Does self-esteem mediate the relationship between stress and exercise addiction?

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Abstract

Background: The risk of exercise addiction is generally associated with high levels of stress and low self-esteem. Previous studies have revealed a significant association between stress, risk of exercise addiction, and self-esteem. However, the mediating effect of the latter was not examined. Aims: Based on the Interactional Model of Exercise Addiction, we hypothesized that stress might influence the risk of exercise addiction through the mediating role of self-esteem.
Method: This cross-sectional study used a convenience sample of 200 Italian exercisers aged 18 to 69 (M = 35; SD = 4.05; 62% females). Participants completed demographic and exercise habits-related questions, the revised Exercise Addiction Inventory, Stress subscale of DASS-21, and the Rosenberg's Self-Esteem Scale in an online survey.
Results: A positive association was found between stress and the risk of exercise addiction. However, a negative association emerged between stress and self-esteem. Furthermore, self-esteem was also related negatively to the risk of exercise addiction. Notably, self-esteem partially mediated the association between stress and the risk of exercise addiction.
Conclusions: Self-esteem plays a role in the stress and exercise addiction relationship. Overall, the results contribute to a better understanding of the complex set of mechanisms that underlie the effects of stress on exercise addiction.

Keywords: exercise addiction, exercise dependence, Italian, mediation, self-esteem, stress.

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Introduction

Physical activity is a beneficial health practice (World Health Organization, 2020), yielding many advantages across physical, psychological, and social dimensions of health. Nonetheless, in a minority of instances, exercise can be abused, potentially evolving into an unhealthy obsession, and fostering maladaptive behaviors because of salient physical activity. Among the various terms employed to characterize this maladaptive behavior, the prevalent terms used are 'exercise addiction' and 'exercise dependence' (e.g., Hausenblas & Symons Downs, 2002; Soraci et al., 2023), encompassing symptoms akin to substance addiction and other behavioral dependencies (Griffiths, 2005). Researchers assert that exercise addiction manifests as a psychological dysfunction wherein individuals lose control over their behavior during physical activity (e.g., Szabo, 2010). Those affected exhibit compulsive behavior, display withdrawal symptoms when unable to exercise, and encounter conflict and adverse life consequences due to an excessive volume of physical activity (Szabo et al., 2016). Several studies have shown that exercise addiction is associated with various health issues, such as anxiety, depression, stress, low self-esteem, skeletal and muscular problems, and eating disorders (Simon-Grima et al., Soraci et al., 2024; 2019; Wågan et al., 2021).

Based on these reasons, several researchers have studied antecedents and consequences of exercise addictions within the research framework of behavioral addictions (e.g., Szabo, 2010). One of the most common theoretical foundations is the 'components model' that comprises six criteria present in all forms of addictions, along with whether they are substance-based or behavior-based. These criteria include salience, conflict, withdrawal, mood modification, tolerance, and relapse (Griffiths, 2005). The characteristics of these six components concerning exercise behavior can be elucidated as follows: (i) Salience: exercise assumes paramount importance in an individual's life, significantly influencing their thoughts and behaviors. (ii) Mood Modification: exercise serves as a means of mood modification, with individuals using it to induce euphoria or alter their emotional state. (iii) Tolerance: there is a growing need to escalate the duration and frequency of exercise to achieve the initial mood-modifying effects. (iv) Withdrawal Symptoms: the surfacing of unpleasant psychological effects when exercise is stopped or reduced. (v) Conflict: conflicts arise in educational, occupational, social, and intrapsychic domains with other activities and individuals (e.g., family members) due to excessive engagement in exercise. (vi) Relapse: there is a tendency to revert to prior maladaptive exercise patterns after periods of abstinence or control.

The prevalence of exercise addiction has been studied mainly among leisure athletes, such as runners, cyclists, and fitness center-goers. A review of the literature (Di Lodovico et al., 2019) reported that there is a higher rate of risk of exercise addiction among endurance athletes (14.3%) compared to gym- and strength disciplines or ball-sport players (e.g., football) (6.2% to 10.4%), all being higher than the rate in the general population (3.0%). In contrast, in a population-wide study, Mónok et al. (2012) found that the rate of the risk of exercise addiction is about 3.0% in the exercising population. A recent Italian study found a prevalence of around 10-11%

(e.g., Soraci et al., 2023). Indeed, according to Di Lodovico et al. (2019), this rate may vary depending on the type of exercise and the assessment instrument used (Marques et al., 2019).

A noteworthy issue is that all studies in this field only examine the "risk" of exercise addiction that may never manifest in dysfunctionality (Szabo & Demetrovics, 2022). Furthermore, exercise addiction currently cannot be diagnosed based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-5 - American Psychiatric Association, 2013) or other clinical reference criteria. Nevertheless, Juwono and Szabo (2021) have identified 100 cases via internet testimonials and reports, but they posited that there are significantly more cases. All these cases included self-harm and symptoms in the components model. Thus, dysfunctional exercise-related behavior can be established. Still, there are less than a dozen published cases of exercise addiction that were identified as clinically problematic (Szabo & Demetrovics, 2022).

Stress and Exercise Addiction: The Interactional Model of Exercise Addiction

The Interactional Model of Exercise Addiction, (Dinardi et al., 2021; Egorov & Szabo, 2013), presents a comprehensive clinical framework underlying the emergence and perpetuation of exercise addiction. This model posits a sequence of interacting factors influencing the risk of exercise addiction: sudden or progressively intolerable life stress serves as a central trigger, propelling individuals toward excessive exercise as a coping mechanism. This stress manifests in various domains, including performance anxiety, failure to meet expectations, role conflict, and injury. In response to these stressors, individuals adopt coping responses, with increased exercise volume and intensity being a common strategy (Egorov and Szabo, 2013). This heightened physical activity often attempts to regain control, alleviate stress, or harness the mood-enhancing effects of exercise-induced endorphin release. The adoption of such coping responses contributes to an elevated risk of exercise addiction (Egorov and Szabo, 2013). What begins as a coping mechanism may evolve into maladaptive behavior, creating a cyclic pattern where exercise, initially utilized for stress management, becomes a potential source of harm. The model underscores the interactive nature of its components, illustrating how stress, coping responses, and exercise addiction form a dynamic interrelationship. The domains of stress influence coping strategies, and the efficacy of these coping responses, in turn, shapes the risk of exercise addiction (Egorov and Szabo, 2013). The Interactional Model of Exercise Addiction provides a holistic perspective on the intricate connections between stress, coping mechanisms, and exercise behaviour, offering insights into the potential development and persistence of exercise addiction in individuals.

In summary, these sources of stress, rooted in exercise-related challenges, could exacerbate the risk of exercise addiction if physical activity is the primary or sole coping mechanism for the individual concerned, as purported by the interactional model of exercise addiction (Egorov and Szabo, 2013). Numerous research (e.g., Kavyani et al., 2021; Pinto et al., 2019) have shown that stress is associated with an increased risk of exercise addiction, even pointing to it as one of the main predictor variables.

The role of self-esteem

Self-esteem is an individual's positive or negative evaluation of themselves (Rosenberg, 1965; Smith et al., 2014). Self-esteem is an essential aspect as it influences several psychological traits in its way. It is associated with mental and physical well-being and life satisfaction (e.g., Schwager et al., 2019). During times of uncertainty and stress, individuals seek ways to master the situation. This search can manifest either through a shift in focus and an escape from stressful thoughts and feelings or through various coping strategies, representing behavioral responses individuals use to manage or tolerate stress (Galanakis et al., 2016). Some may take control in other areas of life.

It was observed that poor self-esteem, whether it is general or specific, is correlated with more maladaptive response patterns and poorer mental health when people encounter stress or difficulties (Galanakis et al., 2016). Self-esteem becomes particularly significant in influencing how individuals navigate and cope with challenging circumstances. Specifically, individuals with poor self-esteem are often inclined to adopt coping strategies that involve distraction from perceived difficulties and a deliberate avoidance of stressful situations and negative emotions, known as "avoidance-coping" in the literature. These coping mechanisms may manifest in various ways, such as an excessive focus on controlling external factors, status, and performance (high perfectionism), stringent control over food intake, weight, and body composition, using alcohol as a means of regulating emotions, or exerting control over exercise and exercise performance in pursuit of the endorphins and positive emotions associated with physical activity (Jafflin et al., 2019) In contrast, more adaptive and effective coping strategies, which can contribute to reduced emotional distress and positive long-term mental health outcomes, may involve adherence to a healthy diet, engaging in hobbies, or spending time outdoors.

While research has, up to now, associated self-esteem with stress and psychological distress, very few studies have evaluated the mediational role of self-esteem in the stress-exercise addiction relationship. For instance, Lee-Flynn et al. (2011) showed that the strong relationship between stress evaluations and psychological distress is reduced after controlling for self-esteem.

Koronczai and colleagues (2013) evaluated the mediating effect of self-esteem in the relationship between body appearance and psychological distress dimensions such as anxiety and depression in a group of Hungarian participants aged between 14 and 34 years. Results indicated that self-esteem partially mediated the link between body dissatisfaction and anxiety, and fully mediated the link between body dissatisfaction and depression.

In brief, higher self-esteem appears to function as a protective factor (e.g., Gori et al., 2021), and consequently, a higher level of self-esteem could be linked to a lower risk of exercise addiction (Gori et al., 2021; Soraci et al., 2023; Wågan et al., 2022). Therefore, it is reasonable to hypothesize that self-esteem could mediate the relationship between stress and risk of exercise addiction, influencing the nature and effectiveness of coping strategies people use in response to exercise-related challenges, as evidenced by previous studies on behavioral addictions (e.g., Servidio et al., 2018). This issue is also important from a prevention perspective.

In designing optimal prevention strategies on psychological stress and exercise addiction, it is crucial to increase knowledge about mediating processes as they may provide further understanding of key factors that may reduce or prevent addictive behaviours. In this work, we aim to test whether self-esteem mediates the relationship between stress and exercise addiction by explaining the connection between the two.

The present study

In line with the previously outlined research and particularly with the Interactional Model of Exercise Addiction (Dinardi et al., 2021; Egorov & Szabo, 2013), it is reasonable to assume that stress has both direct and indirect effects with the risk of exercise addiction, taking self-esteem into account in the model. To the authors' knowledge, few studies have examined this relationship between these three variables in detail (e.g., Wågan et al., 2021). To bridge this gap and allow future international comparative studies, the present study aims to investigate this relationship in detail, thus expanding the knowledge of the exercise addiction phenomenon in the Italian context. The hypotheses are as follows: H1) Stress has an indirect effect on the risk of exercise addiction, through self-esteem (see Figure 1 for the model); H2) Stress is positively correlated with the risk of exercise addiction; H3) Stress is negatively correlated with self-esteem; and finally, H4) Self-esteem is negatively correlated with the risk of exercise addiction.

Fig. 1. Hypothesized research model.
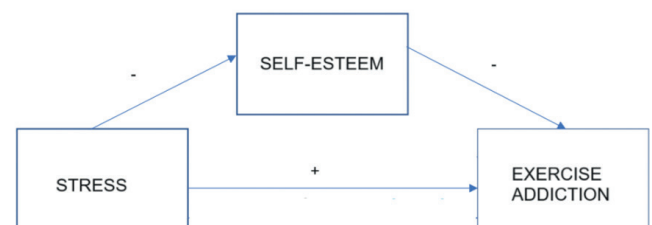
Methods

Ethical approval

The research was conducted according to the Declaration of Helsinki for medical research involving human participants and was approved by University Niccolò Cusano Ethic Committee, Italy. All participants gave their online consent to participate in the study. The identity of the participants was anonymous, and the data were stored in an encrypted online archive, accessible only to the authors of the present study.

Participants and procedure

Participants for the study were enlisted by sharing survey links across various Italian online forums and social media communities, including platforms like Facebook, WhatsApp, and Instagram. The survey was presented as a Google Forms questionnaire. The research team disseminated the link,

extending invitations for individuals to participate voluntarily, anonymously, and without any incentives. Over 30 days during the winter of 2022-2023, 231 volunteer participants clicked on the link. Of these, 200 met the inclusion criteria, which were: (i) at least 18 years old, (ii) being fluent in the Italian language, (iii) exercising regularly (i.e., at least three times a week) and (iv) providing informed consent (31 participants who did not give consent to complete the online questionnaire were excluded). All participants completed the survey anonymously in approximately 10-15 minutes.

Sample size

A power analysis was also conducted using a priori structural equation modeling software to determine the appropriate sample size (Soper, 2022). Based on the power analysis (number of latent variables: 3; number of observed variables: 23; probability level [p]: 0.05; statistical power 0.95; and effect size 0.3), the minimum sample size required was 184 (Soper, 2022).

Measures

The survey encompassed inquiries about socio-demographic details, lifestyle habits, and general exercise-related questions. Participants were prompted to provide information on socio-demographic aspects such as gender, age, and educational level. Additionally, the survey delved into exercise-related details, including the frequency of exercise, with questions about the number of hours devoted to exercise per week. This comprehensive approach aimed to capture a holistic understanding of the participants' backgrounds, habits, and engagement in physical activity.

Exercise Addiction Inventory Revisited (EAI-R). The six-item EAI-R (Szabo et al., 2019; Italian version of the EAI: Gori et al., 2021; Soraci et al., 2023) is an instrument that assesses the risk of exercise addiction. The items (e.g., "If I have to miss an exercise session, I feel moody and irritable") are rated on a six-point scale from 1 (strongly disagree) to 6 (strongly agree). Scores range between 6 and 36; the higher the score, the greater the risk of exercise addiction. Cronbach's alpha in the present study was excellent ($\alpha = 0.90$).

Rosenberg's Self-Esteem Scale (RSES). The 10-item RSES (Rosenberg, 1965; Italian version: Prezza et al., 1997) assessed self-esteem. Items (e.g., "On the whole, I am satisfied with myself") are rated on a four-point scale from 0 (strongly disagree) to 3 (strongly agree). Scores range between 0 and 30, and higher scores indicate greater self-esteem. Cronbach's alpha in the present study was excellent ($\alpha = 0.85$).

Stress subscale of Depression Anxiety Stress Scale-21 (DASS-21). The Stress subscale of 21-item DASS-21 (DASS-21; Henry & Crawford, 2005, Italian version: Bottesi et al., 2015) was used to assess stress. Participants indicate how much they agree with the items about the previous week on a four-point scale from 0 (not at all) to 3 (very much) (e.g., "I found it difficult to relax"). Scores range from 0 to 21, and higher scores indicate greater stress. Cronbach's alpha in the present study was excellent ($\alpha = 0.92$).

Data analysis

The data analysis encompassed a sequence of three steps. Initially, descriptive statistics were computed for the variables under investigation utilizing SPSS version 26 (IBM Corporation, 2011), JASP version 13 (JASP Team, 2020) and Jamovi version 2.4 (The jamovi project, 2023). Mean scores, standard deviations, normality statistics, and Pearson bivariate correlations were calculated. Subsequently, the reliability of the measures was assessed through Cronbach's alpha (i.e., alpha > 0.70 suggests sufficient internal consistency), as the second step. A mediation analysis was performed using jamovi (version 2.4) GLM package (JAMM module). The model explored the direct, indirect (mediated by self-esteem), and total effects of stress on the risk of exercise addiction. Mediation analysis using 5.000 bias-corrected bootstraps was conducted as these are powerful tests even with small samples (Faraway, 2010; Fritz & Mackinnon, 2007; Servidio et al., 2018).

Results

Sample characteristics

The sample (n=200) was composed of 62% females and 48% males, with 56.5% holding a university degree, 40% possessing a high-school certificate, and 3.5% having a lower-level educational certificate. Regarding marital status, 59.5% were single, 31.5% were married, 3.5% were divorced, and 5.5% were separated. In terms of employment status, 78% were employed, and 22% were students. The average age of participants was 35 years (range 18 to 69 years; SD ± 11.42). On average, participants exercised for 5.56 hours per week (SD ± 4.05). Concerning the most preferred type of exercise, 26.5% reported athletics (e.g., running), 14% gym training, and 13.5% football, while the rest (46%) practiced various other sports (e.g., tennis, dance, etc.). Descriptive statistical results for the main measures of the study are summarized in Table 1; and the results indicate an approximately normal distribution, as asymmetry (min= 0.36, max= 0.80, in absolute value) and kurtosis (min= 0.11, max=0.86, in absolute value) fall within the range of ± 1, (e.g., Hair et al., 2010; Muthén & Kaplan, 1985). In the present study, 11% (22 out of 200) of the participants scored ≥ 29 on the EAI-R and are therefore classifiable as being at risk of exercise addiction (e.g., Gori et al., 2021). Of this, 12% are females and 9.2% are males. However, it is worth emphasizing that this gender difference was not statistically significant (χ^2 [1, N = 200] =0.40, p=0.52). Further, regarding gender (male/female) using the t-test analysis, there was no significant difference in the EAI-R score, t (199) =0.185, p= 0.853, effect size (Cohen's d) = 0.02. Using an ANOVA, there is also no difference in the level of education (controlled for age), F (3, 196) = 2.317, p = 0.07, effect size partial η^2 = 0.03 and type of sport, F (11, 188) = 1.346, p= 0.20, effect size partial η^2 = 0.07, in the total EAI-R score.

The results of the Pearson correlational analysis (Table 1) indicate that stress is positively correlated with the risk of

exercise addiction and negatively with self-esteem. On the other hand, the risk of exercise addiction is negatively correlated with self-esteem and positively with stress.

Tab. 1. Correlations and Descriptive Results (N=200)

Variable	*M*	*SD*	1	2	3
1. Self-Esteem	20.75	6.20	–		
2. Stress	11.93	4.68	-0.51***	–	
3. EAI-R	16.61	7.84	-0.45***	0.57***	–

Note: *** p < 0.001. EAI-R= Exercise Addiction Inventory Revised. M= Mean, SD= Standard Deviation.

Mediation analyses

Figure 2 illustrates the outcomes of the mediation analysis (independent variable (X) stress, dependent variable (Y) the risk of exercise addiction, and finally, mediating variable (M) self-esteem, with bootstraps = 5000 and 95% confidence intervals). Within the full regression model 36% of variance (R^2 = .36) of the risk of exercise addiction was explained by the combination of stress and self-esteem. This represents a significant amount of variance explained, F (2, 197) = 55.13, p < .001.

The findings from the present study substantiate the anticipated indirect effects of stress on the risk of exercise addiction, as detailed in Table 2. The results reveal a significant indirect association between stress and the risk of exercise addiction, mediated by the influence of self-esteem, (B = .19, SE = .06, 95% CI: .07; .30, z = 3.13, β = .11, p < .001). However, the direct impact of stress on the risk of exercise addiction remains significant, suggesting a partially mediated pattern, (B = .76, SE = .11, 95% CI: .55; 0.98, z = 6.95, β = .46, p < .001). A Sobel test (Sobel, 1982) was conducted to confirm the partial mediation in the model, z = 2.52, p < .05.
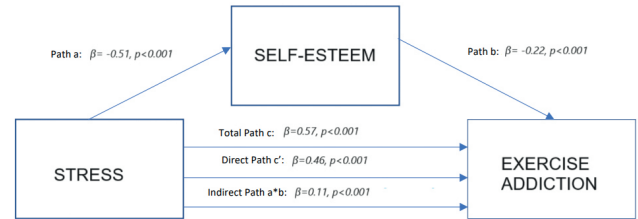
Furthermore, based on the results of the analysis it was found that: stress has a negative association with self-esteem (path a, B = -.67, SE = .08, 95% CI: 0.76; 1.14, z = -8.27, β = -0.51, p < .001) and finally, self-esteem is negatively associated with the risk of exercise addiction(path b, B = -.28, SE = .08, 95% CI: -.44, -.12, z = -3.38, β = -.22, p < .001). The total effect (i.e., combination of direct and indirect effects) of stress on the risk of exercise addiction was as follows: B = .95, SE = .10, 95% CI: .76; 1.14, z = 9.73, β = .57, p < .001.

Fig. 2. Results of the hypothesized model (N=200). All the values are standardized.

Discussion

The primary objective of the present study was to examine the role of self-esteem in the relationship between stress and the risk of exercise addiction (i.e., the indirect effect of stress on the risk of exercise addiction through self-esteem). The results partially confirm the research hypotheses. Specifically, it was observed that stress was indirectly related to the risk of exercise addiction through self-esteem, but mediation is partial, not total (H1 partially supported). This finding indicates that although self-esteem plays a significant and fundamental role in the relationship between stress and the risk of exercise addiction (Gori et al., 2021; Soraci et al., 2023; Wågan et al., 2022), it does not fully mediate this relationship. The study results suggest that self-esteem plays a pivotal role in an individual's ability to cope with stressful situations and mitigate the risk of exercise addiction. However, it is emphasized that self-esteem should be considered within a more intricate model that incorporates other variables, such as personality factors and resilience (Egorov & Szabo, 2013). A comprehensive understanding of the complex relationship between stress, self-esteem, and the risk of exercise addiction necessitates a multifaceted approach. Self-esteem does not exhibit a complete mediation effect when examined as a singular mediator variable. Therefore, a more nuanced model is essential for thoroughly exploring the interplay among these factors.

The mediation analysis results, consistent with previous research (e.g., Egorov & Szabo, 2013; Kavyani et al., 2021; Pinto et al., 2019), confirms that stress significantly predicts the risk of exercise addiction. This agrees with the idea that factors such as performance anxiety, unmet expectations, conflict, and injuries may foster exercise-related stress.

Tab. 2. Estimates of total, direct, and indirect effects of stress on risk of exercise addiction (N=200)

Pathway	Estimate	*SE*	95% CI	β	*z*	*p*
Total effect						
Stress --> EAI-R	.95	.10	.76; 1.14	.57	9.73	< .001
Direct effect						
Stress --> EAI-R	.76	.11	.55; .98	.46	6.95	< .001
Stress --> Self Esteem	-.67	.08	.76, 1.14	-.51	-8,27	< .001
Self Esteem --> EAI-R	-.28	.08	-.44, -.12	-.22	-3.38	< .001
Indirect effect						
Stress --> Self Esteem --> EAI-R	.19	.06	.07; .30	.11	3.31	< .001

Note: Betas β are completely standardized effect sizes; EAI-R= Exercise addiction inventory revised. CI = confidence interval, SE= standard error.

Performance anxiety, which is related to ability assessment, can increase stress, and potentially aggravate the existing risk of exercise addiction. Unmet expectations in exercise and sport can induce stress, especially when goals are unmet. Role conflict occurs when exercise roles clash with crucial life roles, increasing stress. Injuries, common in exercise, can be stressful, especially when they interrupt routines. Overall, stress from exercise challenges can worsen the risk of exercise addiction, establishing a risky circular relationship between physical activity and stress within the risk of exercise addiction model (Dinardi et al., 2021).

Furthermore, the current results suggest that stress is a negative predictor of self-esteem, as shown in previous studies (e.g., Galanakis et al., 2016). These results can be explained by the deleterious nature of stress on psychological well-being. Chronic or excessive stress can gradually erode an individual's self-esteem, negatively affecting self-perception. The effects of stress on mental health can undermine confidence and positive self-evaluation, thus contributing to a decline in self-esteem.

Additionally, consistent with previous studies (e.g., Gori et al., 2021; Wågan et al., 2021), it was observed that self-esteem acts as a negative predictor of risk of exercise addiction. This finding suggests that higher levels of self-esteem are associated with a lower likelihood of developing an addiction to physical activity. Positive self-assessment could act as a protective factor, reducing the risk of exercise addiction and contributing to more balanced psychological well-being.

Furthermore, the correlation results of the present study fully supported the remaining hypotheses (H2, H3 and H4), in line with previous research (e.g., Soraci et al., 2023). Indeed, consistent with prior research findings (e.g., Szabo et al., 2019), the current study reveals a positive correlation between the risk of exercise addiction and mental health outcomes, including positive relationship with stress and negative association with self-esteem. These parallels similar patterns observed in other behavioral addictions, such as sex addiction, gaming addiction or internet addiction (Andreassen et al., 2018; Chiorri et al., 2023; Servidio et al., 2018; Soraci et al., 2022; Szabo et al., 2019), suggesting a commonality in the psychological distress experienced by individuals grappling with various addictive behaviors. Furthermore, the study indicates a negative correlation between the risk of exercise addiction and self-esteem, aligning with and reinforcing the findings of previous research (e.g., Servidio et al., 2018; Soraci et al., 2023; Wågan et al., 2021). As reported by previous studies, higher self-esteem has a lower risk of exercise addiction. On the other hand, lower self-esteem has a higher risk of exercise addiction (e.g., Servidio et al., 2018; Soraci et al., 2023; Wågan et al., 2021).

These results underscore the multifaceted impact of the risk of exercise addiction on mental health, highlighting the need for a more comprehensive understanding and targeted interventions for individuals experiencing loss of control over exercise behavior. These current results strengthen the understanding of the important link between stress and the risk of exercise addiction, supporting the interactional model of exercise addiction (Dinardi et al., 2021; Egorov & Szabo, 2013) and contributing to the growing scientific evidence in this area, that potentially could lead to the development of diagnostic criteria for the clinical classification of exercise addiction.

Limitations and future studies

The present study has several limitations. First, the research was conducted with a relatively small sample of Italian exercisers. Second, a general problem in psychology is that the use of non-probabilistic sampling, characterized by anonymous and voluntary participation and reliance on self-report data, might impact the generalizability of the findings. Third, the gender distribution within the sample was imbalanced, with female overrepresentation. Thus, gender could not be included in the examined model.

Finally, an important limitation is the cross-sectional design. Although the mediating mechanisms conceptualized are plausible, the present study is not able to prove causality. Therefore there can be no claim regarding an experimental mediator effect, but rather of an indirect effect of stress on the risk of exercise addiction via self-esteem (e.g. Cole & Maxwell, 2003). Longitudinal studies would provide a better understanding of the associations between stress, self-esteem, and the risk of exercise addiction.

Future longitudinal multi-wave studies should investigate, with a larger and more representative sample, the relationship between stress and the risk of exercise addiction in more detail, investigating other variables, such as personality and resilience. Furthermore, studies should examine the role of gender, exercise form, exercise intensity and personality factors within the model.

Overall, the current findings suggest that prevention programs focused on improving low self-esteem could help individuals to improve their coping strategies and to ameliorate the risk of relapsing in exercise addiction.

Conclusion

This study reveals a connection between stress and lower self-esteem, which, in turn, is associated with heightened levels of exercise addiction. Conversely, self-esteem is negatively correlated with the risk of exercise addiction. It's crucial to interpret these results cautiously, considering the inherent limitations of the study. Still, the findings underscore the significance of further longitudinal research testing the relationships between different facets of the risk of exercise addiction and stress, particularly with the mediating influence of self-esteem among regular exercisers.

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