



UNIVERSITY OF PADOVA

Department of General Psychology

Bachelor's Degree Course in Psychological Science

Final dissertation

**Towards Reliable and International Screening of The Expanded
Exercise Addiction Inventory (EAI-3): Serbia and Croatia**

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Academic Year 2022/2023

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INTRODUCTION

Exercise is considered to be both physically and psychologically beneficial to one's health. However, sometimes people may exercise without a limit, which can have negative consequences on health, becoming addictive (Terry et al., 2004). Exercise addiction (EA) is considered a dysfunctional behavioral addiction, just like any other non-substance-related addiction, such as gambling. It is characterized by extensive training routine and loss of control over the exercise behavior that negative life consequences can follow. Such consequences can be physical (e.g., suffering from injuries or persisting in exercise despite their existence), psychological (e.g., anxiety, depression, withdrawal symptoms), social (e.g., relationship conflicts with others), or a combination of the three. (Weinstein & Szabo 2023, Jumano & Szabo, 2021, Alcaraz-Ibanez, 2022). It should not be confused with a passion for exercise, which is the extent to which people value their physical activity and dedicate time and physical effort to it. (Szabo & Kovacsik, 2019).

Like other known addictions, EA is believed to have six components: salience, tolerance, mood modification, withdrawal, conflict, and relapse. Moreover, it involves obsessive-compulsive aspects and physical symptoms (like ones exhibited through withdrawal), which can lead to social, medical, and financial problems (Weinstein & Szabo, 2023). Finally, De Coverley Veale (1987) classified EA as primary or secondary. Primary EA involves dependence and compulsive exercise, where the reward directly correlates with fulfilling the activity. In contrast, secondary EA surfaces other known dysfunctions such as anorexia nervosa, bulimia nervosa, or numerous other body-image dysfunctions. Therefore, the reward, in this case, is only indirectly associated with exercise fulfillment (De Coverley Veale, 1987).

In terms of primary diagnosis, EA is considered behavioral addiction, but due to the lack of scientific evidence, this condition is not yet listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association 2013). However, Hausenblas and Symons Downs (2002a) try explaining exercise addiction using a modified version of DSM-IV criteria for substance dependence, according to which three or more criteria must be present:

- Tolerance- represents either a need to increase the amount of exercise to reach a desired effect or losing an effect due to continuous exercise.
- Withdrawal- when in the absence of exercise, a person experiences withdrawal symptoms (e.g., anxiety, restlessness, irritability)
- Intention effects- represents exceeding the amount of time devoted to exercise or exceeding the intended amount to exercise.
- Loss of control- represents unsuccessful attempts to cut down, cease, or control exercise.
- Time- when much time is spent preparing, engaging, or recovering from exercise.
- Conflict- when important social, occupational, or recreational activities occur less often or are stopped.
- Continuance- when exercise is continued despite knowing that the activity is causing physical, psychological, or interpersonal problems.

Apart from these known symptoms, for a behavior to be classified as an addiction, it must trigger physical, psychological, or social harm (Szabo, 2010). The problem remains that without negative consequences, an excessive amount of exercise may not be considered dysfunctional (Szabo & Kovacsik, 2019). Moreover, the problem comes from the confusion about the precise nature of exercise addiction. Ongoing discussion focuses on whether EA should be considered a specifically classified disease or a compensatory behavior used as a control tool among eating disorders (e.g., bulimia nervosa and anorexia nervosa). Last but not least, the issue that needs more attention concerns the lack of evidence for measurement invariance of the scores from frequently used instruments to assess self-reported risk levels of exercise addiction. More specifically, it is unclear whether individuals with different risk factors interpret the scale items similarly, leading us to a potentially biased conclusion (Alcaraz-Ibanez, 2022).

Regarding the EA as a secondary diagnosis, it has a high comorbidity with eating and body-image disorders. Several studies showed a positive correlation between Alexithymia¹ and EA, mediated by body image concerns. Self-esteem was shown to be an important factor,

¹Neuropsychological phenomenon characterized by significant challenges in recognizing, expressing, and describing one's own emotions (Preece et al., 2017)

with a high level significantly reducing the impact of Alexithymia on body image concerns. Moreover, individuals who exercise more than 10 hours per week show a high prevalence of Depressive disorder (56%), Personality disorder (47%), and Obsessive-Compulsive disorder (31%). Some gender differences among the dysfunctional symptoms were found among different athletes. Depressive symptoms were recorded in both genders, with women having slightly higher scores. Furthermore, women exhibited more obsessive and harmonious passion than men with similar exercise intensities. In contrast, males showed higher intensity and dedication to training than women (Weinstein & Szabo, 2023). What is mainly used as a treatment for exercise dysfunction is based on Cognitive-Behavioral therapy. However, there is not yet enough evidence that supports its effectiveness. Some other treatments include Mindfulness-based therapy and Rational emotive behavioral therapy (REBT). Clinical interventions for exercise addiction should include an assessment of the stage of addiction, motivation to change, and comorbidity with other psychological disorders (Weinstein & Szabo, 2023). However, to come to the correct diagnosis and possible treatment, proper assessment tools must be used to determine the presence of EA.

Over time, several assessment tools have been developed for problematic exercise with different theoretical conceptualizations. Among the mainly used instruments are: The exercise Dependent Scale (EDS), which defines problematic exercise based on criteria for substance dependence provided by the DSM-IV, and The Exercise Addiction Inventory (EAI), which defines problematic exercise based on the Griffiths (2005) components model of behavioral addictions (Sicilia, 2022). EDS contains 21 items, rated on a 6-point scale (“never” to “always”) evaluated on the Likert scale. EAI is a self-report, short, valid, and reliable instrument used in numerous published studies. It has been translated into several languages (e.g., Arabic, English, Chinese, Danish, German, French, Hungarian, Italian, and Spanish). It contains six items, rated on a 5-point scale (“strongly agree” to “strongly disagree”) evaluated on the Likert scale. The middle score (3 out of 5) reflected neither agreement nor disagreement. Such neutral opinion on each item (scoring 3) creates a problem since it artificially increases the total score obtained on the EAI. Therefore, the original EAI was revised by further studies to eliminate the midpoint neutral answer (“neither agree nor disagree”) and use a 6-point rating scale (Szabo et al., 2019). Thus, what is used in current studies is The Revised Exercise Addiction Inventory (EAI-R), which has

three levels of agreement and three levels of disagreement (1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = slightly agree, 5 = agree, and 6 = strongly agree; Szabo et al., 2019). Six items investigated in both original and revised versions represent six common symptoms of addiction (Terry, 2004):

- 1) Salience- attitudes and beliefs about exercise behavior based on the perceived importance of exercise.
- 2) Withdrawal- negative emotions experienced when a decrease or a stop in exercise occurs.
- 3) Relapse- returning to the problematic exercise behavior pattern.
- 4) Tolerance- frequency of exercise needed to achieve the desired benefits.
- 5) Mood modification- use of exercise in order to change the mood.
- 6) Conflict- between the exerciser and family or friends arising from the exercising habit.

Present studies provided support for the psychometric properties of the EAI. Notably, internal consistency was good, showing an existence of strong reliability. Additionally, inventory shows excellent validity when compared with the Obligatory Exercise Questionnaire and the Exercise Dependence Scale (Terry, 2004). Despite its good psychometric properties, the EAI requires some further refinement. One of the problems with the mentioned self-reporting instruments is that they are not a diagnostic tool. They provide a risk score that may reflect dysfunctional behavior if it is high; however, excessive exercise does not necessarily represent maladaptive behavior. (Szabo et al., 2015). Moreover, EAI-R does not assess some components that can potentially give us more reliable results (Szabo & Kovacsik, 2019). Such components include an individual's experience of guilt associated with the exercise habit and perceived lack of training quantity or quality (Aidman & Woollard, 2003). Another one concerns persistence in training despite the injury, illness, or medical advice while or before complete recovery (Hausenblas & Symons Downs, 2002a). The last includes possible negative consequences (physical, psychological, or social) resulting from an individual's exercise regime (Berczik et al., 2012). Adding the above-mentioned items can improve the current instrument, showing a better reflection of an addiction (Szabo & Kovacsik, 2019). The expended version of EAI-R, or EAI-3, has been tested in several studies (Granziol et al., 2021; Granziol et al., 2023; Szabo et al., 2019).

Three items were added to assess the “feeling of guilt,” the tendency to “train despite the injury,” and the experience of “negative consequences”. The present study aims to test the factor structure, reliability, and validity of an expanded version of EAI for two countries, Serbia and Croatia. The idea is to determine whether the Expanded version of EAI gives promising results for the sample collected, validating the suggested improvements.

CHAPTER 1

METHODS

1.1.Procedure

Participants were partly recruited online through social media platforms (i.e., Instagram, Facebook, etc.) and partly through administering questionnaires in sports clubs, gyms, and other places where people exercise. The targeted group included individuals with more interest in sports who regularly exercise. The study used the Qualtrics online survey platform (Qualtrics, 2023) for the online participants and the traditional paper and pen method for the others. All the items were translated and back-translated by a native Cyrillic speaker. First, participants had to read a consent form and agree to participate. Then, since data was collected anonymously, participants were asked to make a random code associated with their responses to avoid duplicates. In order to be included in the study, participants needed to be more than 18 years old, active in the preferred sport since for, at least six months, and exercising a minimum of three times per week, at least 150 minutes. Only fully completed responses (100%) were included in the study. The survey did not include any payment or other type of reward. The research was done according to the Declaration of Helsinki².

1.2.Measures

Expanded Exercise Addiction Inventory (EAI-3) is an expanded version of EAI-R, one of the mainly used instruments for measuring EA. Three items were added to the original EAI-R to assess the “feeling of guilt” that is related to an individual's exercise habits, the tendency to “train despite the injury”, and the experience of “negative consequences” (Granziol et al., 2023). The added items were based on empirical evidence that supports their association with EA and were translated following international guidelines (Juwono & Szabo, 2021; Granziol et al., 2021; Beaton et al., 2000). EAI-3 contains nine items, rated on a 6-point scale (“strongly agree” to “strongly disagree”) evaluated on the Likert scale (Figure 1). The score is obtained by simply summing the items' scores, ranging from 6 to 54. A higher score suggests a potentially higher severity of symptoms (Granziol et al., 2023).

² Declaration of Helsinki was developed by The World Medical Association (WMA) as a statement of ethical principles for medical research involving human subjects, including research on identifiable human material and data. (World Medical Association, 2022)

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
Exercise is the most important thing in my life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Concerns have arisen between me and my family and/or my partner about the amount of exercise I do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I use exercise as a way of changing my mood (e.g., to get a buzz, to escape, etc.).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Over time I have increased the amount of exercise I do in a day.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I have to miss an exercise session, I feel moody and irritable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I cut down the amount of exercise I do and then start again, I always end up exercising as often as I did before.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel guilty if I miss planned training or if my training doesn't go as well as planned.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am inclined to train when (or before completely recovered from) illness or injury.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have had physical, psychological and/or social issues due to my exercise regime.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 1

Exercise Dependence Scale-Revised (EDS-R) is a tool used to differentiate between at-risk, non-dependent-symptomatic, and non-dependent-asymptomatic individuals. Moreover, it can specify whether individuals may have a physiological dependence (evidence of withdrawal) or no physiological dependence (no evidence of withdrawal) (Terry et al., 2004). It is the second mostly used measurement tool for EA. EDS contains 29 items, rated on a 6-point Likert scale (“never” to “always”) with a total score ranging from 21 to 126 (Hauseublas & Symons Downs, 2002a; Figure 2). Participants are categorized into three groups: at-risk exercise-dependent, nondependent-symptomatic, or nondependent-asymptomatic. Which group they will fall under depends on the scoring manual in which items or combination of items determine the classification on each of the seven DSM-IV criteria (withdrawal, continuance, tolerance, control loss, a decrease of other activities, time, and effect intention; Hauseublas & Symons Downs, 2002b). The overall score for each category is calculated by adding the ratings for each item, with a higher score suggesting a greater likelihood of developing an EA. Individuals classified into the dependent range on three or more DSM-IV criteria are classified as exercise-dependent. Individuals who scored in the range of three to four are classified as symptomatic, with the possibility of being considered at-risk for exercise dependence. Finally, individuals who score one to two are classified as asymptomatic (Hauseublas & Symons Downs, 2002b).

I exercise to avoid feeling irritable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I exercise despite recurring physical problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I continually increase my exercise intensity to achieve the desired effects/benefits.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I am unable to reduce how long I exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I would rather exercise than spend time with family/friends.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I spend a lot of time exercising.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I exercise longer than I intend.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I exercise to avoid feeling anxious.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I exercise when injured.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I continually increase my exercise frequency to achieve the desired effects/benefits.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I am unable to reduce how often I exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I think about exercise when I should be concentrating on school/work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I spend most of my free time exercising.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I exercise longer than I expect.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I exercise to avoid feeling tense.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I exercise despite persistent physical problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I continually increase my exercise duration to achieve the desired effects/benefits.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I am unable to reduce how intense I exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I choose to exercise so that I can get out of spending time with family/friends.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
A great deal of my time is spent exercising.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5	6
I exercise longer than I plan.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 2

The SCOFF questionnaire (sick, control, stone, fat, food) is a tool used to assess the proneness to an Eating Disorder. It is a simple, highly effective screening test and has been translated into many languages worldwide. It contains five items, with the two choice answers (“Yes” or “No”; Figure 3). The total score ranges from 0 to 5, obtained by simply summing the items' scores. A score higher than two suggests risk for an Eating Disorder (Hill et al., 2010; Morgan et al., 1999). Since there is a high comorbidity between EA and Eating Disorders, the scale represents a helpful tool in Exercise addiction studies (Weinstein & Szabo, 2023).

	Yes	No
Do you make yourself sick because you feel uncomfortably full?	<input type="radio"/>	<input type="radio"/>
	Yes	No
Do you worry that you have lost control over how much you eat?	<input type="radio"/>	<input type="radio"/>
	Yes	No
Have you recently lost more than one stone (14 lb) in a 3-month period?	<input type="radio"/>	<input type="radio"/>
	Yes	No
Do you believe yourself to be fat when others say you are too thin?	<input type="radio"/>	<input type="radio"/>
	Yes	No
Would you say that food dominates your life?	<input type="radio"/>	<input type="radio"/>

Figure 3

Obsessive-Compulsive Inventory-Revised (OCI-R) is a tool used to assess the potential existence of common Obsessive-Compulsive Disorder (OCD) symptoms. It contains 18 items with six subscales (washing, checking, ordering, obsessing, hoarding, and neutralizing). Items are rated on a 5-point scale from 0 to 4 (“not at all” to “extremely”), with a total score ranging from 0 to 70 (Figure 4). A higher score signifies a higher OCD symptoms presentation. Moreover, according to a study by Abramowitz & Deacon (2006), OCI-R demonstrated good validity and effective discrimination of OCD from other anxiety disorders. With a high prevalence of OCD in individuals who exercise, OCI-R is a valuable tool for assessing EA (Weinstein & Szabo, 2023).

	Not at all	A little	Moderately	A lot	Extremely
I have saved up so many things that they get in the way.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I check things more often than necessary.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I get upset if objects are not arranged properly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I feel compelled to count while I am doing things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I find it difficult to touch an object when I know it has been touched by strangers or certain people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I find it difficult to control my own thoughts.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I collect things I don't need.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I repeatedly check doors, windows, drawers, etc.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I get upset if others change the way I have arranged things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I feel I have to repeat certain numbers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I sometimes have to wash or clean myself simply because I feel contaminated.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I am upset by unpleasant thoughts that come into my mind against my will.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I avoid throwing things away because I am afraid I might need them later.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I repeatedly check gas and water taps and light switches after turning them off.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I need things to be arranged in a particular way.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I feel that there are good and bad numbers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I wash my hands more often and longer than necessary.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all	A little	Moderately	A lot	Extremely
I frequently get nasty thoughts and have difficulty in getting rid of them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 4

Ten-Item Personality Inventory (TIPI) is a tool investigating the Big-Five personality dimensions (extroversion, agreeableness, openness to experience, conscientiousness, and emotional stability). It is a short measure where each item consists of two descriptors (i.e., two items per dimension), rated on a 7-point Likert scale (“disagree strongly” to “agree strongly”; Figure 5). The scoring of each dimension (from 2 to 14) is done by summing the first item's score and the reverse score of the second item. It is shown to be beneficial in studying the relationship between the Big-Five dimensions and other constructs and outcomes (Gosling et al., 2003). Therefore, because several associations are found between

Big Five personality traits and EA, TIPI has been included in the study as an assessment tool (Bircher et al., 2017).

	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
Extraverted, enthusiastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Critical, quarrelsome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dependable, self-disciplined.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Anxious, easily upset.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Open to new experiences, complex.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reserved, quiet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sympathetic, warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Disorganized, careless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Calm, emotionally stable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conventional, uncreative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 5

1.3 Analytic plan

All the statistical analyses were conducted through the R software (R Core Team, 2021). The analytic plan can be divided into three different analyses:

1. Confirmatory factor analysis
2. Reliability
3. Validity through correlation

Confirmatory factor analysis (CFA) has been widely used to prove structural validity in theory-based instrument construction (Li, 2016). Since the aim of the study was to test the structure of EAI-3 found by Granzio and colleagues (2023), exploratory factor analysis was not conducted. Multiple criteria were applied to measure the goodness-of-fit of the EAI-3 assessment model. The first was the *Comparative Fit Index (CFI)*, where results above 0.95 indicated an adequate fit and results under 0.90 inadequate fit. The second included *Root Mean Square Error of Approximation (RMSEA)* with scores below 0.05 indicating a good

fit and above 0.10 poor fit (Monok et al., 2012). The factor structure was tested by using the Weighted least square (WLSMW) estimator specially designed for skewed data. A study by Li (2016) showed that WLSMW is less biased and more accurate factor loading across all the experimental conditions (i.e., regardless of sample size, the number of categories, etc.) in comparison to previously used estimators.

Reliability was tested by applying Cronbach's Alpha (Cronbach, 1951) and McDonald's Omega (McDonald, 1999). For both parameters, results above 0.70 represent adequate reliability.

Validity was tested using the Spearman correlation coefficient, correlating the scores between the EAI and the other scales used.

CHAPTER 2

RESULTS

2.1. Sample characteristics

In total, 204 participants were judged as eligible for the present study. Participants were recruited from two countries, Serbia and Croatia respectively. All the sample spoke one language (with the difference in Alphabet use: Cyrillic and Latin). Among the participants, 57.45% were males and 48.54% were females. The mean age was 34.47 years (SD= 13,52; Range 18-70). The mean age of becoming regularly active in sports was 12.96 (SD= 7,66; Range 4-70). To take part in the study, participants needed to exercise a minimum of 150 minutes per week. Data collected yield a mean of 72,24 minutes duration of a typical training session (SD= 43.32; Range 30-150). The minimum number of exercise sessions required by the study was 3 per week, with our participants having a mean of 3.77 (SD= 1.17; Range 3-7). Almost half of the participants perceived themselves as amateur/ recreational exerciser (44.73%), while only 9.65% declared themselves professional athletes. The remaining participants declared to be neither amateur nor professional exercisers (45.61%). Almost three-quarters of participants declared that the aim of their exercise concerned their health (physical or mental; 72.81), while 21.05% declared the mastery of improvement of their skills in the related sport as a reason. Social reasons were declared by 6.14% of participants. Finally, 8.33% of the participants reported having some physical or mental disorder diagnosis.

2.2 Factor analysis

In the study by Granzio et al. (2023), Exploratory factor analysis (EFA) suggested two potential factors. The first factor (F1) considered items that examined habits, relevance, and amount of exercise, named “Health Relevance” (HR; EAI3_1, EAI3_3, EAI3_4, EAI3_6). The second factor (F2) considered items that examined the consequences of excessive exercise, named “Addiction Tendency” (AT; EAI3_5, EAI3_8, EAI3_7, EAI3_2). The model obtained an excellent fit of the data regarding CFI (CFI= 0.98) and RMSEA (RMSEA= 0.042; 90%CI [0.0- 0.081]). The results of CFA on the subscales are displayed in Figure 6.

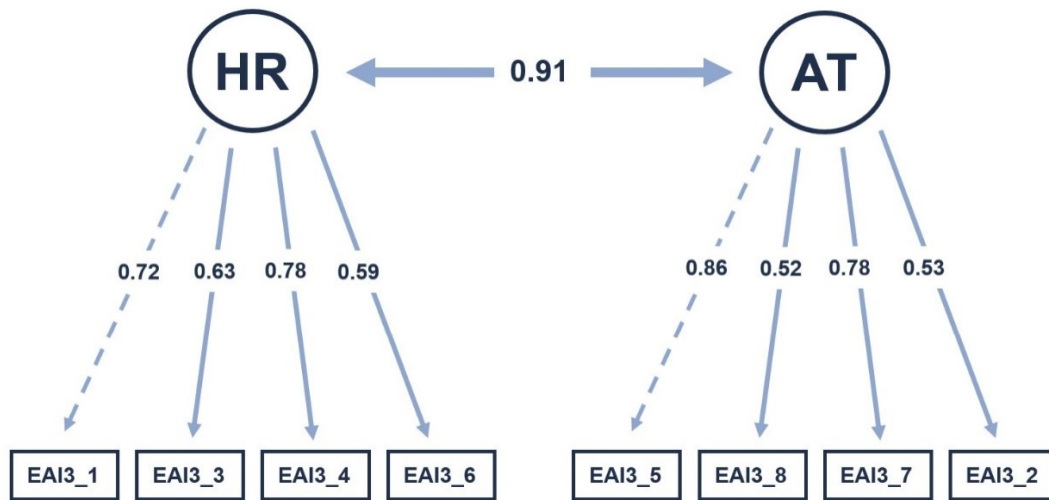


Figure 6

In terms of reliability, the total scale showed good reliability, with a value of Cronbach's α equal to 0.88 and the value of McDonald's ω equal to 0.91. Moreover, subscales HR and AT showed adequate reliability, with HR having Cronbach's α equal to 0.79 and McDonald's ω equal to 0.84, while AT had Cronbach's α equal to 0.81 and McDonald's ω equal to 0.87.

Validity was tested through correlation with other measures. Table 1 contains the correlation between EAI-3 scores (including both total scale and subscale scores) and the scores of the other scales used in the study. The EAI-3 total score and subscales (AT, HR) positively correlated with the total scores of EDS-R, OCI0R, and SCOFF-R. The TIPI's Conscientiousness score negatively correlated only with HR scores, while total EAI scores were negatively correlated with all the Emotional Stability and Openness scores. Additionally, the AT subscales obtained lower correlational scores than the HR scale, suggesting that the AT correlates more with the pathological constructs.

EAI3	Measure	Correlation
HR	EDS-R	0.303
AT	EDS-R	0.429
Total	EDS-R	0.364
HR	OCI-R (Tot)	0.090
AT	OCI-R (Tot)	0.586
Total	OCI-R (Tot)	0.335
HR	SCOFF (Tot)	0.285
AT	SCOFF (Tot)	0.327
Total	SCOFF (Tot)	0.365
HR	Extraversion	0.354
AT	Extraversion	0.189
Total	Extraversion	0.244
HR	Agreeableness	0.046
AT	Agreeableness	0.435
Total	Agreeableness	0.161
HR	Conscientiousness	-0.158
AT	Conscientiousness	0.394
Total	Conscientiousness	0.244
HR	Emotional stability	-0.436
AT	Emotional stability	-0.284
Total	Emotional stability	-0.428
HR	Openness	-0.509
AT	Openness	-0.008
Total	Openness	-0.184

Table 1

CHAPTER 3

DISCUSSION

Sports, exercise, or regular physical activity can positively affect psychological and physical health. However, in some cases, individuals tend to lose control over the amount of exercise, which transforms into a dysfunctional practice that can have harmful consequences. Such negative consequences can affect all aspects of one's life, which is why it is essential to develop reliable tools for assessing Exercise Addiction. Such tools can help conceptualize the disorder, yield more research, a better operational definition of EA, and, overall, more knowledge on the topic. So far, the most used instrument is EAI. An extended instrument was developed to improve the original EAI tool by adding criteria that define EA more precisely.

The first new criterion was added to assess the feeling of guilt, which can be caused by many different reasons and on any level of involvement in physical activity. Another item was added to assess the tendency to exercise even with the injury, not fully recovered or against the medical advice. Lastly, the third item was added to assess the negative consequences of excessive exercise. In the study by Granziol and colleagues (2023), the results suggested that the model with the best fit should not consider the last added item (i.e., Item 9). Since the present study aimed to investigate the goodness of fit of extended EAI, or EAI-3, on the data collected from two countries, Serbia and Croatia, Item 9 was included in the survey, but all the analyses were done without it.

The study examined the confirmatory factor analysis, reliability, and correlational validity. A new assessment model was described with two factors (HR, AT; Granziol et al., 2023). The first factor (HR) included items related to the more positive sides of exercise, such as the level of importance individuals give to sports or the tendency to use exercise to change their mood. The second factor (AT) included items related to the more pathological sides of exercise, such as conflict with family and friends arising from the individual's exercise regime or the need to increase the amount of exercise to feel a satisfying effect. Moreover, the second subcategory included two added items to EAI-3, testing the feeling of guilt and exercising despite the injury.

After being tested, the EAI-3 showed an excellent fit of the data in the overall sample and all subcategories. All the items in the Health relevant (HR) subcategory had similar strong correlation values, representing a good health indicator. However, the Addiction tendency (AT) subcategory items show a higher discrepancy. Item 5 (“the need to increase the amount of exercise to feel the positive effect”) had the highest correlational value. Such a result represents a good risk parameter, suggesting a possible tolerance problem among Serbian and Croatian exercisers. On the other hand, Item 8 and Item 3 had a lower correlation value, representing a less strong addiction indicator. A lower score on Item 8 (“training despite the injury”) suggests that participants are more prone to stop exercising when injured and wait for complete recovery to start practicing again. A lower score on Item 3 (“conflict with family and friends”) suggests that participants' family and friends view excessive exercising more positively. One of the reasons for such a result can be due to the fact that Serbia and Croatia are known for a high number of very successful professional athletes, with some being the best in the world in their chosen sport. In such a culture, family and friends can be more prone to believe that higher involvement in sports is good for overall health, disregarding the negative effects it may have. Moreover, this could also be a possible reason for a high correlational value in Item 5.

Lastly, the overall scale and the subscales showed good reliability scores and correlations with other psychometric measures. The EAI-3 correlated positively and moderately with Obsessive-Compulsive behavior and Eating Disorder. A slightly lower positive correlation was found between EAI-3 and EDS-R. The negative correlation of the EAI-3 total score with the TIPI's Emotional stability and Openness scores suggests that even pathological aspects of the exerciser's personality can be linked to an EA. Finally, the AT subscale obtained lower correlational scores than the HR scale, suggesting that the AT correlates more with the pathological constructs. Such findings corroborated with previously done study (Umberto et al., 2023).

The additions discussed, and the findings meet the request of previous studies (Blaydon et al., 2004; Sicilia et al., 2020; Umberto et al., 2023). The main goal was to find an instrument that can detect not only quantitative differences in the structure of EA but also different patterns of responses or profiles. In the original EAI tool, some of the items might be taken as negative, while they are adaptive (Szabo & Demetrovics, 2022). For example,

professional athletes and individuals with dysfunctional practicing habits might both score high on certain items. The problem is that such a high result for professional athletes is considered normal compared to an excessive exerciser, making it hard to discriminate between potentially harmful and harmful exercise. However, the two-factor structure of EAI-3, which reflects the two different ways of thought regarding exercise behavior, might be clinically helpful in resolving such a problem, becoming a promising clinical screening tool.

3.1.Limitations

The present study has some limitations. First, online participants were less likely to completely fill out the questionnaire compared to those who did it with paper and pen. Such a problem could be due to a lower attention span when looking at the screen with higher chances of interruption. However, online recruitment was less time-consuming, and the survey was easier to administer and database. Second, some items lost their specificity when translated into Cyrillic, which can consequently yield less reliable results. For example, most participants reported the first item, “Do you make yourself sick because you feel uncomfortably full?” in the SCOFF-R tool as very hard to interpret. This limitation suggests that further refinement of the items should be done to make translation easier and more adaptable across different languages.

3.2.Conclusion

The study's results suggested that the validation of the structure of EAI-3 studied by Granzio and colleagues (2023) among Serbian and Croatian athletes is promising. First, such results provided initial support for the psychometric properties of EAI-3. More importantly, it added to a better and more detailed understanding of the EA across different countries. The findings in the current study should be used as a step forward in better identifying of dysfunctional exercise habits among Serbian and Croatian exercisers. As mentioned before, these countries are known for many successful professional athletes, making exercising more prevalent with a possible higher risk of unhealthy engagement. Results supporting the two-factor structure of EAI-3 can lead to better discrimination between professional athletes and excessive exercisers. Such finding can be essential for individuals regarding these two countries to expand their knowledge on the topic and implement healthier habits and beliefs about exercise. Moreover, validating such a structure can help clinicians diagnose more accurately

and develop effective treatments for both populations. Nevertheless, a good fit of the EAI-3 structure for Serbia and Croatia can be an encouraging step for conducting more research to corroborate present findings across populations of particular interest, age and sex or different languages and translations of EAI-3.

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