. lower) and depression (vs. lower), and higher levels of neuroticism and narcissism.

In contrast, factors associated with lower risk of exercise addiction are ages 40–49 and 50 years or older (vs. being 19 years old or younger), higher BMI, exercising three to four days per week (vs. less than two days per week), no exercise at gymnasium (vs always and sometimes) and higher levels of the personality traits intellect/imagination and agreeableness.

Significant Multivariate (Adjusted) Correlates of Exercise Addiction

Table 2 shows the results of the multivariate (adjusted) linear regression analysis for being at risk of exercise addiction. The model for exercise addiction was significant ($p < 0.001$) and explained 38.4% of the variance in exercise addiction.

Demographics

Females, compared to males, were associated with higher risk of exercise addiction. However, persons 40 years or older had lower risk of exercise addiction compared to persons 19 years or younger. Additionally, higher BMI was associated with lower risk of exercise addiction.

Exercise and Sports Participation

Participation in running (vs. nonparticipation) was associated with higher risk of exercise addiction. Additionally, compared to persons exercising two days or less a week, persons exercising three or four days a week, five to six days a week, every day, or multiple times a day had higher risks of being addicted to exercise. Moreover, participation in competitive sports at the low (vs. nonparticipation), middle (vs. nonparticipation), or top (vs. nonparticipation) national level was associated with higher risk of exercise addiction. Conversely, individuals who do not, often or sometimes exercise in a gymnasium had lower risk of being addicted to exercise compared to individuals who always exercise in a gymnasium.

Anxiety and Depression Symptoms

Persons with higher anxiety symptoms (vs. lower symptoms) had a higher risk of exercise addiction. Similarly, persons with higher depression symptoms (vs. lower symptoms) had a higher risk of exercise addiction.

Personality

Higher scores on neuroticism and narcissism were associated with higher risk for exercise addiction, whereas intellect/imagination and agreeableness were associated with lower risk of exercise addiction.

Table 2

Bivariate (crude) and Multivariate (adjusted) Correlates of Exercise Addiction

	Crude				Adjusted			
Variable	*B*	*SE*	*β*	*t*	*B*	*SE*	*β*	*t*
Sex								
Male	Ref				Ref			
Female	1.27	0.12	0.11	10.24***	0.55	0.12	0.05	4.66***
Age (years)								
≤ 19	Ref				Ref			
20–29	0.91	0.13	0.08	7.00***	- 2.70	0.19	- 0.02	- 1.42
30–39	0.43	0.15	0.03	2.87**	0.32	0.21	0.02	1.56
40–49	- 0.94	0.15	- 0.07	- 6.15***	- 0.37	0.22	- 0.03	- 1.72
≥ 50	- 2.90	0.19	- 0.17	- 15.23***	- 1.58	0.24	- 0.09	- 6.57***
BMI (kg/m^2)	- 0.19	0.02	- 0.13	- 11.74***	- 0.05	0.01	- 0.04	- 3.69***
Married/cohabitation/in a relationship								
No	Ref				Ref			
Yes	0.72	0.13	0.06	5.56***	- 0.19	0.11	- 0.02	- 1.69
Weightlifting								

No	Ref				Ref			
Yes	2.27	0.14	0.18	16.49***	- 0.07	0.14	- 0.01	- 0.47
Running								
No	Ref				Ref			
Yes	2.26	0.13	0.19	17.38***	0.85	0.11	0.07	7.57***
Exercise frequency								
≤ 2 days a week	Ref				Ref			
3–4 days a week	- 1.55	0.13	- 0.14	- 12.24***	5.18	0.19	0.45	27.61***
5–6 days a week	2.40	0.13	0.21	18.99***	7.30	0.19	0.63	37.81***
Daily	2.92	0.20	0.16	14.47***	8.21	0.23	0.45	35.12***
> daily	4.69	0.31	0.17	14.96***	9.32	0.32	0.33	29.43***
Gymnasium exercise								
Always	Ref				Ref			
Often	1.35	0.13	0.11	10.27***	- 0.36	0.14	- 0.03	- 2.62**
Sometimes	0.29	0.16	0.02	1.83	- 0.87	0.17	- 0.06	- 5.22***
No	- 2.68	0.14	-0.21	-18.96***	- 1.45	0.18	- 0.11	- 8.21***
High-performance sport								
No	Ref				Ref			
International level	2.38	0.66	0.04	3.60***	0.43	0.53	0.01	0.81

Top national level	2.56	0.43	0.07	6.00***	0.84	0.35	0.02	2.37*
Middle national level	2.20	0.24	0.10	9.08***	1.11	0.20	0.05	5.45***
Low national level	1.10	0.20	0.06	5.32***	0.82	0.17	.05	4.84***
Anxiety								
HADS ≤ 7	Ref				Ref			
HADS > 7	3.63	.12	.32	29.85***	1.70	0.13	0.15	13.55***
Depression								
HADS ≤ 7	Ref				Ref			
HADS > 7	2.96	0.20	0.17	15.03***	1.12	0.18	0.06	6.40***
Personality								
Neuroticism	0.48	0.02	0.30	28.56***	0.26	0.02	0.17	14.91***
Extraversion	0.00	0.02	- 0.00	- 1.19	0.02	0.02	0.01	1.11
Intellect/imagination	- 0.13	0.02	- 0.07	- 6.59***	- 0.09	0.02	- 0.05	- 5.50***
Agreeableness	- 0.07	0.02	- 0.03	- 3.05**	- 0.09	0.02	- 0.05	- 4.63***
Conscientiousness	- 0.03	0.02	- 0.02	- 1.61	0.01	0.02	0.01	0.64
Narcissism	0.04	0.01	0.07	6.38***	0.05	0.01	0.10	9.49***

HADS: Hospital Anxiety and Depression Scale. Ref: Reference category.
***$p < .001$, **$p < .01$, *$p < .05$.
R^2 (Adjusted) = 38.4%.

Discussion

Understanding important aspects of exercise addiction may be relevant for public health, as excessive exercise could lead to negative physical and psychological health outcomes (Lukács et al., 2019; Maceri et al., 2019; Trott et al., 2020a). The aim of the present study was to determine the prevalence of exercise addiction in a sample of the Norwegian population, and to examine the correlates of exercise addiction.

Prevalence of Exercise Addiction

Despite variations in prevalence estimates of exercise addiction (Marques et al., 2019), research has found the overall prevalence in general populations as ranging between 0.5% in Hungary (Mònok et al., 2012) and 6.4% in the US (Cunningham et al., 2016). The estimated prevalence of exercise addiction in the present study (0.8%) is within this range. Particularly, it is similar to the estimated prevalence of 0.5% in a Hungarian general population study (Mònok et al., 2012). The estimated prevalence of exercise addiction among men (0.7%) is similar to results of a previous Norwegian study that found a 0.4% prevalence of exercise dependence among Norwegian men (Trana, 2013). Additionally, the estimated prevalence of exercise addiction among our general population of Norwegian women (0.9%) is novel (Dumitru et al., 2018; Lukács et al., 2019; Marques et al., 2019). Moreover, our finding of a lack of a sex difference in exercise addiction prevalence is consistent with results of a systematic review on the topic (Dumitru et al., 2018). Our finding that the highest prevalence of exercise addiction is among persons who exercise more than once daily (7.2%) is understandable given that the prevalence of exercise addiction is elevated among individuals who exercise frequently (Dumitru et al., 2018; Lukács et al., 2019; Marques et al., 2019).

Correlates of Exercise Addiction

Demographics

Although the sex difference in exercise addiction prevalence did not reach statistical significance, we found that females are associated with higher risk of exercise addiction compared to males. This finding is novel as most of the research on sex differences focuses on specific groups such as university students or recreational athletes (Dumitru et al., 2018). It is plausible that females may have a higher risk of exercise addiction due to their lower levels of body appreciation (He et al, 2020) and increased risk of mental health problems compared to males (Baxter et al., 2014; Ferrari, 2013).

Additionally, our finding that being 40 years or older is associated with lower risk of exercise addiction compared to persons 19 years or younger is in line with our expectations and previous research indicating a positive association between younger age and risk of exercise addiction (Lichteinstein et al., 2018a). Another possible explanation for this finding is that the mean level of agreeableness, which we find is negatively associated with exercise addiction, tends to increase during the lifespan, whereas the mean level of neuroticism, which is positively associated with exercise addiction, has a tendency to decline (Graham et al., 2020; Larsen et al., 2017). Also, younger persons are more prone to addiction disorders (Ross & Ivis, 1999). Particularly, adolescence and young adulthood is well known as a life period of greater insecurity and life stress where exercise addiction may develop as a coping strategy, as proposed by the interactional model of exercise addiction (Egorov & Szabo, 2013). Moreover, our finding that higher BMI is associated with lower risk of exercise addiction can be explained by additional findings on exercise and sports participation, particularly on exercise frequency.

Exercise and Sports Participation

Our finding that participation in running is associated with a higher risk of exercise addiction may be explainable by the fact that running is a convenient exercise mode to achieve high intensity training (Lukás et al., 2019), and is more effective in reducing stress

and anxiety in line with the interactional model of exercise addiction (Egorov & Szabo, 2013). Moreover, our finding that individuals who exercised three days a week or more have a higher risk of exercise addiction compared to individuals who exercised two days or less a week is in line with our hypothesis and results of previous studies showing a positive correlation between exercise frequency and excessive exercise (Trana, 2013). Increased amounts of exercise are addressed in three out of five addiction components in EAI (tolerance, withdrawal and relapse) (Griffiths et al., 2005), and therefore fairly expected. However, in the EAI, exercise addiction is also encompassed by the salience, conflict, and mood modification. It is therefore reasonable that exercise addiction also can be driven by factors other than frequency, and that the amount of exercise alone is not enough to determine whether or not a person is at risk of exercise addiction.

Also, our finding that participation in high-performance sports is associated with higher risk of exercise addiction is in line with previous studies indicating that the prevalence of exercise addiction increases with the level of competition (De la Vega et al., 2016). It is also reasonable to believe that individuals who engage in high-performance sports have elevated scores on the addiction components salience and tolerance, perhaps because exercising on a competitive level is a professional task thereby not only increasing the time spent exercising, but also increasing the impact exercise has on their lives. However, it has been suggested that for elite athletes, high exercise frequency might not reflect excessive exercise and a psychological dysfunction, but rather overcommitment and dedication (De la Vega et al., 2016). Uncertainty about the basis of comparison between competitive and noncompetitive individuals have also been proposed (Egorov & Szabo, 2013).

Furthermore, in corroboration of our hypothesis, persons who always exercise in a gymnasium had a higher risk of exercise addiction compared to persons who do not always exercise in a gymnasium. This finding is in line with evidence indicating a significantly

higher score on exercise dependence among men exercising at the gym for more than five hours a week (Trana, 2013). This finding is also consistent with previous findings showing that individuals who are classified as exercise dependent spend more time at the gym than individuals who do not meet the criteria for exercise dependence (Lejoyeux et al., 2008).

Anxiety and Depression Symptoms

Our finding that persons with anxiety symptoms have a higher risk of exercise addiction is consistent with previous research finding a significant correlation between trait anxiety and commitment to exercise (Spano, 2011). Furthermore, a study on exercise addiction in amateur runners found a positive relationship between anxiety and exercise addiction (Lukács et al., 2019). The interactional model of exercise addiction (Egorov & Szabo, 2013) suggests that individuals use exercise as a way of reducing their anxiety levels. Additionality exercisers frequently experience withdrawal symptoms such as anxiety when they are not exercising (Landolfi, 2013). Exercise addiction could therefore emanate from having to increase the amount of time exercising to achieve the same anxiety reduction as before.

The present study also shows that persons with higher depression symptoms (vs. lower depression symptoms) have a higher risk of becoming addicted to exercise. This finding is consistent with our expectations as well as previous findings (Lichtenstein, Nielsen, et al., 2018). The positive association between symptoms of depression and exercise addiction is explainable by the interactional model of exercise addiction where exercise is understood and explained as a mechanism to cope with psychological distress (Egorov & Szabo, 2013). It has been suggested that for individuals with exercise addiction, exercise could be a dysfunctional coping mechanism for regulating mood states such as depression (Hausenblas & Giacobbi, 2004)

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Personality

Previous studies have found a positive association between neuroticism and exercise addiction (Andreassen et al, 2013; Bircher et al., 2017; Hausenblas & Giacobbi, 2004). Indeed, neuroticism is generally a risk factor for psychopathology (Winter & Kuiper, 1997) and has been associated with increased risk for both behavioural and chemical addictions (Andreassen et al, 2013; Bucher et al., 2019; Gossop & Eysenck, 1980). Consistent with the above findings and our expectation, higher neuroticism was associated with higher risk for exercise addiction. Indeed, neuroticism in the present study was found to be the personality trait with the strongest association (positive) with exercise addiction. Additionally, our finding that the risk of being addicted to exercise is higher for individuals with elevated narcissism scores is consistent with our hypothesis, and previous findings (Bircher et al., 2017; Bruno et al., 2014; Zeigler-Hill et al., 2021). It is plausible that exercise addiction develops when individuals over time exercise more intensely and frequently to validate their identity and self-worth, feel good about themselves, and receive positive attention from others (Bircher et al., 2017; Bruno et al., 2014; Myers & Zeigler-Hill, 2012; Zeigler-Hill et al., 2021).

In contrast to our hypothesis, the results show that individuals with higher scores on intellect/imagination have a lower risk of exercise addiction. As persons with higher scores on intellect/imagination have a lower tendency to enjoy routine activities, and a higher tendency to enjoy new activities and experiences (Costa & McCrae, 1992), this might make them less vulnerable to developing exercise addiction since it involves compulsive and repetitive exercise. Furthermore, as hypothesized, our results also show that individuals with higher scores on agreeableness are at lower risk of exercise addiction. This finding is consistent with previous findings (Andreassen et al., 2013) and is plausible as agreeableness is associated with positive mental health and social wellbeing (Lamers et al., 2012) and is generally a

protective factor for the development of behavioural addictions (Andreassen et al., 2013). Our finding on agreeableness is however inconsistent with a previous finding that agreeableness is positively associated with exercise addiction (Kern, 2010). Differences in sampling may account for the discrepancies in findings on agreeableness given that exercise addiction prevalence varies according to sample characteristics (Dumitru et al., 2018; Lukács et al., 2019; Marques et al., 2019).

Implications for Practice and Future Research

Our findings have implications for professionals working within the healthcare system, policymakers, professionals working at gymnasiums, and researchers. Due to the potential life impairments associated with exercise addiction (Szabo et al., 2015), the development of preventive and treatment interventions is important. Such interventions may be more efficient if consideration is given to the demographic, exercise and sports, mental health, and personality risk and protective factors identified in our study. Particularly, targeted interventions for persons who exercise more than once daily, adolescents and athletes who compete at the medium, top, and international levels may be beneficial since they have elevated prevalences of exercise addiction risk.

One research implication of our findings is the inconclusiveness on gender differences. Future research is needed to elucidate this topic, as knowledge about possible gender differences is important to fully understand the nature of exercise addiction. Moreover, we found a higher prevalence of exercise addiction among the Norwegian male population compared to a previous study (Trana, 2013). Future research should prioritize longitudinal studies of both genders to identify potential gender differences in exercise addiction. Additionally, further research examining associations between social media use and health and fitness habits, particularly exercise addiction may be beneficial. Moreover, given our finding of a high prevalence of exercise addiction risk among adolescents and evidence that

addictions often manifest in adolescence (Griffiths, 1997; Ross & Ivis, 1999), future research on exercise addiction among adolescents is important. A youth version of the EAI (Lichtenstein, Griffiths, et al., 2018) may be useful for this purpose. Finally, future research focusing on the risky groups identified in our study (e.g., persons who exercise 5 days a week or more, adolescents, and high-performance athletes) may contribute to the understanding of exercise addiction.

Strengths and Limitations

The present study has several strengths. To our knowledge, this is the first population-wide investigation on the prevalence and correlates of exercise addiction in Norway. Particularly, to our knowledge, this is the first study worldwide to report on the prevalence of exercise addiction among general population women (Dumitru et al., 2018; Lukács et al., 2019; Marques et al., 2019). Most previous studies have been based on small and/or non-representative samples such as high school and university students, and sports-specific samples (Dumitru et al., 2018; Lukács et al., 2019; Marques et al., 201). The present study enhances previous research given its broad and large sample size, high statistical power, and the inclusion of various important variables based on previous research on exercise addiction. Furthermore, all scales used in the present study were previously well-validated and showed high internal consistency except for intellect/imagination ($\alpha = 0.67$) which is considered problematic in content and replicability (Matthews et al., 2009; McAdams, 1992).

Nevertheless, our study also has some limitations that need to be noted when interpreting our results. First, there is no guarantee that all the participants are based in Norway, despite the questionnaire being in Norwegian and published on the website of an online Norwegian newspaper. Secondly, our data collection is based on a web-based convenience sample. Additionally, we relied on self-reports which are vulnerable to factors such as social desirability. There is also a possibility that individuals who engage in

competitive sports underreport on self-report questionnaires, as indicated by previous studies showing that athletes responding to eating disorder questionnaires underreport due to possible stigmatization (Fairburn & Beglin, 1994; Sundgot-Borgen & Torsveit., 2004).

Also, the EAI is based on self-reports rather than a clinical diagnosis (Griffiths et al., 2005). Similarly, the criteria for exercise addiction have been shown to be diverse (Griffiths et al., 2005; Hausenblas & Symons Downs, 2002b; Ogden et al, 1997) and even though EAI has proven to be a valid and reliable tool (Griffiths et al., 2005), it might not capture all aspects of exercise addiction. Moreover, the present study is correlational and can therefore not be used to draw conclusions about causality. Furthermore, some trivial associations may have been found to be significant due to the very large sample size and high statistical power.

Conclusion

The estimated prevalence of exercise addiction in the general population of Norway is 0.8% with no significant sex-differences in exercise addiction prevalence. Our findings highlight the demographic, exercise and sports, mental health, and personality risk and protective factors of exercise addiction in the Norwegian general population. These findings broaden current understanding of the phenomenon of exercise addiction and have implications for practice. Our findings also suggest the need for further population-based studies as well as longitudinal, experimental and registry-based studies to highlight the phenomenon of exercise addiction in the general population and specific subpopulations such as adolescents, and high-performance and recreational athletes.

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