Current Psychology
https://doi.org/10.1007/s12144-022-02892-8

Psychological impact of COVID-19 restrictions among individuals at risk of exercise addiction and their socio-demographic correlates: A Saudi Arabian survey study

Nabeel Kashan Syed[1,2] · Saad S. Alqahtani[1,2] · Abdulkarim M. Meraya[1,2] · Mohamed Hassan Elnaem[3] · Ahmed A. Albarraq[1,2] · Mamoon H. Syed[1,2] · Rayan A. Ahmed[4] · Mark D. Griffiths[5]

Accepted: 9 February 2022

Abstract
Exercise addiction (EA) has been described as a condition of psychological dysfunction characterized by excessive and obsessive exercise patterns, show withdrawal symptoms when unable to exercise, and experience numerous conflicts and other negative consequences in their social and professional lives, due to the extremely high volumes of exercise. The main objective of the present study was to assess the risk of exercise addiction among a Saudi Arabian sample of regular exercisers and to investigate possible associations between their inability to exercise during the COVID-19 pandemic lockdown (due to the closure of public gyms, swimming pools, and health clubs) and depression, anxiety, and loneliness. A total of 388 regular-exercising Saudis participated in an online cross-sectional survey over three months (December to February 2021). The study sample comprised 89.9% (males) and 10.1% (females), with a mean age of 28.59 years (SD ± 6.69). A 36-item online self-report survey was used for data collection. The prevalence of being at risk of exercise addiction among participants of the present study was 13.1%. Positive significant associations were noted between risk of exercise addiction and depression ($r = .41$; $p < .01$), risk of exercise addiction and anxiety ($r = .20$; $p < .01$), and risk of exercise addiction and loneliness ($r = .17$; $p < .01$). The findings of the present study suggest that those individuals at risk of exercise addiction might also be at an elevated risk of developing negative psychological impact owing to the disruption of the amount of exercise engaged in due to COVID-19 pandemic-related restrictions and therefore these high-risk individuals should receive appropriate psychological support to help them overcome the negative impact of the ongoing pandemic.

Keywords COVID-19 pandemic · Lockdown · Exercise addiction · Depression · Anxiety · Saudi Arabia

Introduction

Exercise is defined as physical activity that which is structured, planned, and repetitive with an objective of improving or maintaining physical fitness (Alkhateeb et al., 2019; Caspersen et al., 1985). Exercise positively impacts individuals' physical health and psychological well-being (Bouchard et al., 1994). Exercise carried out in moderation is highly beneficial. However, it can also be extremely harmful and have destructive effects if done without limits (Yates, 1991; Szabo, 1995, 1998, 2000). In extreme cases, it may also lead to addiction (Griffiths, 1997). Exercise addiction is not commonly prevalent (Veale, 1987 & 1995; Szabo, 2000) but when it does, it has wide-ranging detrimental consequences for those affected. Many scholars have asserted exercise addiction to be

a condition of psychological dysfunction, characterized by the inability of the individuals to control their exercising behaviors (e.g., Griffiths, 1997; Szabo, 2010). Such individuals engage in exercise compulsively, show withdrawal symptoms when unable to exercise, and due to the extremely high volumes of exercise, they experience numerous conflicts and other negative consequences in their social and professional lives (Szabo et al., 2015; Szabo et al., 2016). This definition can further be described by the six criteria in the addiction components model (comprising salience, mood modification, tolerance, withdrawal, conflict, and relapse) which have been asserted to be present in all types of addiction (substance or behavior-based) (Griffiths, 2005). The addiction components model has also been shown to have a justifiable application to exercise addiction (Griffiths, 1996, 1997, 2005). Consequently, exercise addiction describes individuals involved in detrimental levels of physical activity (Szabo et al., 2013; Terry et al., 2004) and those who are engaged in it to an extent of developing dependence (Griffiths, 1996, 1997; Terry et al., 2004), losing control (Scharmer et al., 2020), and results inproblematic behavior (Gori et al., 2021).

Although exercise addiction has gained increasing research attention, there is no formal recognition in any psychiatric diagnostic texts. This has partly been due to the absence of any specific agreed-upon diagnostic criteria and a definitive mechanism that convincingly explains the onset of the development of exercise addiction. Ashton et al. (2020) and Mandolesi et al. (2018) have highlighted many health–related benefits of regular exercise (Alcaraz-Ibáñez et al., 2021). Literature reviews on exercise and individuals' psychological well-being have also concluded that regular exercise has wide-ranging beneficial effects including the positive outcomes for health promotion, treatment of many diseases, and decreasing mental health outcomes (Chekroud et al., 2018) including anxiety (Ströhle et al., 2009) and depression (Helmich et al., 2010). Regular exercise has also shown to have an inverse relationship with anxiety and depression (e.g., Sonza et al., 2021; Szabo et al., 2016). However, the negative impact of excessive exercise has been reported in the literature for over 50 years. Baekeland (1970) first noted exercise addiction while examining the effects of lack of exercise on sleeping patterns. Glasser (1976) described extreme exercise as a 'positive addiction'. Sachs and Pargman (1979, 1981, 1984) further detailed the concept and introduced the term 'running addiction'. They also described many characteristic withdrawal symptoms, including anxiety, irritation, and restlessness. Adams (2009) noted that exercise addiction had the potential to negatively impact the individual's physical as well as psychological well-being. Hausenblas and Symons-Downs (2002) described exercise addiction as a behavioral disorder having both physiological symptoms (e.g., tolerance, and withdrawal) and psychological symptoms (e.g., anxiety, and depression). Exercise addiction has also been referred to as the "dark face" of exercise and has been shown to negatively impact human health (Tekkursun Demir & Turkeli, 2019). A study conducted by Lichtenstein et al. (2018) further reported a relationship between exercise addiction, anxiety, and depression, as well as unusual eating attitudes. Ashton et al. (2020) and Mandolesi et al. (2018) reported that the possible benefits of exercise might be compromised if it becomes addictive. Body image (i.e., an individual’s perceptions, beliefs and attitudes about their own body) might also be an important motivator for exercise

(Brudzynski & Ebben, 2010). Individuals reporting exceptionally high concerns about their weight and physical appearance are most likely to have exercise addiction (Gori et al., 2021).

The prevalence of exercise addiction is higher among participants with higher weekly exercise volumes. Trott et al. (2020), conducted a systematic review and meta-analysis of 13 studies with a combined sample size of 3635, and noted the prevalence of exercise addiction to be 8.1% among general exercisers, 5.0% among amateur competitive athletes, and 5.5% among university students). However, in the only study using a nationally representative sample, Mónok et al. (2012) reported the risk of exercise addiction to be 0.3%-0.5% among the general population in Hungary.

Over the past decade, the most utilized instrument to assess the risk of exercise addiction has been the Exercise Addiction Inventory (EAI; Griffiths et al., 2005; Terry et al., 2004). Griffiths et al.'s (2005) study of the EAI's psychometric properties found it to have very good concurrent validity when compared with the Obligatory Exercise Questionnaire (OEQ) (r=.80) and the Exercise Dependence Scale (EDS) (r=.81). The probable reasons for selecting EAI over other instruments is that it is based on behavioral addiction theory rather than it being based on the criteria for substance dependence such as the EDS. The EAI is a short (six-item instrument) relatively easy to understand, administer, and interpret. It also yields similar results as the other longer instruments previously used. Owing to its ease of use and rating, the EAI can also be used by individuals not trained in psychometric assessment (Terry et al., 2004). Therefore, the EAI is a practical, valid and highly reliable instrument that can screen for the risk of exercise addiction. The slightly revised version (EAI-R) with a six-point Likert scale as compared to the five-point Likert scale of the EAI demonstrated improved psychometric properties. Furthermore, the concurrent validity of EAI-R and EDS-R was found to be very good (r=.87) (Szabo et al., 2019). Due to these aforementioned advantages, the EAI-R was preferred as the key screening instrument for the present study. The total scores of EAI-R range from 6 to 36, where higher scores indicate a greater risk of exercise addiction. Szabo et al (2019), used a cut-off score ≥29 (80% of total score 36 = 28.8 (therefore, approximately equal to 29; the nearest integer) for assessing individuals at risk of exercise addiction. The same cut-off score (≥29) as Szabo et al. (2019) was also used in the present study.

The COVID-19 pandemic

At the time of writing (end of January 2022), over 350 million individuals worldwide had been diagnosed with the coronavirus disease-2019 (COVID-19), and over 5.61 million individuals had died from it (Worldometer, 2022a). In Saudi Arabia there have been over 652,000 diagnosed cases and over 8900 deaths (Worldometer, 2022b). The COVID-19 pandemic has negatively affected individuals of all ages and across cultures and has caused psychological distress (Alnohair et al., 2021; Syed & Griffiths, 2020). Additionally, as strict spatial distancing measures have resulted in a decrease in social contact, it has also been speculated that

this results in increased loneliness as well, which could, in turn, result in mood disorders and self-harm, along with an exacerbation of any pre-existing mental health problems (Holmes et al., 2020).

A meta-analysis of 12 studies conducted by Bueno-Notivol et al. (2021) examining the prevalence of depression during the ongoing pandemic reported country-wide prevalence rates of depression to be in the range of 14.7%-48.3% in China (Lei et al., 2020; Gao et al., 2020), 38.9% in India (Kazmi et al., 2020), 32.7% in Italy (Mazza et al., 2020), 25.4% in Denmark (Sonderskov et al., 2020), 22.1% in the UK (Shevlin et al., 2020), and 7.4% in Vietnam (Nguyen et al., 2020). Compared with a 2017 globally estimated prevalence of depression of 3.44%, the pooled prevalence of 25% reported by Bueno-Notivol et al. (2021) during the COVID-19 pandemic appears to be nearly seven times higher, therefore highlighting a heightened psychological impact of the ongoing pandemic amongst the general public. Increased levels of loneliness were reported during the initial phase of the COVID-19 pandemic (Groarke et al., 2020; Killgore et al., 2020). Another study, examining the different predictors of loneliness prior to, as well as during the ongoing pandemic, also reported the prevalence of similarly high levels of loneliness during the pandemic (Bu, Steptoe & Fancourt, 2020). Another pandemic-related study reported social isolation coupled with feelings of loneliness to be associated with elevated levels of anxiety and depression (Holmes et al., 2020), and in some extreme cases, resulting in suicidal ideation, suicide attempts, and actual suicide (Calati et al., 2020; Dsouza et al., 2020). Steptoe et al. (2013) noted social isolation to negatively impact the overall amount of physical activity (Steptoe et al., 2013). The closing of gymnasiums, fitness centers, health clubs, and swimming pools, coupled with stringent restrictions on outdoor activities, including exercise during the initial phases of the pandemic not only reduced social contact but also greatly reduced individuals' physical activity and this potentially had a negative impact on the behavioral and psychological well-being of the population (Lim, 2021).The outdoor pandemic-related restrictions resulted in the disruption of the amount of exercise, regular exercisers were involved in, thus putting them at an elevated risk of developing negative psychological impact.

It was hypothesized that the prevalence of depression, anxiety and loneliness would be higher in the participants at risk of exercise addiction as compared to those not at risk of exercise addiction. Due to spatial distancing and strict restrictions on outdoor movement, many individuals have reported difficulties in maintaining physically active and healthy lifestyles (Lim, 2021). Saudi Arabia was one of the first countries to implement unprecedented and timely preventive measures such as mandatory use of face masks, strict spatial distancing measures, and movement restrictions to curb the spread of COVID-19 (Algaissi et al., 2020). By March 12 (2020), all events, gatherings (social and governmental) were either canceled or postponed. Consequently, all air travel (international and domestic), sports events, and working in shared spaces (with exceptions of essential work such as security and health care) were also suspended (Algaissi et al., 2020). Subsequently, the Saudi Ministry of Sports announced the suspension of all sports activities as well as competitions, along with the closing down of all stadiums, sports centers, swimming pools, and gymnasiums

(Yezli & Khan, 2020). With an increased prevalence of psychological distress worldwide due to the ongoing pandemic and the fact that no prior research into exercise addiction has been conducted in Saudi Arabia, the present study assessed the prevalence of being at risk of exercise addiction in a sample of regular exercisers and investigated possible associations between the inability to exercise due to COVID-19 related restrictions and depression, anxiety, and loneliness.

Methods

Study design and study sample

Data were collected using an anonymous, online cross-sectional survey. *Google Forms* was used for preparing and hosting the self-report survey. The invitation link for participating in the survey was circulated on different social media platforms (*Instagram, WhatsApp, Facebook, Twitter*) on various fitness-related groups across different regions of Saudi Arabia. Sharing of the invitation link among the participants' personal and professional contacts was highly encouraged. Frequent reminders were also sent to persuade the participants to complete the survey. The study participants were recruited on social media as well as by snowball convenience sampling. Data collection was carried out from December 18 (2020) to February 18 (2021). The survey was completed by Saudi male and female regular exercisers engaged in different forms of exercise (walking, running/jogging, cycling, cardio/aerobics, swimming, and weight training). The final sample comprised 388 participants, mostly males (n=349; 89.9%) and a few females (n=39; 10.1%). Participants' age ranged from 20 to 46 years, with a mean age of 28.59 years (SD ± 6.69).

Inclusion and exclusion criteria

The participants for being included in the study had to (i) be Saudi males or females who were at least 18 years of age, (ii) should participate in exercise for at least 30 minutes per day and at least three days per week (i.e., exercising for a minimum of 90 minutes/week) (Szabo et al., 2019), prior to and during the COVID-19 pandemic, (iii) have a proper understanding of Arabic (and/or) English languages (Syed et al., 2020), (iv) be willing to participate in the study, and (v) be willing to provide informed consent. Individuals not fulfilling the inclusion criteria were excluded from the study.

Data collection tools

A self-administered 36-item questionnaire was used as a tool for data collection(see Supplementary Material 1 and 2). The survey comprised five sections. Section 1 comprised 16 questions regarding participants' socio-demographics. Section 2 comprised the six-item Exercise Addiction Inventory-Revised (EAI-R; Szabo et al., 2019). Section 3 comprised the nine-item Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001). Section 4 comprised the two-item Generalized Anxiety Disorder Scale (GAD-2;

Kroenke et al., 2007). Section 5 comprised the three-item University of California, Los Angeles (UCLA) Loneliness Scale (Hughes et al., 2004).

Measures

Socio-demographic information

Participants were asked to report their gender, nationality, region of current residence, marital status, living status, age group, exact age, family income, exercise frequency (sessions per week), duration of workout (minutes per day), exercise type (before and during the ongoing pandemic), and how important they considered their body image (rated on a single question with three responses: 'not that important', 'important' or 'very important').

Exercise Addiction Inventory-Revised (EAI-R)

The six-item EAI-R was used for assessing the risk of exercise addiction. An item example includes, "*Overtime, I have increased the amount of exercise I do in a day",* the items of which are scored on a six-point scale, from 1 (*strongly disagree)* to 6 (*strongly agree).* The total scores ranged from 6 to 36. Higher scores indicate a greater risk of exercise addiction. A cut-off score ≥29 was used for assessing individuals at risk of exercise addiction (Szabo et al., 2019). Internal consistency of EAI-R in the present study was very good (α =.93). Split half correlation and the Spearman-Brown coefficient of the EAI-R was .97. A principal components analysis based on Eigen values (4.38) and scree-plot confirmed that all the six items of EAI-R corresponded to a single component explaining 72.92% of the variance. All the items had strong factor loadings (>.7).

Patient Health Questionnaire (PHQ-9)

The nine-item PHQ-9 was used for assessing depression over the previous two-week period. An example item is *"Little interest or pleasure in doing thing",* the items of which are scored on a four-point scale, from 0 (*not at all*) to 3 (*nearly every day*). The total scores ranged from 0 to 27. A cut-off score of ≥10 was used to diagnose depression (Kroenke et al., 2001). Internal consistency of PHQ-9 in the present study was excellent (α =.96). Guttman Split half coefficient of the PHQ-9 was .94 and the Spearman-Brown coefficient was .96. A principal components analysis based on Eigen values (7.14) and scree-plot confirmed that all the nine items of PHQ-9 corresponded to a single component explaining 79.32% of the variance. All the items of PHQ-9 showed strong factor loadings (>.7).

Generalized Anxiety Disorder-2

The two-item GAD-2 was used to assess generalized anxiety disorder over two weeks. An item example includes, *"Not being able to stop or control worrying",* the items of which are scored on a four-point scale, from 0 (*not at all*) to 3 (*nearly every day*). The total scores ranged from 0 to 6. A cut-off score of ≥3 has shown 83% specificity and 86% sensitivity in diagnosing generalized anxiety disorder (Kroenke et al., 2007). Internal consistency of GAD-2 in the present study was very good (α =.83). The Guttman Split half coefficient was .83 and the Spearman-Brown coefficient was .83. A principal components analysis based on Eigen values (1.70) and scree-plot confirmed that both the items of GAD-2 corresponded to a single component explaining 85.18% of the variance. Both of the GAD-2 items had strong factor loadings (>.9).

Three-item UCLA Loneliness Scale

The three-item UCLA Loneliness Scale was used to assess loneliness in the current sample. An item example includes, *"How often do you feel left out?",* the items of which are scored on a three-point scale from 1 (*hardly ever*) to 3 (*often*). The total scores ranged from 3 to 9. A higher score indicates greater loneliness. Previous research has used a cut-off score >6 for loneliness (Hughes et al., 2004). Internal consistency of the UCLA Loneliness Scale in the present study was satisfactory (α =.77). The Guttman Split half coefficient was .72 and the Spearman-Brown coefficient was .79. A principal components analysis based on Eigen values (2.08) and scree-plot confirmed that all the three items of scale corresponded to a single component and explained 69.24% of the variance. All three UCLA Loneliness Scale items had strong factor loadings (>.7).

Survey instrument validation, translation, and pilot study

All the scales were translated into Arabic using forward-backward translation method (Beaton et al., 2000). An independent professional bilingual translator with expert proficiency in both English and Arabic languages was utilized to translate the original English version of the five sections, 36-item survey (demographics, EAI-R, PHQ-9, GAD-2, and the three-item UCLA loneliness scale) into Arabic, which was then reviewed by a study author with bilingual language proficiency. Any discrepancies, if present, were then discussed with the independent translator. Following the resolution of any discrepancies, the final version was then prepared and subsequently approved by them. The approved version of the Arabic questionnaire was then back translated into English by a different bilingual expert, having no prior knowledge of the original English versions of the questionnaire. Finally, the forward and the backward translated versions were then reviewed by all the bilingual study authors. The survey was piloted in a focus group of 38 participants for assessing the instrument's ease of use and completion time (Hertzog, 2008, Hill, 1998; Isaac & Michael, 1995; Roscoe, 1975; Syed et al., 2020; Treece & Treece, 1982). The participants in the pilot study easily understood the questions with an average completion time of approximately eight minutes. The sample of the pilot study was also used to test the validity and reliability of the scale and was subsequently excluded from the final analysis. A separate sample comprising 388 participants was then used for

hypotheses testing. The internal consistency (Cronbach's alpha), split half correlation (Guttman split half coefficient), the Spearman-Brown coefficient, and EFA of the Arabic version of the instruments used in the pilot study are reported above in the measures section.

Data collection

Data were collected using an anonymous online survey. Informed consent was acquired by requesting the participants to select 'Yes' for a compulsory question seeking their consent. Providing informed consent was imperative for the participants to proceed to other sections of the survey. A 'No' answer automatically ended the survey, and the corresponding response was considered a dropout. The respondents' inability to complete any question (or) any section rendered the response incomplete and was consequently excluded from statistical analysis (Ahsan et al., 2021). A completion time similar to that of the pilot study (eight minutes) was also observed in the main study. A total of 448 began the survey, and 388 participants completed the survey providing a response rate of (388/448) 86.61%.

Sample size calculation

Raosoft sample size calculator was used for calculating the Sample size for the present study. On the basis of an approximate population size of 200,000, margin of error of 5%, confidence interval of 95% as well as power $(1 - \beta)$ of 0.80 along with a distribution response of 50%, a sample size of 384 was calculated (Alnohair et al., 2021; RaoSoft, 2020; Syed et al., 2020). The sample size was cross-checked using Open Epi (Sullivan, Dean & Soe, 2009) with a population size of 1,000,000; having a finite population correction factor, confidence limit of 5%, as well as a design effect of 1, yielding a sample size of 384 (Yakubu et al., 2016).

Data analysis

For data analysis, Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL., USA) (version 23) was used. Participants' socio-demographics were analyzed by descriptive statistics and were expressed as frequencies, total percentages, means, and standard deviations. Cross-tabulations with Pearson's chi-square were used to calculate statistically significant associations between the variables. Fisher's exact test was used for variables having cell sizes of less than five. Pearson's correlation coefficient was calculated to examine significant associations between continuous variables (i.e., scores of different scales). Multivariable binary logistic regression was used for examining any possible associations between participants' socio-demographics with being risk of exercise addiction as the outcome variable (Syed et al., 2020). The alpha level was set at $p<.01$ to determine statistical significance.

Results

As part of the preliminary analysis, normality of the data was confirmed using Shapiro-Wilk along with Kolmogorov-Smirnov tests.

Sample characteristics / Socio-demographics

The socio-demographics of study participants are shown in Table 1. A total of 388 individuals who exercised regularly participated. The percentage of males (n=349; 89.9%) was considerably higher than that of the females (n=39; 10.1%). Participants mean age was 28.59 years (SD ± 6.69). All participants were Saudi nationals (n=388; 100%). The percentage of participants at risk of exercise addiction was found to be 13.1% (n=51; 51/388). More than half of participants were from the central and southern regions of Saudi Arabia (n=241; 62.1%), whereas the northern region contributed the least study participants (n=9; 2.3%). The highest percentage of the sample studied was from the age group of 20-29 years (52.8%), and the lowest percentage was from the 40-49 age group (5.2%). Just over half of participants (51%) were unmarried/single, while the remainder were married (39.7%) or divorced (9.3%). More than half of study participants (67.5%) lived with their family or friends, while the remainder lived alone (32.5%). During the period of study, more than three-quarters of participants (78.9%) earned below 15,000 Saudi Riyals (SAR) per month (approximately $4000[US] per month). For over three-quarters of participants (79.4%), their body shape or physique was either important or very important.

Association between prevalence of being at risk of exercise addiction and participant's socio-demographics

The participants were asked about their exercise schedule prior to and during the ongoing pandemic (when stadiums, gymnasiums, fitness centers, health clubs and swimming pools were closed due to COVID-19 related restrictions). In terms of the exercise frequency before the pandemic, it was noted that 72.5% of participants at risk of exercise addiction exercised for five days or more in comparison with only 2.1% of individuals not at risk of exercise addiction. Almost the entire sample of those not at risk of exercise addiction (97.9%) exercised for only three or four days prior to the pandemic (p<.001). During the pandemic it was noted that 88.2% of the sample at risk of exercise addiction exercised for a maximum of five days as compared to only 8% of the sample not at risk of exercise addiction. A very high proportion of these participants (92%) exercised only for three or four days (p<.001). With regards to the exercise duration prior to the pandemic, it was found that 88.2% of the participants at risk of exercise addiction exercised for a minimum of 90 minutes daily as compared to only 23.2% of the participants not at risk of exercise addiction (p<.001). A high percentage of these participants (76.8%) exercised for a maximum of 60 minutes daily. During the pandemic, the majority of the sample at risk of exercise addiction (82.4%) exercised for 60 minutes daily (the maximum duration of outdoor activity allowed) in comparison to only 0.9% of those not at risk of exercise addiction. Almost all of these participants (94.1%) exercised for only 30 minutes daily. Regarding the type of exercise before the pandemic, it was noted that more than four-fifths of the sample at risk of exercise addiction (84.3%) were involved in cardiovascular exercises and weight training as opposed to only 18.4% of the sample not at risk of exercise addiction, two-thirds of these participants (63.8%) were involved in walking, running, cycling, and cardio (p<.001). In contrast, during the pandemic all the participants not at risk of exercise addiction were only involved in walking

(56.1%), jogging/running (30.3%) and cycling (13.6%) as compared to 70.6% of the participants at risk of exercise addiction who were involved in cardiovascular exercises even during the pandemic (p<.001) (Table 2).

The total weekly exercise volume was calculated by the multiplication of exercise frequency and the duration of exercise sessions. The average weekly volume of exercise before the pandemic was 260.80 minutes per week (SD ± 156.90) (approximately 4.35 hours per week), whereas, during the pandemic, it was 126.77 minutes per week (SD ± 70.65) (approximately 2.11 hours per week). The overall reduction in exercise during the pandemic was 48.5%. Based on the weekly volume of exercise, the study sample was further divided into participants who exercised less than 180 minutes per week and those who exercised more than 180 minutes per week. With regards to the weekly volume of exercise before the pandemic, it was noted that more than half of participants not at risk of exercise addiction (54.3%) exercised less than 180 minutes per week, while all the participants at risk of exercise addiction (100%) exercised more than 180 minutes per week (p<.001). During the pandemic, it was noted that almost all of the participants not at risk of exercise addiction (94.4%) exercised less than 180 minutes per week as compared to a similarly high percentage of the participants at risk of exercise addiction who exercised more than 180 minutes per week (94.1%) even during the pandemic (p<.001) (Table 2).

Table 2 reports the sample characteristics concerning the risk of exercise addiction. The majority of study participants at risk of exercise addiction were males (89.9%), but this finding did not yield any statistically significant association. Also, the risk of exercise addiction and the region of current residence did not have any statistically significant association. The risk of exercise addiction was statistically significantly associated with (i) being divorced or being unmarried/single (p<.001), (ii) being aged 20–29 years (p<.01), (iii) living alone (p<.001), (iv) earning more than 15000 SAR per month (approximately $4000[US] per month) ($p$<.001), (v) exercising more than five days per week (p<.001), (vi) exercising more than 60 minutes per day (p<.001), (vii) exercising more than 180 minutes per week (p<.001), (viii) engaging in cardio and weight training (p<.001), and (ix) considering their body image to be very important (p<.001). Statistically significant associations were also noted between risk of exercise addiction and (i) prevalence of depression (p<.001), (ii) prevalence of generalized anxiety (p<.001), and (iii) prevalence of loneliness (p<.001) (Table 2). Positive significant associations were also noted between risk of exercise addiction and depression (r=.41; p<.01), risk of exercise addiction and generalized anxiety (r=.20; p<.01), and risk of exercise addiction and loneliness (r=.17; p<.01).

Prevalence rates of depression, generalized anxiety and loneliness

Prevalence in the present study was calculated based on the formula presented below.

$$\text{Prevalence} = \frac{\text{Number of people in sample with characteristic}}{\text{Total number of people in sample}}$$

The prevalence rates in the total study sample were found to be 24.2% for depression (94/388), 32.7% for generalized anxiety (127/388), and 31.4% for loneliness (122/388) (Table 3). The prevalence rates among the participants at risk of exercise addiction were found to be 76.5% for depression (39/51), 60.8% for generalized anxiety (31/51), and 70.6% for loneliness (36/51), (Table 3).

Odds of being at risk of exercise addiction

Multivariable binary logistic regression is used when the outcome variable is a binary variable. It calculates the adjusted odds ratio, which provides the odds of how likely (AOR>1) or less likely (AOR<1) a participant is to develop the outcome variable. Because the outcome variable in the present study is also a binary variable (i.e., at risk of exercise addiction/not at risk of exercise addiction), therefore a multivariable binary logistic regression was used for examining any possible associations between participants' socio-demographics and the outcome variable. The results are shown in Table 4. It was found that married individuals were 0.003 times less likely to be at risk of exercise addiction as compared to those who were divorced (AOR:0.003; CI 95%:0.001-0.04; p<.001). Regarding monthly income, those earning 5001-10,000 SAR per month were 0.02 times less likely to be at risk of exercise addiction than those earning in excess of 15000 SAR per month (AOR:0.02; CI 95%:0.002-0.12; p<.001). Participants who considered their body image not to be that important for them were 0.02 times less likely to be at risk of exercise addiction in comparison to those who considered their body image to be very important for them (AOR:0.02; CI 95%:0.002-0.25; p<.01). Participants who were engaged in just walking and cycling were 0.08 less likely to be at risk of being addicted to exercise compared with those who engaged in cardiovascular exercises and weight training (AOR:0.08; CI 95%: 0.009-0.68; p<.05) (Table 4).

Discussion

The present study assessed the prevalence of being at risk of exercise addiction in a Saudi sample of regular exercisers. The study also investigated possible associations between the inability to exercise due to COVID-19 related restrictions and depression, anxiety, and loneliness. The prevalence of being at risk of exercise addiction in the present study, utilizing the EAI-R among 388 regular exercisers was 13.1%. This finding is fairly consistent with Szabo et al (2019), who by utilizing the same instrument (EAI-R) also reported the prevalence of being at risk of exercise addiction to be 11.5%. The findings are also relatively similar to Vega et al (2020), who conducted a similar study while utilizing the EAI among 1079 exercisers from eight Spanish-speaking nations and reported the prevalence of being at risk of exercise addiction of 15.2% during the COVID-19 pandemic. The present study also found that the weekly volume of exercise among participants before the pandemic (260.80 minutes per week) to be similar to that which were reported by Szabo et al. (2019) (i.e., 254.50 minutes per week).

From a cultural perspective, the recent wide-ranging socio-economic changes taking place in Saudi Arabia have led to an array of regulations paving the way for the effective implementation of one of the Kingdom's most popular initiative, i.e., the 'Vision 2030 Plan' (Althumiri et al., 2021). This initiative has empowered young Saudis to take full advantage of the ample opportunities arising from the Kingdom's economic reforms along with easily available state support for launching their own business enterprises in the rapidly evolving fitness industry (Arabnews, 2021). Along with other initiatives, 'Vision 2030' includes the 'Quality of Life Program' which promotes healthy lifestyles in Saudi Arabia. This has allowed the opening of new fitness centers all across the Kingdom, catering to both genders as well as allowing the opening of exclusive female fitness centers (Arab News, 2017). Introduction of physical activity classes in female schools is also one of the Quality of Life Program's new feature (Reuters, 2017). Under this plan, the government has also successfully implemented various quality of life initiatives that which includes programs (as well as resources) supporting and encouraging citizens' participation in exercise along with special emphasis on leading healthy lifestyles (Vision2030, 2021). Almohammadi et al. (2021) also reported young adults to have recently shown an increased interest in fitness-related activities and in bodybuilding. With so much emphasis being laid on lifestyle modifications coupled with easy access to a wide array of gyms and fitness centers, this might not only have contributed to an increase in the number of Saudis visiting gyms, fitness centers and engaging in regular exercise but might have also potentially put them at an increased risk of being addicted to exercise.

With regards to the duration of exercise, it was noted that 88.2% of participants at risk of exercise addiction, exercised for a minimum of 90 minutes/day prior to the pandemic, but during the pandemic 82.4% of participants at risk of exercise addiction could only exercise for 60 minutes/day outside (the maximum duration of outdoor activity allowed). In terms of hours of exercise per week, it was noted in the present study that the participants exercised for an average of 4.35 hours per week prior to the pandemic as compared to 2.11 hours per week during the pandemic (i.e., a 48.51% reduction during the pandemic). These figures are in contrast to de la Vega et al. (2020), who reported 9.22 hours of exercise per week prior to the pandemic and 4.54 hours per week during the pandemic in their sample. However, the overall percentage decrease in exercise as reported by de la Vega et al.'s study (49.24%) is comparatively similar to that in the present study (48.51%). With a reduction of close to 50% in the hours of weekly exercise, it appears that COVID-19 related restrictions might have contributed to the decrease in the amount of time spent exercising among adult Saudi nationals. Some plausible explanations for this could be that during the initial days of the pandemic, a movement permit was made mandatory for non-essential travel. A maximum of one-hour outdoor travelling permission was granted during curfew hours (initially from 3pm to 7am, later from 7pm to 7am). This required booking a one-hour time slot through the mobile application called 'Tawakkalna' (Alanzi, 2021). Many regular exercisers (i) might not have been familiar with the use of this application and/or (ii) may not have been able to get available time-slots due to pre-bookings by other individuals needing them for essential travel such as seeking medical help. Moreover, individuals usually tend to engage in outdoor exercise (e.g., walking, jogging, cycling, running, playing outdoor

games) at times when the temperatures are relatively low (i.e., during morning or evening hours) and with curfew being implemented during such hours, it made venturing out very difficult.

Even though the participants at risk of exercise addiction were able to overcome these restrictions and involve themselves in some kind of physical activity or exercise, the COVID-19-related outdoor movement restrictions resulted in markedly decreasing the number of hours available to exercise outdoors per week and therefore they were unable to match the weekly volumes of exercise they usually were accustomed to prior to the pandemic. It was also found that most of the individuals at risk of exercise addiction in the present sample were engaged in weight training and cardiovascular exercises. Most individuals do not have weight training equipment at home, and cardio exercises are usually done under the supervision of an expert trainer. The closing down of gyms and fitness centers and with no access to such exercising equipment, along with strict restrictions on outdoor activities (Algaissi et al., 2020; Yezli & Khan, 2020), are most likely to have impacted their habitual exercising schedules. The extremely high prevalence rates of moderate/moderately severe depression (76.5%), generalized anxiety (60.8%) and loneliness (72.5%) among those participants at risk of exercise addiction highlights the fact that the unforeseen and the abrupt disruption of the weekly volumes of exercise might potentially have severely and negatively impacted their psychological well-being (although some of this may also be attributed to the pandemic itself). This can further be explained by the fact that a very low proportion of those participants not at risk of exercise addiction showed moderate/moderately severe depression (16.3%), generalized anxiety (28.5%) and loneliness (25.5%), thus confirming our hypothesis. Thaxton (1982), while examining exercise dependence among individuals who were regular runners (i.e., involved in running for a minimum duration of a year and a minimum frequency of five days a week), also made a comparable observation that even slight variations from running schedules may result in increased depression among habitual runners.

The prevalence of depression in the total study sample was 24.2% (as assessed with the PHQ-9; cut-off $\geq$ 10). These figures are within the range of the reported prevalence of depression among the Chinese general population during the ongoing pandemic (16.5%-48.3%; Gao et al., 2020; Wang et al., 2020). Another COVID-19 related study conducted in China (n=205) reported the prevalence of depression as 29.2% (Zhang et al., 2020). Salari et al (2020) conducted a meta-analysis of 14 general population studies during the ongoing pandemic (n=44,531) and reported a pooled prevalence rate of 33.7%. In the same study, Salari et al. (2020) also reported the pooled prevalence of anxiety to be 31.9% from 19 studies (n=63,439). The present study also had a fairly similar finding wherein the prevalence of generalized anxiety in the total study sample was found to be 32.7%. Similarly, the prevalence of loneliness in the total study sample was found to be 31.4%. This finding is relatively comparable with Groarke et al. (2020) who also reported similarly high rates of loneliness in the U.K during COVID-19-related lockdowns (27%). The findings of the present study are also

consistent with the findings of the UCL COVID-19 Social Study which also reported 32.5% of its participants felt lonely sometimes and 18.3% felt lonely often during the ongoing pandemic (Bu, Steptoe & Fancourt, 2020).

Steptoe et al. (2013) also noted that social isolation can negatively impact the overall amount of physical activity. Moreover, social isolation, quarantine (self or enforced), strict spatial distancing measures, and limited social interaction during extended lockdowns have previously been shown to negatively impact individuals' psychological well-being (Dsouza et al., 2020; Syed & Griffiths, 2020). These pandemic-related stressors might have exacerbated the already negative psychological impact being caused by the sudden and drastic decrease in the weekly volumes of exercise among those individuals at risk of exercise addiction (due to pandemic-related outdoor movement restrictions which might potentially have contributed to the negative and severe psychological impact on the participants at risk of exercise addiction). Even though the sample characteristics of participants in the present study may not be completely identical with the aforementioned studies, the findings bear similarity in the psychological impact of the pandemic and also bring to light a new high-risk population (i.e., regular exercisers) and their psychological distress due to COVID-19 related restrictions. Previous studies have concentrated on the psychological impact the ongoing pandemic had on different groups, including migrants (Guadago, 2020), celebrities (Mamun et al., 2020), and individuals with histories of mental health disorders and addiction (Syed & Griffiths, 2020). However, few have considered habitual exercisers to be a high-risk group during the pandemic.

In the present study statistically significant association between the importance of body image and the risk of exercise addiction were also observed. These findings are consistent with Back et al. (2021), who even though did not find physical appearance orientation to be a significant predictor of exercise dependence, but reported physical appearance orientation and obsessive passion to be significantly correlated with exercise dependence. Similar findings were also reported by Landolfi (2013), who concluded that individuals placing too much importance on body appearance indulged in excessive exercise in their quest for achieving or maintaining their perception of the perfect body.

For tackling the unparalleled public health crises arising as a consequence of the ongoing pandemic, the Saudi Ministry of Health (MoH), in collaboration with Saudi Data and Artificial Intelligence Authority (SDAIA), introduced an array of initiatives along with developing numerous mobile applications that include *Tawakkalna, Tabaud, Mawid,* and *Sehha* (Alanzi, 2021) to create awareness among the general public, for obtaining movement permits during curfew, for contact tracing, booking online appointments, as well as providing online consultations (Alanzi, 2021). Along with that, *Da'em*, an online confidential round-the-clock wellness program, has also been introduced to provide psychological support for all healthcare workers in Saudi Arabia (Banjar & Alaqeel, 2020). Usually, in Arab countries, negative perceptions and stigma are frequently associated with mental health illnesses (Elzamzamy & Wadoo, 2020). The reluctance of the general public to acknowledge their mental health issues and seek appropriate professional help are significant barriers in tackling this problem (Wadoo et al., 2020). Owing to the sensitivities (both geographical and cultural)

commonly seen associated with mental illnesses in the Arab countries, there is an immediate need to educate the vulnerable and high-risk groups (including habitual exercisers) to acknowledge that they are at an increased risk of being negatively impacted psychologically owing to the restrictions imposed by the pandemic. This needs to be coupled with encouraging individuals to seek professional help to overcome the psychological impact of the ongoing pandemic, which would then inhibit the risk of exercise addiction developing. Individuals should be encouraged to exercise in moderation as well.

Some of the strengths of the present study include it being conducted across all the regions of Saudi Arabia. Participants from varied demographics across different socio-economic backgrounds were represented. Participants across a wide range of age groups were also included in the study. To the best of the authors' knowledge, the present study is the first to assess the risk of exercise addiction amongst the Saudi population. Similarly, the study is the first in Saudi Arabia to investigate associations between the inability to exercise among regular exercisers (owing to the closure of public exercise facilities during the COVID-19 pandemic-related restrictions) and depression, anxiety, and loneliness.

Some potential limitations of the present study include its short duration and the honesty of the responses. The study also relied on individuals to recall exercise patterns prior to the pandemic, subject to memory recall biases. Another limitation was that the weekly volume of exercise in the present study was categorized similar to Szabo et al (2019) and not according to the World Health Organization's recommendations (WHO, 2020). Further research is warranted to explore the temporal relationship in-between exercise addiction as well as depression. It was not possible to assess the causal relationship due to the cross-sectional study design. Data collection by a web-based survey was the only reasonably safe method, in view of the strict COVID restrictions in place. High EAI-R scores are only a reflection of the possible risk of exercise addiction and therefore, should be interpreted with caution as they do not have diagnostic value. Diagnoses can only be made by clinicians through follow-up interviews. The test-retest reliability of EAI-R could not be confirmed owing to data being collected online using a convenience snowball sampling technique. Additionally, with the invitation link being disseminated on social media, elderly individuals not having internet access, not being active on social media and not having proper knowledge of *Google Forms* might have found it difficult to participate. Moreover, due to convenience sampling, the study was not representative of the larger Saudi population. The snowball convenience sampling technique may also have led to potential selection bias.

Conclusions

The findings of the present study suggest that exercise addiction may be exacerbated by the negative detrimental effects caused by the COVID-19 pandemic. This warrants the need for initiatives to provide psychological support for the vulnerable and high-risk groups (old people, individuals with co-morbidities, immune-suppressed patients, economically weak, migrants, celebrities, individuals with histories of mental illnesses and addiction, as well as habitual exercisers). There is also a pressing need for educational

resilience programs (online, if they cannot be conducted in-person) for the above-mentioned vulnerable and high-risk individuals in facilitating them to overcome the psychological impact of the ongoing pandemic. Individuals at risk of exercise addiction should be counseled regarding the harmful effects of excessive exercise and recommended to exercise in moderation.

Declarations

Funding: No financial support was available for this study.

Conflicts of interest/Competing interests: The authors declare that the research was conducted in the absence of any commercial or financial relationships that might be construed as a potential conflict of interest. The authors also declare that no competing interests.

Availability of data and material (data transparency): Access to study data can be provided by the corresponding authors upon reasonable request.

Code availability (software application or custom code):Not Applicable.

Authors' contributions: N.K.S., S.A.Q., A.K.M., M.H.E., A.A.B., R.A.A., M.H.A., M.D.G., conceptualization, methodology, investigation, formal analysis, writing-original draft preparation; N.K.S., S.A.Q., A.K.M., M.H.E., A.A.B., R.A.A., M.H.A., M.D.G., methodology, investigation, formal analysis, validation; N.K.S., S.A.Q., A.K.M., M.H.E., A.A.B., R.A.A., M.H.A., M.D.G., investigation, formal analysis, N.K.S., S.A.Q., A.K.M., M.H.E., A.A.B., R.A.A., M.H.A., M.D.G., formal analysis, data curation; N.K.S., S.A.Q., A.K.M., M.H.E., A.A.B., R.A.A., M.H.A., M.D.G., investigation, formal analysis; N.K.S., S.A.Q., A.K.M., M.H.E., A.A.B., R.A.A., M.H.A., M.D.G., supervision, project administration, writing-review and editing. All authors have reviewed and agreed to the published version of the manuscript.

Ethical approval: Institutional Research Review and Ethics Committee (IRREC) of Jazan University provided the necessary ethical approval (Approval Number: 1862/1610/1441) before starting the study.

Consent to participate: Informed consent was obtained from all subjects involved in the study.

Consent for publication (include appropriate statements): All the authors have consented submission of the manuscript to this journal and provided their consent for its publication.

References

Adams, J. (2009). Understanding exercise dependence. *Journal of Contemporary Psychotherapy, 39*, 231–240.

Ahsan, W., Syed, N. K., Alsraeya, A. A., Alhazmi, H. A., Najmi, A., Bratty, M. A., Javed, S., Makeen, H. A., Meraya, A. M., Albarraq, A. A., &Alqahtani, S. S. (2021). Post-vaccination survey for monitoring the side effects associated with COVID-19 vaccines among healthcare professionals of Jazan province, Saudi Arabia. *Saudi Medical Journal*, *42*(12), 1341–1352.

Alanzi T. (2021). A review of mobile applications available in the app and Google play stores used during the COVID-19 outbreak. *Journal of Multidisciplinary Healthcare*, *14,* 45–57.

Algaissi, A. A., Alharbi, N. K., Hassanain, M., & Hashem, A. M. (2020). Preparedness and response to COVID-19 in Saudi Arabia: Building on MERS experience. *Journal of Infection and Public Health*, *13*(6), 834–838.

Alkhateeb, S. A., Alkhameesi, N. F., Lamfon, G. N., Khawandanh, S. Z., Kurdi, L. K., Faran, M. Y., Khoja, A. A., Bukhari, L. M., Aljahdali, H. R., Ashour, N. A., Bagasi, H. T., Delli, R. A., Khoja, O. A., & Safdar, O. Y. (2019). Pattern of physical exercise practice among university students in the Kingdom of Saudi Arabia (before beginning and during college): A cross-sectional study. *BMC Public Health*, *19*(1), 1716.

Almohammadi, A. M., Edriss, A. M., & Enani, T. T. (2021). Anabolic-androgenic steroids and dietary supplements among resistance trained individuals in western cities of Saudi Arabia. *BMC Sports Science, Medicine & Rehabilitation*, *13*(1), 117.

Alnohair, S., Syed, N. K., Ahmed, H. G., Sharaf, F., Alshehri, F., Haque, S., & Griffiths, M. D. (2021). COVID-19 pandemic related excessive electronic media exposure and mental health in Saudi Arabia. *European Review for Medical and Pharmacological Sciences*, *25*(22), 6941–6958.

AlTamimi, A. A., Albawardi, N. M., AlMarzooqi, M. A., Aljubairi, M., & Al-Hazzaa, H. M. (2020). Lifestyle behaviors and socio-demographic factors associated with overweight or obesity among Saudi females attending fitness centers. *Diabetes, Metabolic Syndrome and Obesity, 13*, 2613–2622.

Althumiri, N. A., Basyouni, M. H., AlMousa, N., AlJuwaysim, M. F., Almubark, R. A., BinDhim, N. F., Alkhamaali, Z., &Alqahtani, S. A. (2021). Obesity in Saudi Arabia in 2020: Prevalence, distribution, and its current association with various health conditions. *Healthcare*, *9*(3), 311.

Ashton, R. E., Tew, G. A., Aning, J. J., Gilbert, S. E., Lewis, L., & Saxton, J. M. (2020). Effects of short-term, medium-term and long-term resistance exercise training on cardiometabolic health outcomes in adults: Systematic review with meta-analysis. *British Journal of Sports Medicine, 54*, 341–348.

Arab News (2021). Saudi Arabia's fitness buffs flex their entrepreneurial muscles. Retrieved January 23, 2022, from: https://www.arabnews.com/node/1966531/saudi-arabia

Arab News (2017). Saudi Arabia to start granting female gym licenses this month. Retrieved January 23, 2022, from: https://www.arabnews.com/node/1052881/saudi-arabia.

Back, J., Josefsson, T., Ivarsson, A., & Gustafsson, H. (2021). Psychological risk factors for exercise dependence. *International Journal of Sport and Exercise Psychology*, *19,* 461-472.

Baekeland, F. (1970). Exercise deprivation: sleep and psychological reactions. *Archives of General Psychiatry*, *22*(4), 365–369.

Banjar, W.M., & Alaqeel, M.K. (2020). Healthcare worker's mental health dilemma during COVID-19 pandemic: a reflection on the KSA experience. *Journal of Taibah University Medical Sciences, 15,* 255-7.

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*, *25*(24), 3186-3191.

Bouchard, C. E., Shephard, R. J., & Stephens, T. E. (1994). Physical activity fitness and health: the model and key concepts. In: Bouchard, C., Shephard, R. J., Stephens, T. (Eds.). *Physical activity fitness and health: International proceedings and consensus statement* (pp. 77-88). Champaign, IL: Human Kinetics.

Brudzynski, L.R., & Ebben, W. (2010). Body image as a motivator and barrier to exercise participation. *International Journal of Exercise Science*, *3*, 14–24.

Bu, F., Steptoe, A., & Fancourt, D. (2020). Who is lonely in lockdown? Cross-cohort analyses of predictors of loneliness before and during the COVID-19 pandemic. *Public Health*, *186,* 31–34.

Bueno-Notivol, J., Gracia-García, P., Olaya, B., Lasheras, I., López-Antón, R., & Santabárbara, J. (2021). Prevalence of depression during the COVID-19 outbreak: A meta-analysis of community-based studies. *International Journal of Clinical and Health Psychology, 21*(1), 100196.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports*, *100*(2), 126–131.

Calati, R., Nemeroff, C. B., Lopez-Castroman, J., Cohen, L. J., & Galynker, I. (2020). Candidate biomarkers of suicide crisis syndrome: What to test next? A concept paper. *International Journal of Neuropsychopharmacology*, *23*(3), 192–205.

Chekroud, S. R., Gueorguieva, R., Zheutlin, A. B., Paulus, M., Krumholz, H. M., Krystal, J. H., & Chekroud, A. M. (2018). Association between physical exercise and mental health in 1·2 million individuals in the USA between 2011 and 2015: A cross-sectional study. *The Lancet Psychiatry*, *5*(9), 739–746.

De la Vega, R., Almendros, L. J., Barquín, R. R., Boros, S., Demetrovics, Z., & Szabo, A. (2020). Exercise addiction during the COVID-19 pandemic: An international study confirming the need for considering passion and perfectionism. *International Journal of Mental Health and Addiction*, 1–12. Advance online publication. https://doi.org/10.1007/s11469-020-00433-7

Dsouza, D. D., Quadros, S., Hyderabadwala, Z. J., & Mamun, M. A. (2020). Aggregated COVID-19 suicide incidences in India: Fear of COVID-19 infection is the prominent causative factor. *Psychiatry Research, 290,* 113145.

Elnaem, M. H., Kamarudin, N. H., Syed, N. K., Huri, H. Z., Dehele, I. S., & Cheema, E. (2021). Associations between socio-demographic factors and hypertension management during the COVID-19 pandemic: Preliminary findings from Malaysia. *International Journal of Environmental Research and Public Health*, *18*(17), 9306. https://doi.org/10.3390/ijerph18179306

Gao, J., Zheng, P., Jia, Y. , Chen, H., Mao, Y., Chen, S., Wang,Y., Fu, H., & Dai, J. (2020). Mental health problems and social media exposure during COVID-19 outbreak. *PloS One, 15*, e0231924.

Glasser, W. (1976). *Positive addictions.* Harper and Row, New York.

Gori, A., Topino, E., & Griffiths, M. D. (2021). Protective and risk factors in exercise addiction: A series of moderated mediation analyses. *International Journal of Environmental Research and Public Health*, *18*(18), 9706.

Griffiths, M.D. (1996). Behavioural addiction: An issue for everybody? *Journal of Workplace Learning, 8*(3), 19–25.

Griffiths, M.D. (1997). Exercise addiction: A case study. *Addiction Research*, *5*(2), 161–168.

Griffiths, M.D. (2002). *Gambling and gaming addictions in adolescence.* Leicester. British Psychological Society/Blackwells.

Griffiths, M. D. (2005). A "components"model of addiction within a biopsychosocial framework. *Journal of Substance Use, 10*(4), 191–197.

Griffiths, M.D., Szabo, A., & Terry, A. (2005). The Exercise Addiction Inventory: A quick and easy screening tool for health practitioners. *British Journal of Sports Medicine, 39*, 31–32.

Groarke, J. M., Berry, E., Graham-Wisener, L., McKenna-Plumley, P. E., McGlinchey, E., & Armour, C. (2020). Loneliness in the UK during the COVID-19 pandemic: Cross-sectional results from the COVID-19 Psychological Wellbeing Study. *PloS One*, *15*(9), e0239698.

Hausenblas, H. A., & Downs, D. S. (2002). Exercise dependence: A systematic review. *Psychology of Sport and Exercise*, *3*(2), 89-123.

Helmich, I., Latini, A., Sigwalt, A., Carta, M. G., Machado, S., Velasques, B., Ribeiro, P., & Budde, H. (2010). Neurobiological alterations induced by exercise and their impact on depressive disorders [corrected]. *Clinical Practice and Epidemiology in Mental Health*, *6*, 115–125.

Hertzog, M. A. (2008). Considerations in determining sample size for pilot studies. *Research in Nursing & Health,31*, 180-191.

Hill, R. (1998). What sample size is "enough" in internet survey research? *Interpersonal Computing and Technology*, *6*(3-4). Retrieved Nov 12, 2020, from http://www.emoderators.com/ipct-j/1998/n3-4/hill.html

Holmes, E.A., O'Connor, R.C., Perry, V.H., Tracey, I., Wessely, S., Arseneault, L., Ballard, C., Christensen, H., Silver, R.C., Everall, I. & Ford, T. (2020). Multidisciplinary research priorities for the COVID-19 pandemic: A call for action for mental health science. *The Lancet Psychiatry, 7*(6), 547–60.

Hughes, M. E., Waite, L. J., Hawkley, L. C., & Cacioppo, J. T. (2004). A short scale for measuring loneliness in large surveys: Results from two population-based studies. *Research on Aging, 26*(6), 655–672.

Kazmi, S. S. H., Hasan, K., Talib, S., & Saxena, S. (2020). COVID-19 and Lockdown: A study on the impact on mental health. *SSRN Electronic Journal*, http://dx.doi.org/10.2139/ssrn.3577515

Killgore, W.D.S., Cloonan, S.A., Taylor, E.C., & Dailey, N.S., 2020. Loneliness: A signature mental health concern in the era of COVID-19. *Psychiatry Research,290,* 113117.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16*(9), 606–613.

Kroenke, K., Spitzer, R. L., Williams, J. B., Monahan, P. O., & Löwe, B. (2007). Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Annals of Internal Medicine*, *146*(5), 317–325.

Landolfi, E. (2013). Exercise addiction. *Sports Medicine, 43*(2), 111–119.

Lei, L., Huang, X., Zhang, S., Yang, J., Yang, L., & Xu, M. (2020).Comparison of prevalence and associated factors of anxiety and depression among people affected by versus people unaffected by quarantine during the COVID-19 epidemic in south-western China. *Medical Science Monitor*, *26*, e924609-1

Lichtenstein, M.B., Nielsen, R.O., Gudex, C., Hinze, C.J., & Jørgensen U. (2018). Exercise addiction is associated withemotional distress in injured and non-injured regular exercisers. *Addictive Behavior Reports*, *8,* 33–39.

Lim, M. A. (2021). Exercise addiction and COVID-19-associated restrictions. *Journal of Mental Health, 30,* 135-137.

Mandolesi, L., Polverino, A., Montuori, S., Foti, F., Ferraioli, G., Sorrentino, P., & Sorrentino, G. (2018). Effects of physical exercise on cognitive functioning and well-being: biological and psychological benefits. *Frontiers in Psychology,* 9, 509.

Mamun, M.A., & Griffiths, M.D., (2020). First COVID-19 suicide case in Bangladesh due to fear of COVID-19and xenophobia: possible suicide prevention strategies. *Asian Journal of Psychiatry, 51*, e102073.

Mamun, M. A., Syed, N. K., & Griffiths, M. D. (2020). Indian celebrity suicides before and during the COVID-19 pandemic and their associated risk factors: Evidence from media reports. *Journal of Psychiatric Research*, *131,* 177-179.

Marques, A., Peralta, M., Sarmento, H., Loureiro, V., Gouveia, É. R., & Gaspar de Matos, M. (2019). Prevalence of risk for exercise dependence: A systematic review. *Sports Medicine, 49*(2), 319–330.

Mazza, C., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli,C., & Roma, P. (2020). A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: Immediate psychological responses and associated factors. *International Journal of Environmental Research and Public Health, 17*, e3165.

Mónok, K., Berczik, K., Urbán, R., Szabó, A., Griffiths, M.D., Farkas, J., Magi, A., Eisinger, A., Kurimay, T., Kökönyei, G., Kun, B., Paksi, B., & Demetrovics, Z. (2012). Psychometric properties and concurrent validity of two exercise addiction measures: A population wide study in Hungary. *Psychology of Sport and Exercise, 13*, 739-746.

Nguyen, H. C., Nguyen, M. H., Do, B. N., Tran, C. Q., Nguyen, T.T. P., Pham, K. M., Pham, L. V., Tran, K. V., Duong, T. T., Tran,T. V., Doung, T. H., Nguyen, T. T., Nguyen, Q. H., Huang, T. M.,Nguyen, K. T., Pham, T. T. M., Yang, S., Chao, J. C. J., & Duong,T. V. (2020). People with suspected COVID-19 symptoms were more likely depressed and had lower health-related quality of life: The potential benefit of health literacy. *Journal of Clinical Medicine, 9*, 965.

RaoSoft (2020). Online sample size calculator. Retrieved January 23, 2022, from: http://www.raosoft.com/samplesize.html.

Reuters (2017). Saudi Arabia to introduce physical education for schoolgirls. Retrieved September 9, 2021, from: https://www.reuters.com/article/us-saudi-education-women-idUSKBN19W1DM.

Roscoe, J.T. (1975) *Fundamental research statistics for the behavioral sciences.* New York: Holt, Rinehart and Winston.

Sachs, M. L., & Pargman, D. (1979). Running addiction: A depth interview examination. *Journal of Sport Behavior, 2*(3), 143-155.

Sachs, M.L. (1981). Running addiction. In: Sacks, M. & Sachs, M. (Eds.), *Psychology of running* (pp. 116–126). Champaign, IL: Human Kinetics.

Sachs, M.L. & Pargman D. (1984). Running addiction. In: Sachs M. L., &Buffone G. W. (Eds.).*Running as therapy: An integrated approach* (pp. 231-253). Lincoln, NE: University of Nebraska Press.

Salari, N., Hosseinian-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., Rasoulpoor, S., & Khaledi-Paveh, B. (2020). Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: A systematic review and meta-analysis. *Global Health*, *16,* 57.

Satici, B., Saricali, M., Satici, S.A., & Griffiths, M.D. (2020). Intolerance of uncertainty and mental well-being: serial mediation by rumination and fear of COVID-19. *International Journal of Mental Health and Addiction*. Advance online publication. https://doi.org/10.1007/s11469-020-00305-0.

Saudi Vision 2030 (2021). Quality of life program. Retrieved September 9, 2021, from: https://www.vision2030.gov.sa/en/programs/QoL

Scharmer, C.; Gorrell, S.; Schaumberg, K., & Anderson, D. (2020) Compulsive exercise or exercise dependence? Clarifying conceptualizations of exercise in the context of eating disorder pathology. *Psychology of Sport and Exercise,46*, 101586.

Shevlin, M., McBride, O., Murphy, J., Miller, J.G., Hartman, T.K.,Levita, L., Mason, L., Martinez, A.P., McKay, R., Stocks, T. V.A., Bennett, K.M., Hyland, P., Karatzias, T., & Bentall, R.P. (2020). Anxiety, depression, traumatic stress, and COVID-19 related anxiety in the UK general population during the COVID-19 pandemic. *PsyArXiv.*https://psyarxiv.com/hb6nq?fbclid=IwAR2-oeNKPdDs89ThulzLqAjgxq51dag7bZrwXsJ-34ue3EcdqChJ1hWcBw.

Sønderskov, K.M., Dinesen, P.T., Santini, Z.I., & Østergaard,S. D., (2020). The depressive state of Denmark during the COVID-19 pandemic. *Acta Neuropsychiatrica, 32*(4), 226-228.

Sonza, A., da Cunha de Sá-Caputo, D., Sartorio, A., Tamini, S., Seixas, A., Sanudo, B., Süßenbach, J., Provenza, M. M., Xavier, V. L., Taiar, R., & Bernardo-Filho, M. (2021). COVID-19 lockdown and the behavior change on physical exercise, pain and psychological well-being: An international multicentric study. *International Journal of Environmental Research and Public Health*, *18*(7), 3810.

Ströhle, A., Graetz, B., Scheel, M., Wittmann, A., Feller, C., Heinz, A., & Dimeo, F. (2009). The acute antipanic and anxiolytic activity of aerobic exercise in patients with panic disorder and healthy control subjects. *Journal of Psychiatric Research*, *43*(12), 1013–1017.

Steptoe, A., Shankar, A., Demakakos, P., & Wardle, J. (2013). Social isolation, loneliness, and all-cause mortality in older men and women. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(15), 5797–5801.

Sullivan, K. M., Dean, A., & Soe, M. M (2009). On academics. OpenEpi: A web-based epidemiologic and statistical calculator for public health. *Public Health Reports, 124*, 471–474.

Syed N.K., & Griffiths M.D. (2020). Nationwide suicides due to alcohol withdrawal symptoms during COVID-19 pandemic: A review of cases from media reports. *Journal of Psychiatric Research*, *130*, 289-291.

Syed, N. K., Syed, M. H., Meraya, A. M., Albarraq, A. A., Al-Kasim, M. A., Alqahtani, S., Makeen, H. A., Yasmeen, A., Banji, O., & Elnaem, M. H. (2020). The association of dietary behaviors and practices with overweight and obesity parameters among Saudi university students. *PloS One*, *15*(9), e0238458.

Szabo, A. (1995). The impact of exercise deprivation on well-being of habitual exercisers. *Australian Journal of Science and Medicine in Sport, 27*, 68–75.

Szabo, A., Frenkl, R. & Caputo, A. (1997). Relationships between addiction to running, commitment to running, and deprivation from running: A study on the internet. *European Yearbook of Sport Psychology*, *1*, 130–147.

Szabo, A. (1998). Studying the psychological impact of exercise deprivation: Are experimental studies hopeless? *Journal of Sport Behavior, 21*, 139–147.

Szabo, A. (2000). Physical activity and psychological dysfunction. In: Biddle, S., Fox, K., &Boutcher, S. (Eds.), *Physical activity and psychological well-being* (pp. 130–153). London: Routledge.

Szabo, A. (2010). *Addiction to exercise: A symptom or a disorder?* Hauppauge, NY: Nova Science Publishers.

Szabo, A., de la Vega, R.M., Ruiz-Barquin, R., & Rivera, O. (2013). Exercise addiction in Spanish athletes: Investigation of the roles of gender, social context and level of involvement. *Journal of Behavioral Addictions*, *2,* 249–252.

Szabo, A., Griffiths, M. D., de La Vega Marcos, R., Mervó, B., & Demetrovics, Z. (2015). Methodological and conceptual limitations in exercise addiction research. *The Yale Journal of Biology and Medicine,* 88(3), 303–308.

Szabo, A., Griffiths, M. D., &Demetrovics, Z. (2016). Exercise addiction. In V. Preedy (Ed.), *The neuropathology of drug addictions and substance misuse* (Vol. 3) (pp. 984–992). London: Academic Press.

Szabo, A., Pinto, A., Griffiths, M. D., Kovacsik, R., & Demetrovics, Z. (2019). The psychometric evaluation of the Revised Exercise Addiction Inventory: Improved psychometric properties by changing item response rating. *Journal of Behavioral Addictions, 8*(1), 157-161.

Tekkurşun Demir, G., &Türkeli, A. (2019). Examination of exercise addiction and mental strength levels of students of sport sciences faculty. *Journal of Sport Sciences Researches*, *4*(1), 10-24.

Terry, A., Szabo, A. & Griffiths, M. (2004) The Exercise Addiction Inventory: A new brief screening tool. *Addiction Research and Theory, 12*, 489-499.

Thaxton, L. (1982). Physiological and psychological effects of short-term exercise addiction on habitual runners, *Journal of Sport Psychology*, *4*(1), 73-80.

Treece, E. W., & Treece, J. W. (1982). *Elements of research in nursing* (3rd ed.). St. Louis, MO: Mosby.

Trott, M., Jackson, S.E., Firth, J., Fisher, A., Johnstone, J., Mistry, A., Stubbs, B. & Smith, L., (2020). Exercise addiction prevalence and correlates in the absence of eating disorder symptomology: A systematic review and meta-analysis. *Journal of Addiction Medicine*, *14*(6), e321-e329.

Veale, D. (1987). Exercise dependence. *British Journal of Addiction, 82,* 735–740.

Veale, D. (1995). Does primary exercise dependence really exist? In: Annett, J., Cripps, B. & Steinberg, H.(Eds.), *Exercise addiction: Motivation for participation in sport and exercise* (pp. 1–5). Leicester: British Psychological Society.

WHO (2020). WHO guidelines on physical activity and sedentary behavior. Retrieved September 9, 2021, from: https://apps.who.int/iris/bitstream/handle/10665/336656/9789240015128-eng.pdf?sequence=1&isAllowed=y

Worldometer (2022a). Coronavirus cases. Retrieved January 15, 2022, from: https://www.worldometers.info/coronavirus/

Worldometer (2022b). Coronavirus cases. Retrieved January 15, 2022, from: https://www.worldometers.info/coronavirus/country/saudi-arabia/

Yakubu, K., Flinkenflögel, M., Okoye, I., Lodenyo, M. M., Popoola, O., & Mohamoud, G. (2016). Perceived competency deficits and challenges of family medicine trainees in sub-Saharan Africa. *Education for Primary Care*, *27*(5), 358–365.

Yates, A. (1991). Compulsive exercise and the eating disorders: Toward an integrated theory of activity. New York: Brunner/Mazel.

Yates, A., Shisslak, C., Cargo, M. & Allender, J. (1994). Over commitment to sport: Is there a relationship to eating disorders? *Clinical Journal of Sport Medicine*, *4,* 39–46.

Yezli, S., & Khan, A. (2020). COVID-19 social distancing in the Kingdom of Saudi Arabia: Bold measures in the face of political, economic, social and religious challenges. *Travel Medicine and Infectious Disease*, *37*, 101692.

Zhang, J., Lu, H., Zeng, H., Zhang, S., Du, Q., Jiang, T., & Du, B. (2020). The differential psychological *dist*ress of populations affected by the COVID-19 pandemic. *Brain, Behavior, and Immunity*, *87*, 49–50.

Table 1. Socio-demographics / sample characteristics (N=388)

Variable	*Options*	*Frequency (n)*	*%*
Gender	Male	349	89.9
	Female	39	10.1
Nationality	Saudi	388	100
Region of current residence	Eastern	50	12.9
	Western	88	22.7
	Central	103	26.5
	Southern	138	35.6
	Northern	9	2.3
Marital status	Unmarried / Single	198	51.0
	Married	154	39.7
	Divorced	36	9.3
Living status	Living with family/friends	262	67.5
	Living alone	126	32.5
Age group (in years)	20-29	205	52.8
	30-39	163	42.0
	40-49	20	5.2
Exact age (in years)	Mean 28.59	**SD** ± 6.69	
Family income (SAR / month) (Saudi Riyals - SAR)	< 5000	45	11.6
	5001 - 10000	200	51.5
	10001 - 15000	61	15.7
	> 15,000	82	21.1
Importance of body image	Not that Important	80	20.6
	Important	183	47.2
	Very Important	125	32.2
	Exercising pattern before the lockdown		
Exercise frequency (sessions/week)	Three	221	57.0
	Four	123	31.7
	Five	9	2.3
	Six	25	6.4
	Seven	10	2.6
Duration of workout (minutes/day)	30	22	5.7
	45	50	12.9
	60	199	51.3
	90	79	20.4
	120	38	9.8

Variable	*Options*	*Frequency (n)*	*%*
Weekly volume of exercise	Mean: 260.80 minutes/week (Approximately 4.35 hours/week)	**SD** ± 156.90	
Weekly volume of exercise(category)	< 180 Minutes/week	183	47.2
	> 180 Minutes/week	205	52.8
Type of exercise	Walking &cycling	98	25.3
	Walking, running &cycling	49	12.6
	Walking, running, cycling &cardio	73	18.8
	Cardio &swimming	19	4.9
	Swimming	44	11.3
	Cardio & weight training	105	27.1
	Exercising pattern during the lockdown		
Exercise frequency(sessions/week)	Three	279	71.9
	Four	37	9.5
	Five	72	18.6
Duration of workout(minutes/day)	30	325	83.8
	45	18	4.6
	60	45	11.6
Weekly volume of exercise	Mean: 126.77 minutes/week (Approximately 2.11 hours/week)	**SD** ± 70.65	
Weekly volume of exercise(category)	< 180 minutes/week	321	82.7
	> 180 minutes/week	67	17.3
Type of exercise	Walking	197	50.8
	Running	107	27.6
	Cycling	48	12.4
	Cardio	36	9.3

589 **Table 2. Cross-tabulation of prevalence of risk of exercise addiction with sample characteristics**
590

Variables	*Not at risk of Exercise Addiction 'n (%)'*	*At risk of Exercise Addiction ' n (%)'*	*Total n (%)*	*(Chi square) χ^2*	*p-value*
Gender					
Male	302 (89.6%)	47 (92.2%)	349 (89.9%)	.32	*.57*
Female	35 (10.4%)	4 (7.8%)	39 (10.1%)		
Region of current residence					
Eastern	44 (13.1%)	6 (11.8%)	50 (12.9%)		
Western	78 (23.1%)	10 (19.6%)	88 (22.7%)	9.10	*.50* (Fisher Exact)
Central	83 (24.6%)	20 (39.2%)	103 (26.5%)		
Southern	126 (37.4%)	12 (23.5%)	138 (35.6%)		
Northern	6 (1.8%)	3 (5.9%)	9 (2.3%)		
Marital status					
Unmarried	174 (51.6%)	22 (43.1%)	196 (50.5%)	64.98	$p<.001$ (Fisher Exact)
Married	153 (45.4%)	2 (3.9%)	155 (39.9%)		
Divorced	10 (3.0%)	27 (52.9%)	37 (9.5%)		
Living status					
Living with family or friends	250 (74.2%)	12 (23.5%)	262 (67.5%)	51.83	$p<.001$
Living alone	87 (25.8%)	39 (76.5%)	126 (32.5%)		
Age group (in years)					
20-29	168 (49.9%)	37 (72.5%)	205 (52.8%)	8.88	.009 ($p<.01$) (Fisher Exact)
30-39	150 (44.5%)	13 (25.5%)	163 (42.0%)		
40-49	19 (5.6%)	1 (2.0%)	20 (5.2%)		
Monthly income (in SAR)					
< 5000	73 (21.7%)	1 (2.0%)	74 (19.1%)		
5,001-10,000	206 (61.1%)	4 (7.8%)	210 (54.1%)	125.79	$p<.001$ (Fisher Exact)
10,001-15,000	38 (11.3%)	23 (45.1%)	61 (15.7%)		
> 15,000	20 (5.9%)	23 (45.1%)	43 (11.1%)		
Before the pandemic					
Exercise frequency (days/week)					
3	221 (65.6%)	0 (0.0%)	221 (57.0%)		
4	109 (32.3%)	14 (27.5%)	123 (31.7%)		
5	4 (1.2%)	5 (9.8%)	9 (2.3%)	117.18	$p<.001$ (Fisher Exact)
6	2 (0.6%)	23 (45.1%)	25 (6.4%)		
7	1 (0.3%)	9 (17.6%)	10 (2.6%)		

Variables	*Not at risk of Exercise Addiction 'n (%)'*	*At risk of Exercise Addiction 'n (%)'*	*Total n (%)*	*(Chi square) χ^2*	*p-value*
Exercise duration (minutes/day)					

30	19 (5.6%)	0 (0.0%)	19 (4.9%)		
45	42 (12.5%)	0 (0.0%)	42 (10.8%)		
60	198 (58.8%)	6 (11.8%)	204 (52.6%)		
90	64 (19.0%)	22 (43.1%)	86 (22.2%)	94.81	$p<.001$ (Fisher Exact)
120	14 (4.2%)	23 (45.1%)	37 (9.5%)		
Exercise type					
Walking & cycling	96 (28.5%)	2 (3.9%)	98 (25.3%)		
Walking, running & cycling	47 (13.9%)	2 (3.9%)	49 (12.6%)		
Walking, running, cycling &cardio	72 (21.4%)	1 (2.0%)	73 (18.8%)	85.26	$p<.001$ (Fisher Exact)
Cardio &swimming	17 (5.0%)	2 (3.9%)	19 (4.9%)		
Swimming	43 (12.8%)	1 (2.0%)	44 (11.3%)		
Cardio & weight training	62 (18.4%)	43 (84.3%)	105 (27.1%)		
Importance of Body Image					
Not that important	78 (23.1%)	2 (3.9%)	80 (20.6%)		
Important	180 (53.4%)	3 (5.9%)	183 (47.2%)	90.43	$p<.001$ (Fisher Exact)
Very important	79 (23.4%)	46 (90.2%)	125 (32.2%)		
Weekly volume of exercise					
< 180 minutes/week	183 (54.3%)	0 (0.0%)	183 (47.2%)		$p<.001$ (Fisher Exact)
> 180 minutes/week	154 (45.7%)	51 (100.0%)	205 (52.8%)	52.42	
During the ongoing pandemic					
Exercise frequency (days/week)					
3	274 (81.3%)	5 (9.8%)	279 (71.9%)		
4	36 (10.7%)	1 (2.0%)	37 (9.5%)	144.95	$p<.001$ (Fisher Exact)
5	27 (8.0%)	45 (88.2%)	72 (18.6%)		
Exercise duration (minutes/day)					
30	317 (94.1%)	8 (15.7%)	325 (83.8%)		
45	17 (5.0%)	1 (2.0%)	18 (4.6%)	194.41	$p<.001$ (Fisher Exact)
60	3 (0.9%)	42 (82.4%)	45 (11.6%)		
Exercise type					
Walking	189 (56.1%)	8 (15.7%)	197 (50.8%)		
Jogging/running	102 (30.3%)	5 (9.8%)	107 (27.6%)	171.82	$p<.001$ (Fisher Exact)
Cycling	46 (13.6%)	2 (3.9%)	48 (12.4%)		
Cardio	0 (0.0%)	36 (70.6%)	36 (9.3%)		

Variables	*Not at risk of Exercise Addiction 'n (%)'*	*At risk of Exercise Addiction 'n (%)'*	*Total n (%)*	*(Chi square) χ^2*	*p-value*
Weekly volume of exercise					
<180 minutes/week	318 (94.4%)	3 (5.9%)	321 (82.7%)		

> 180 minutes/week	19 (5.6%)	48 (94.1%)	67 (17.3%)	243.74	$p<.001$
Prevalence of risk of exercise addiction and prevalence of depression (PHQ-9 Scale)					
No/Mild depression	282 (83.7%)	12 (23.5%)	294 (75.8%)	87.30	$p<.001$
Moderate/Moderately Severe Depression	55 (16.3%)	39 (76.5%)	94 (24.2%)		
Prevalence of risk of exercise addiction and prevalence of loneliness (UCLA 3-item Loneliness Scale)					
Not lonely	251 (74.5%)	15 (29.4%)	266 (68.6%)	41.74	$p<.001$
Lonely	86(25.5%)	36 (70.6%)	122 (31.4%)		
Prevalence of risk of exercise addiction and prevalence of generalized anxiety (GAD-2 Scale)					
No anxiety	241 (71.5%)	20 (39.2%)	261 (67.3%)	20.99	$p<.001$
Anxiety	96 (28.5%)	31 (60.8%)	127 (32.7%)		

Table 3. Prevalence rates of risk of exercise addiction, depression, generalized anxiety and loneliness

Option	*Cut-off score*	*Frequency (n)*	*%*
Prevalence of risk of exercise addiction (EAI-R)	≥29	51	13.1
Prevalence of depression (PHQ-9 Scale)	≥10	94	24.2
Prevalence of generalized Anxiety (GAD-2 Scale)	≥3	153	32.7
Prevalence of loneliness (3-item UCLA Loneliness Scale)	> 6	124	31.4

Table 4. Odds of risk of exercise addiction with selected socio-demographics in a Saudi Arabian sample

	Adjusted	*95% C.I.*		*p-value*
Determinant	*Odds ratio (AOR)*	*Lower*	*Upper*	
Marital status				*p*<.001
Unmarried	0.03	0.005	0.27	*p*<.01
Married	0.003	0.001	0.04	*p*<.001
Divorced				***Ref***
Monthly income (Saudi Riyals/month)				*p*<.001
< 5,000	0.17	0.02	1.76	0.14
5,001-10,000	0.02	0.002	0.12	*p*<.001
10,001-15,000	1.45	0.33	6.45	0.62
> 15,000				***Ref***
Importance of body image				*p*<.01
Not that important	0.02	0.002	0.25	*p*<.01
Important	0.15	0.03	0.76	*p*<.05
Very important				***Ref***
Exercise type				*p*<.05
Walking and cycling	0.08	0.009	0.68	*p*<.05
Walking, running and cycling	0.21	0.03	1.32	0.10
Walking, running, cycling and cardio	0.03	0.001	0.82	*p*<.05
Cardio and swimming	1.18	0.10	13.43	0.89
Swimming	0.051	0.001	1.825	0.10
Cardio and weight training				***Ref***

C.I.=Confidence Interval; Variables that were included in the multivariable binary logistic regression model were marital status, monthly income, importance of body image, and type of exercise. Risk of exercise addiction was the outcome variable.