

## **Problematic exercise – a new behavioral addiction**

### *Problematica exercițiului fizic excesiv – o nouă adicție comportamentală*

**Marinela Minodora Manea, Bogdana Susana Milea, Alexandra Câmpean**

*“Iuliu Hațieganu” University of Medicine and Pharmacy Cluj-Napoca,  
Clinical Psychology Department*

#### **Abstract**

The benefits of regular physical activity on health and quality of life are undeniable. Currently, many researchers draw attention to the fact that this healthy behavior might become under certain circumstances a behavior at risk for the development of dependence. Once the problem of excessive physical exercise was raised, different authors proposed a number of terms to define it: addiction, dependence, compulsive physical exercise. Today, the term exercise addiction is mainly used by researchers in this area. The lack of consensus in the literature regarding the definition of excessive physical exercise has led to its staged approach along a four-phase continuum (Freimuth et al., 2011). The results of this evaluation suggest that passing from a normal to a problematic style of physical training occurs through a gradual increase of the daily exercise routine, in the context of an enhanced need to use physical activity as a coping mechanism. Regarding the possible etiology of excessive physical exercise, neurobiological and psychosocial hypotheses are considered. Data on the epidemiology of sport addiction have estimated a 3% prevalence in the general population. There are scales for the evaluation of excessive physical exercise, as well as studies that show which sports predispose more to sport dependence. Literature data suggest that 15-20% of sport-dependent persons have comorbidities such as other addictions or anorexia nervosa. In the literature, cognitive behavioral therapy is reported to have a success potential in these cases.

**Keywords:** problematic exercise, behavioral addiction, sport dependence, endogenous opioids, anorexia nervosa, compulsivity, impulsivity

#### **Rezumat**

Beneficiile activității fizice regulate asupra sănătății și calității vieții sunt incontestabile. În prezent, un grup numeros de cercetători atrag atenția asupra potențialului ca acest comportament sănătos să devină, în anumite contexte, un comportament la risc pentru dezvoltarea unei dependențe. Odată ridicată problematica exercițiului fizic excesiv, autorii au propus o serie de termeni care să îl definească, fiind denumit adicție, dependență, exercițiu fizic compulsiv. Astăzi, termenul de adicție la exerciții fizice este principalul utilizat de către cercetătorii din domeniu. Lipsa de consens în literatura de specialitate în ceea ce privește definirea exercițiului fizic excesiv a condus la abordarea acestuia în trepte pe un continuum în 4 faze (Freimuth et al., 2011). Rezultatele acestei evaluări sugerează că trecerea de la un stil de antrenament fizic normal la unul problematic se face printr-un proces gradual de augmentare a rutinei zilnice de efort fizic, în contextul unei nevoi crescute de a utiliza activitatea fizică ca mecanism de coping. În ceea ce privește posibila etiologie a exercițiului fizic excesiv, ipotezele neurobiologice și cele psihosociale sunt luate în calcul. Datele referitoare la epidemiologia adicției la sport au estimat o prevalență de 3% în populația generală. Există scale de evaluare a exercițiului fizic excesiv, precum și studii care atestă care sporturi predispun într-o măsură mai ridicată la dependența de sport. Datele din literatură sugerează că 15-20% dintre persoanele dependente de sport prezintă patologii comorbide, precum alte adicții sau anorexia nervoasă. În literatura de specialitate, terapia cognitiv comportamentală este citată cu potențial de reușită la aceste cazuri.

**Cuvinte cheie:** exercițiu fizic la risc, adicția, dependența de sport, opioide endogene, anorexie nervoasă, compulsivitate, impulsivitate

---

*Received:* 2017, December 3 ; *Accepted for publication:* 2017, December 26

*Address for correspondence:* “Iuliu Hațieganu” University of Medicine and Pharmacy, Cluj County Clinical Emergency Hospital, Psychiatric Clinic III, Unit 3, No. 43, Victor Babes St., 400012 Cluj-Napoca, Romania

*E-mail:* minodora.manea@gmail.com

*Corresponding author:* Manea Marinela Minodora minodora.manea@gmail.com

*https://doi.org/10.26659/pm3.2018.19.1.37*

## Introduction

Regular physical exercise of moderate intensity is a central pillar of efforts for the promotion and maintenance of health worldwide (Pate et al., 1995). Many studies confirm the beneficial role, both physical and mental, of physical training on the human body in all age groups, with the increase in quality of life and functionality (Peluso & Guerra de Andrade, 2005). In addition, the symptoms of a number of diseases are significantly improved (Morgan, 1985) by adopting a lifestyle that includes sustained moderate physical exercise.

However, a series of studies (Freimuth et al., 2011; Adams & Kirkby, 2002; Adams, 2009) draw attention to the possible negative effects of excessive physical exercise, while researchers and theorists in the field focus on its conceptualization, definition and possible subsequent nosology.

This study aims to synthesize the currently available literature related to excessive physical exercise.

## Background

Regular physical exercise can be described as a repeated and planned structured set of activities that involve movement, with a sufficient frequency, duration and intensity, for health promotion purpose (Berczik et al., 2012).

In 1976, Glasser used for the first time the term “positive addiction” in the literature, emphasized the beneficial effects of sport and described a positive correlation between the intensification of physical training and the improvement of health status (Berczik et al., 2012). Subsequently, Morgan questioned this fact, based on a number of psychiatric clinical cases in which engagement in excessive physical exercise led not only to injuries, but also to neglect of daily duties (Morgan, 1979). Thus, excessive physical exercise might be understood as an inability to reduce or stop physical exercise, despite its harmful effects on health (Naylor et al., 2011).

Once the problem of excessive physical exercise was raised, different theorists in the field proposed a number of terms to define it: addiction (Berczik et al., 2012), dependence (de Veale, 1995), obligatory exercise (Pasman & Thompson, 1988), compulsive exercise (Yates, 1991) or “driven exercise” (Fairbum, 2008), each proposed term being based on distinct etiopathogenic theories.

Currently, the term “exercise addiction” seems to be mainly used by researchers in the field. A literature review (Berczik et al., 2012) maintains that this term most accurately expresses the characteristics of this type of behavior, because it incorporates both the idea of dependence (evidenced by the presence of tolerance and the development of withdrawal syndrome on cessation of activity) and compulsion.

## From excess to addiction

A study conducted in 2011 (Freimuth et al.) highlights the need to make a differential diagnosis between addictive, excessive and high performance physical exercise. In the first place, the authors emphasize the need to differentiate between dependence, compulsion and an impulse control

disorder regarding excessive training.

Increased impulsivity is considered a component of addictive behavior (Brewer, Potenza, 2008), being defined as a rapid response to internal or external stimuli, without taking into consideration the possible negative consequences motivated by a positive reward (Grant & Potenza, 2006).

In the case of dependence, in addition to the development of tolerance and withdrawal, the person concerned becomes aware of the negative consequences of excessive physical exercise, but chooses to ignore them (Cook et al., 2011).

Stephen Stahl reports that from a behavioral, neurobiological and neuronal circuit point of view, dependence develops in the context of increased impulsivity, which gradually turns into compulsion through repeated action (Stahl, 2008).

Addiction is defined as a behavioral process that leads to either pleasure or the improvement of inner discomfort, being characterized by repeated failure to control behavior and, at the same time, by its maintenance despite the appearance of negative consequences (Berczik et al., 2012). A number of researchers have found that in the case of excessive exercisers, the presence of other symptoms characteristic of addiction is described: tolerance, withdrawal, perseverance, mood changes, personal conflict and relapse (Berczik et al., 2012; Griffiths, 2005; Szabo, 2010).

Adams and Kirkby, in a literature review published in 2002, concluded that empirical and anecdotal evidence supports the presence of withdrawal syndrome on discontinuation of physical activity in the case of persons who practice an intensive sport (Adams & Kirkby, 2002).

The description of these symptoms represented an important pillar in the identification of sport dependence, but recent studies have shown that a certain degree of discomfort may also occur in the case of persons who practice sport under normal conditions and suddenly discontinue its practice; thus, emphasis should be rather placed on the type, frequency and intensity of withdrawal symptoms, not just on the presence or absence of withdrawal (Berczik et al., 2012; Szabo et al., 1996).

In the case of sport dependence, a compulsive component was also described, defined as the need to take action in order to suppress upsetting thoughts or emotions (Freimuth et al., 2011). In addition to diminishing anxiety, sport practice induces a decrease of anger, depression and boredom (Rosa et al., 2004; Zmijewski & Howard, 2003), as well as an overall improvement of well-being and self-esteem (Scully et al., 1998).

De Coverley Veale, in a study published in 1987, differentiated between primary and secondary exercise dependence. Secondary exercise dependence occurs following another mental disorder, more frequently in the context of an eating disorder. On the other hand, in primary sport dependence, motivation is rather exercise itself than weight loss. Some researchers question the existence of primary sport dependence (Bamber et al., 2000), but Szabo and Griffiths (Griffiths, 2005; Szabo, 2010) described a number of cases in which excessive exercise was not associated with eating disorders.

## When does frequent exercise become addiction?

Freimuth shows in an article published in 2011 that the distinction between a regular, sustained exercise program and addiction is difficult to make because in order to obtain beneficial effects on health, physical exercise should be performed relatively frequently and over long time periods, as well as because exercise tolerance naturally increases in time and the practice of a sport does not exclude the possibility of negative consequences (e.g. injuries), these characteristics also being common to addiction (Freimuth et al., 2011).

Furthermore, research in this area postulated the theory according to which the capacity for affective modulation intrinsic to physical activity and implicitly mood improvement represent one of the mechanisms by which a person can become sport dependent (Adams & Kirkby, 2002). On the other hand, affective regulation by sport is a feature common to all humans, and not all those who perform physical exercise at an increasing intensity and frequency become dependent (Freimuth et al., 2011).

In fact, a cross-sectional study conducted in 2002 evidenced that the frequency of physical training is not significantly correlated with the level of physical or mental health, with self-esteem or affective disorders (Ackard et al., 2002).

From a psychological point of view, recreational exercise can be differentiated from risk exercise by evaluating the motivation that underlies the practice of a sport (Freimuth et al., 2011). Thornton and Scott (1995) demonstrated that the possibility of developing sport dependence increases in the case of persons who perform exercise in order to avoid unpleasant emotions or to change their physical appearance with the aim of increasing their self-esteem compared to those who train in order to improve their physical performance and fitness.

Johnston et al. (2011) mention in an article published in 2011 the lack of consensus in the literature regarding the definition of excessive physical exercise and propose its approach from a qualitative point of view, in stages along a continuum. The authors assessed a group of 32 women aged between 16-77 years, who practiced regular, sustained exercise. The results of this evaluation suggest that passing from a normal to a problematic style of physical training occurs through a gradual increase of daily exercise routine, in the context of an enhanced need to use physical activity as a coping mechanism.

## Elaboration of diagnostic criteria for exercise dependence

Considering that DSM 5 (\*\*\*, 2013; \*\*\*, 2016) reserves a separate chapter for non-substance related addictive behavior starting with gambling disorder, but with insufficient evidence for other groups of repetitive behaviors, called *behavioral addictions*, with subcategories such as “sex addiction”, “exercise addiction”, or “shopping addiction”, this new nomenclature opens the way to new research directions concerning the definition of behaviors with addictogenic potential (Freimuth et al., 2011; Freimuth, 2008). In this regard, Downs et Hausenblas (Downs et al., 2004 ; Hausenblas et al., 2002) identified a

series of possible diagnostic criteria for sport dependence, according to the model of DSM IV TR criteria for substance dependence (\*\*\*, 2000; \*\*\*, 2003):

- Tolerance: increasing the amount of physical exercise in order to obtain the desired effect (excitement or the feeling of fulfillment).

- Withdrawal: in the absence of training, experiencing negative effects such as anxiety, irritability, concern or sleep disorders.

- Lack of control: unsuccessful attempts to diminish physical exercise or to stop it for a certain time period.

- Intentional effects: an inability to maintain the proposed routine, evidenced by consistent exceeding of the time allocated to training.

- Time: a considerable length of time is allocated to training or recovery after exercise.

- Limitation of activities: social, occupational and/or recreational activities are diminished or stopped as a direct consequence of excessive training.

- Perseverance: continuing training despite the awareness that this activity creates or exacerbates a series of physical, psychological and/or interpersonal problems.

It should be mentioned that other theorists, such as Elbourne and Chen, propose delaying the establishment of diagnostic criteria and emphasize the need for a phenomenological and etiopathological understanding of excessive physical exercise in a first stage (Elbourne & Chen, 2007).

Furthermore, there is currently no clear delineation between the practice of an intensive sport within normal limits and a possible disorder. In this context, Freimuth et al. (2011) proposed 4 stages of behavior associated with physical exercise:

- Stage 1: Recreational exercise, motivated by an increase in quality of life and the sensation of well-being secondary to the practice of a sport.

- Stage 2: Risk exercise, associated with the affective modulation capacity of physical exercise through an increase of positive affects and a diminution of negative affects such as depression and anxiety, which allows for deviation from normal healthy behavior to compensatory behavior.

- Stage 3: Problematic exercise. At this stage, a differentiation is made between subjects who perform recreational physical exercise, integrating it into their daily program, and problematic subjects, who tend to organize their daily activities depending on their exercise program, which becomes increasingly rigid (Johnston et al., 2011). Also, at this stage, secondary negative consequences become predominant, manifesting at individual level (e.g. continuation of exercise beyond the limit of exhaustion, self-criticism) and at social level (activity becomes solitary, close persons feel they are abandoned in favor of sport), as well as by the development of withdrawal symptoms (e.g. irritability) on cessation or diminution of the imposed regimen. The author also describes the development of non-discriminatory behavior (e.g. if a person injures their leg while practicing their favorite exercise, they take up another sport, for example weightlifting) (Freimuth et al., 2011).

- Stage 4: Sport dependence. The frequency and

intensity of exercise increase until this becomes the central point of life, interferes with daily routine, and is mainly motivated by the diminution of withdrawal symptoms, with the presence of negative social, professional and self-image consequences.

### **Possible etiologies described in the literature**

#### *A). Neurobiological perspectives*

##### *1. The endogenous opioid hypothesis*

Wagemaker and Goldstein suggested in 1980 that the sensation of euphoria felt by many people during exercise is the result of physiological changes in the brain (Wagemaker & Goldstein, 1980). Thoren et al. (1990) reported that intense physical exercise activates the endogenous opioid system, with a significant increase in the concentration of B-endorphins (Thoren et al., 1990). Moreover, the release of endorphins would lead to a rise in insulin secretion, an essential process in the restoration of energy reserves after sustained exercise, suggesting that endorphins might reinforce post-exercise behavior. Thus, persons who perform intense, sustained exercise might become dependent on endogenous endorphins secreted in the brain (Adams & Kirkby, 2002).

Steinber et al. (1995) studied the relationship between endogenous endorphins and the well-being reported after exercise, with contradictory results, and despite the proposed theories and parallels drawn between well-being after exercise and after exogenous opioid consumption, no direct relationship between withdrawal symptoms following discontinuation of exercise (Adams & Kirkby, 2002) and the variations of endogenous opioids has been so far established.

##### *2. The catecholaminergic hypothesis*

Thompson & Blanton (1987) proposed the hypothesis of sympathetic hormonal excitation, which maintains that an increase in physical exercise tolerance leads to an increase in the metabolic rate and through it, to a reduction of adrenaline and noradrenaline secretion. This results in an enhancement of lethargy and fatigue. According to the authors, in order to fight this state, an intensification of exercise is required to induce excitation levels similar to those before exercise. Also, in accordance with the literature data, the authors state that regular physical exercise can diminish depressive symptoms by raising circulating catecholamine levels (Adams & Kirkby, 2002). Thus, they conclude that withdrawal symptoms occurring after sustained exercise (lethargy, fatigue) are similar to depressive symptoms that occur in the context of catecholamine (NA, A) depletion. On the other hand, other researchers evidence that the dynamics of brain catecholamine levels during exercise in humans is unknown, because no direct measurements of catecholamine concentrations in the brain can be performed (Berczik et al., 2012).

##### *3. The thermogenic hypothesis*

Exercise causes an increase in the body temperature, followed by a secondary diminution of somatic anxiety, which is closely related to an increase in temperature in certain brain regions (Craft & Perna, 2004). Thus, it can be postulated that increased levels of anxiety may be associated with an enhanced need for physical exercise (Berczik et al., 2012).

#### *4. The dopaminergic hypothesis*

A study carried out in mice by De Castro & Duncan (1985) suggests that chronic exercise leads to enhanced dopaminergic secretion, which results in a compensatory drop in dopaminergic receptors, explaining the diminution of depressive symptoms in the context of physical exercise; at the same time, given that an individual requires an increase of dopaminergic levels by exercise to compensate the receptor reduction, this mechanism might explain exercise dependence.

Adams suggests that in the case of a decrease in hedonic pleasure from other activities, an individual may need to maintain a more intense exercise regimen for an optimal activation of the dopaminergic mediated reward circuit (Adams & Kirkby, 2002).

Gapin et al. (1985) correlated the elevation in the risk of exercise dependence with a frontal lobe asymmetry that occurs in the presence of addictive disease.

##### *B). Psychosocial perspectives*

In 1995, Szabo proposed the cognitive evaluation theory to better understand the etiology of sport addiction. According to this theory, once individuals have started using physical exercise as a method of coping with stress, they learn to depend on physical activity as a mode of relaxation. Subsequently, rationalization is used to explain the excess. When physical activity is stopped, negative feelings such as irritability, guilt, anxiety occur, which are withdrawal symptoms. Given that sport is the main coping mechanism, increasingly intense training is performed to suppress unpleasant sensations, and a vicious circle is formed (Berczik et al., 2012).

The affect regulation hypothesis states that physical exercise has a dual effect on mood, causing an enhancement of positive affects and a diminution of negative affects. When the motivation for practicing a sport consists of reducing the negative affects, in the context of a more prolonged discontinuation of exercise, their intensity increases and the individual must increase the intensity and duration of exercise to cope with these (Berczik et al., 2012).

In 2017, Bircher et al. published a systematic literature review on the correlation of some personality traits with exercise dependence. Thus, concerning the Big Five system, the results of a number of studies are contradictory: some studies describe a positive correlation between sport dependence and extraversion, high levels of neuroticism and openness and low levels of agreeableness and conscientiousness, but other studies refute these hypotheses.

Regarding Cloninger's personality dimensions, sport dependence was associated with high persistence and harm avoidance and low self-directedness and maturity levels. A high level of perfectionism, especially self-oriented and maladaptive perfectionism, was correlated with sport addiction. Low self-esteem and high self-criticism, as well as a high degree of narcissism were also correlated with excessive training (Bircher et al., 2017).

In a 2001 study, Spano revealed the implication of obsessive tendencies in the development of exercise dependence, and another study conducted in 2014 (Miller & Mesagno) showed that a combination of narcissism, perfectionism and obsessive compulsion can be a good predictor for the development and progression of sport

dependence.

A study carried out in 586 women aged between 17 and 55 years identified a number of variables that differentiate subjects who perform physical activities in a healthy way from those with a pathological behavior. Subjects who perform frequent exercise, have strong emotional investment in physical exercise and are highly committed to it show significant correlations with the associated psychopathology, unlike another category, who also practice sport frequently, with some degree of commitment, but have no psychological fixation on physical activity and are adaptable. Thus, the psychological fixation factor is the most correlated with mental disorders, independently of the frequency of exercise (Ackard et al., 2002).

In 2011, Taranis et al. proposed a multidimensional personality model of an excessive exerciser, the described traits being: compulsivity, affect regulation, behavioral rigidity, perfectionism and concerns related to weight and physical appearance.

A study carried out by Naylor et al. in 2011 women evidenced that the presence of high exercise belief is statistically significantly associated with a set of obsessive beliefs, with the presence of obsessive-compulsive symptoms and eating disorders. At the same time, the presence of obsessive beliefs and behaviors in a person predisposes that person to the development of an exercise regimen aimed at a significant weight loss and to the development of safety behaviors (Naylor et al., 2011). Obsessive beliefs may occur in relation to physical training and they can lead to rigid behaviors.

A study conducted in 2010 in a group of 421 adolescents of both sexes analyzed the implications of sociocultural pressure on the development of excessive training behavior.

Sociocultural pressure involves the feedback that a subject receives from the media, parents and friends. This study found that the relationship between sociocultural pressure and the need for intense physical exercise is mediated by the subjects' level of investment in their physical appearance and image, i.e. their need to lose weight or increase their muscle mass. The study revealed the fact that boys are more focused on exercise as a means to change their physical appearance compared to girls. In the case of girls, the impact of social pressure on the body image is higher (White & Halliwell, 2010).

## Epidemiology

Literature data on the epidemiology of sport addiction are preliminary and inconsistent. A literature review conducted by Sussman et al. (2011) estimated a prevalence of about 3% in the general population. Among participants in ultramarathons and physical education students, the prevalence is even higher (Freimuth et al., 2011).

A study on triathlons reported a 52% prevalence of sport addiction in the group. Other researchers showed that 26% of the men and 25% of the women who practiced running as a sport were dependent on it (Berczik et al., 2012). According to Lejoyeux et al. (2008), 42% of the members of a Parisian fitness room had sport dependence symptoms.

Significant variations between different studies regarding the prevalence of sport dependence are more

probably present because of the unclear definition of dependence, as well as because of the use of ineffective evaluation tools (Berczik et al., 2012).

Two studies conducted in USA and UK, respectively, which used the EDS and EAI scales, two psychometrically valid assessment tools, showed that 2.5% and 3%, respectively, of the population that performed regular exercise met the criteria for addiction (Berczik et al., 2012).

## Exercise dependence assessment scales

- The *Exercise Dependence Scale* (EDS-R) (Downs et al., 2004) and the *Exercise Addiction Inventory* (EAI) (Terry et al., 2004) are two easy-to-use, highly valid and reliable scales, developed with the aim of identifying excessive exercisers, which differentiate between asymptomatic, symptomatic and dependent subjects (Freimuth et al., 2011).

- The EDS scale contains 7 subscales: tolerance, withdrawal, intentional effect, lack of control, time, diminution of other activities and perseverance (Berczik et al., 2012).

- The *Exercise Dependence Questionnaire* scale measures the compulsivity of exercise and includes 8 subscales: interference with social life/family life/work; positive reward; withdrawal symptoms; exercise as a weight control method; insight; exercise for social, health and stereotyped behavior reasons (Ogden et al., 1997).

- The *Exercise Beliefs Questionnaire* scale is a more rarely used general assessment tool, which evaluates distinct thoughts and beliefs related to physical exercise, based on the following factors: social desirability; physical appearance; mental and emotional functionality; vulnerability to aging (Loumidis & Wells, 1998).

- The *Commitment to Exercise Scale* examines the pathological aspects of physical training and associated compulsive activities (Davis et al., 1993).

- The *Exercise Orientation Questionnaire* scale comprises 6 factors: self-control, exercise orientation, self-deprecation, weight loss, competitiveness and identity. It measures attitudes toward exercise and additional behaviors (Yates et al., 2001).

- The *CET Compulsive Exercise Test* scale is a 24-item self-report scale developed to assess the central components of exercise in the case of eating disorders. It includes 5 subscales: avoidance of withdrawal and behavior motivated by strict rules, exercise as a weight control strategy, mood improvement, lack of pleasure in the context of exercise, and program rigidity, with high scores indicating more severe pathology (Berczik et al., 2012).

- The *Obligatory Exercise Questionnaire* scale comprises 20 items that identify a series of attitudes and activities related to physical exercise, with high scores on this scale suggesting high levels of feeling obligated to exercise (Freimuth et al., 2011).

## Which sports predispose more to excessive physical training?

The review conducted by Berczik et al. (2012) reports that so far, research on different forms of excessive exercise, with the description of specific characteristics or the comparison of dysfunctionality levels, has been inconsistent. This article highlights the fact that most of

the knowledge of sport addiction is derived from studies performed on long-distance runners, aerobic exercisers and bodybuilders. There are fewer empirical data on dancers, martial arts fighters, weightlifters and triathlons.

### Comorbidities

Despite the limited number of available studies, the literature data suggest that 15-20% of sport dependent persons have other associated addictions (Aidman & Woollard, 2003). Of these, the most common are the abuse of psychostimulants such as caffeine, cocaine and amphetamines (George, 2000), anabolic steroids (Peluso, 2005), sexual behaviors, eating behaviors and compulsive shopping, as well as work dependence (Freimuth et al., 2011).

A study published in 2018 (Szabo et al.) shows that sport addiction is not correlated with alcohol dependence and that there is a negative correlation between nicotine consumption and excessive exercise.

Sport dependence is frequently associated with eating disorders, the literature data suggesting a 39-48% incidence of these comorbidities (Freimuth et al., 2011; Klein et al., 2004).

Excessive exercise is very common in patients with anorexia nervosa, with a lifelong prevalence of up to 80% of cases. Anorexia nervosa cases in which intensive exercise is associated have a higher incidence of obsessive-compulsive symptoms (Young et al., 2013), a poorer prognosis and a higher rate of relapse (Dalle Grave et al., 2008; Carter et al., 2004).

### The negative consequences of excessive physical training

An article published in 2001 (Adams & Kirkby), aiming to evaluate the literature data related to the physiological and psychological consequences of excessive training, reports that excessive physical training induces changes in the neuroendocrine balance, with a decrease in the body's capacity to repair tissue destruction, a reduction of muscle mass progressing to muscle atrophy, circulatory alterations, and fertility and reproductive disorders in both sexes. Other reported changes are adrenergic dysfunction, a decrease in plasma beta-endorphin concentrations, and a reduction of gonadal steroid levels.

This review also mentions a possible immunological dysfunction, with decreased replication of the cells involved in immunity and diminished body resistance to infections.

Regarding the impact of excessive training on the cardiovascular system, in addition to potential effects on blood pressure values (Adams & Kirkby, 2001), a study carried out in 2017 (Müssigbrodt et al.) draws attention to the risk of developing atrial fibrillation following excessive exercise.

Furthermore, a study conducted in 2016 (Sun et al.) on mice subjected to high-intensity exercise showed a decrease in their cognitive capacity (decreased learning and memory capacity), through immunological changes in the hippocampus.

### Treatment

In the case of sport dependence, abstinence is not a desideratum, moderate exercise being an important part of a healthy lifestyle. Although the literature provides few recommendations regarding specific treatment for this problem, cognitive behavioral therapy might be successful in these cases, focusing on increasing awareness about the adverse effects of excessive training, identifying dysfunctional automatic cognition, and associating behavioral strategies (Johnston et al., 2011).

Weinstein & Weinstein (2014) suggests that excessive exercisers should be evaluated and treated depending on the degree of symptom severity, as well as depending on comorbidities or other possible associated addictions.

In terms of methods for the prevention of excessive exercise, Adams proposes the periodization of training in order to maintain a balanced regimen of regular physical activities, as well as dietary antioxidant supplementation (vitamins A, C, E) to prevent the harmful effects on immunity (Adams & Kirkby, 2001; Adams, 2009).

On the other hand, De Coverly Vale (1987) highlights the fact that in the case of persons who have developed sport addiction, the suggested prevention methods are ineffective, because these individuals either do not know or do not wish to implement the described prevention methods.

In the context of an increasing prevalence of body image disorders, eating disorders and excessive exercise in the young population, Australian researchers (Yager & O'Dea, 2010) conducted a study in which they proposed a set of educational interventions based on self-esteem improvement, media education and the development of cognitive dissonance related to these aspects, in a cohort of 170 male and female subjects. Following the program, an improvement of self-esteem, body image and the need for muscle mass gain was observed, as well as an amelioration of eating disorders and excessive physical training, which suggests the possibility of curricular health education interventions.

Landolfi proposes the implementation of recommendations for healthy physical training at national level, as proposed by the Canadian Society for Exercise Physiology (Landolfi, 2013).

### Conclusions

1. The benefits of regular physical activity on health, functionality and quality of life are undeniable. However, an increasing number of researchers draw attention to the fact that this healthy behavior might become under certain circumstances a behavior at risk for the development of dependence.

2. The factors that the literature suggests to be involved in the development of exercise dependence are biological, psychological, psychosocial; further studies are required to establish a causal relationship between these.

3. Some researchers propose to stage the risk of sport dependence and advocate a different therapeutic approach from case to case, depending on the severity of symptoms. Diagnostic criteria for exercise dependence according to international classifications in force have been proposed.

4. A number of instruments have been developed to quantify excessive exercise.

5. The negative consequences of excessive training are both psychological and somatic, with an unfavorable impact on the circulatory, musculoskeletal and immune systems.

6. Empirical data on a possible treatment of excessive exercisers are limited; cognitive behavioral therapy has been proposed as a possible therapeutic approach.

7. In our opinion, rigorous studies on a greater number of subjects, with clear inclusion and exclusion criteria are required in order to get a wider perspective on this issue. Otherwise, there is a risk for trivializing this subject, with the possibility of either over- or underdiagnosis, which might lead to an undesired stigma, on the one hand, and to failure to recognize the symptoms, with negative consequences on health, on the other hand.

### Conflicts of interest

There are no conflicts of interest.

### References

- Ackard DM, Brehm B J, Steffen JJ. Exercise and eating disorders in college-aged women: Profiling excessive exercisers. *Eating Disorders* 2002;10(1):31-47.
- Adams J, Kirkby RJ. Excessive Exercise as an Addiction: a Review. *Addiction Research and Theory* 2002;10(5):415-437.
- Adams J, Kirkby RJ. Exercise dependence and overtraining: The physiological and psychological consequences of excessive exercise. *Sports Med, Training Rehab.* 2001;10(3):199-222.
- Adams J. Understanding exercise addiction. *J. Contemp. Psychother.* 2009;39(1):231-240.
- Aidman EV, Woollard S. The influence of self-reported exercise addiction on acute emotional and physiological responses to brief exercise deprivation. *Psychol. Sport Exerc.* 2003;4(3):225-236.
- Bamber DJ, Cockerill IM, Carroll D. The pathological status of exercise dependence. *Br J Sports Med* 2000;34(2):125-132.
- Berczik K, Szabo A, Griffiths MD, Kurimay T, Kun B, Urbán R, Demetrovics Z. Exercise Addiction: Symptoms, Diagnosis, Epidemiology, and Etiology. *Substance Use & Misuse.* 2012;47(4):403-417.
- Bircher J, Griffiths MD, Kasos K, Demetrovics Z, Szabo A. Exercise Addiction: a Two Decade Systematic Review of the Empirical Literature (1995-2016). *Baltic J Sports Health Sci.* 2017;3(106):19-33.
- Brewer JA, Potenza MN. The neurobiology and genetics of impulse control disorders: relationships to drug addictions. *Biochem.Pharmacol.* 2008;75(1):63-75.
- Carter JC, Blackmore E, Sutander-Pinnock K, Woodside DB. Relapse in anorexia nervosa: a survival analysis. *Psychol Med* 2004;34(4):671-679.
- Cook B, Hausenblas H, Tuccitto D, Giacobbi PR Jr. Eating disorders and exercise: A structural equation modeling: Analysis of a conceptual model. *Eur. Eat. Disord. Rev.* 2011;19(3):216-225.
- Craft LL, Perna FM. The benefits of exercise for the clinically depressed. *Prim. Care Companion J. Clin. Psychiatry* 2004;6(3):104-111.
- Dalle Grave R, Calugi S, Marchesini G. Compulsive exercise to control shape or weight in eating disorders: prevalence, associated features and treatment outcome. *Compr Psychiatry* 2008;49(4):346-352.
- Davis C, Brewer H, Ratusny D. Behavioral frequency and psychological commitment: Necessary concepts in the study of excessive exercising. *J Behav Med* 1993;16(6):611-628.
- De Castro JM, Duncan G. Operantly conditioned running: effects on brain catecholamine concentrations and receptor densities in the rat. *Pharmacol Biochem Behav* 1985;23(4): 495-500.
- De Coverley Veale DM. Exercise addiction. *Br. J. Addict.* 1987;82(7):735-740.
- Downs DS, Hausenblas HA, Nigg CR. Factorial validity and psychometric examination of the Exercise Dependence Scale-Revised. *Meas. Phys. Educ. Exerc. Sci.* 2004;8(4):183-201.
- Elbourne KE, Chen J. The continuum model of obligatory exercise: A preliminary investigation. *J Psychosom Res* 2007;62(1):73-80.
- Fairburn CG. *Cognitive behavior therapy and eating disorders.* London: Guilford Press, 2008.
- Freimuth M, Moniz S, Kim SR. Clarifying Exercise Addiction: Differential Diagnosis, Co-Occurring Disorders, and Phases of Addiction. *Int. J. Environ. Res. Public Health* 2011;8(10): 4069-4081.
- Freimuth M. *Addicted? Recognizing Destructive Behavior before It's too Late;* Rowman & Littlefield Publishers, Inc: Lanham, MD, USA, 2008.
- Gapin J, Etnier J, Tucker D. The relationship between frontal brain asymmetry and exercise addiction. *J. Psychophysiol.* 2009;23(3):135-142.
- George AJ. Central nervous system stimulants. *Baillieres Best Pract Res Clin Endocrinol Metab.* 2000;14(1):79-88.
- Glasser W. *Positive Addiction.* New York, NY, USA: Harper & Row; 1976
- Grant JE, Potenza MN. Compulsive aspects of impulse-control disorders. *Psychiatr.Clin. North Am.* 2006;29(2):539-549.
- Griffiths M D. A “components” model of addiction within a biopsychosocial framework. *J Substance Use* 2005;10(4):191-197.
- Hausenblas HA, Downs DS. How much is too much? The development and validation of the Exercise Addiction scale. *Psychology and Health* 2002;17(4):387-404.
- Johnston O, Reilly J, Kremer J. Excessive exercise: From quantitative categorisation to a qualitative continuum approach. *Eur. Eat. Disord. Rev.* 2011;19(3):237-248.
- Klein DA, Bennett AS, Schebendach J, Foltin RW, Devlin MJ, Walsh BT. Exercise “addiction” in anorexia nervosa: Model development and pilot data. *CNS Spectrums* 2004;9(7):531-537.
- Landolfi E. Exercise Addiction. *Sports Med.* 2013;43(2):111-119.
- Lejoyeux M, Avril M, Richoux C, Embouazza H, Nivoli F. Prevalence of exercise addiction and other behavioral addictions among clients of a Parisian fitness room. *Comprehensive Psychiatry* 2008;49(4):353-358.
- Loumidis KS, Wells A. Assessment of beliefs in exercise dependence: The development and preliminary validation of the exercise beliefs questionnaire. *Personality and Individual Differences* 1998;25(3):553-567.
- Miller KJ, Mesagno C. Personality Traits and Exercise Dependence: Exploring the Role of Narcissism and Perfectionism. *Int J Sport Exerc Psychol* 2014;12(4):368-381.
- Morgan WP. Affective beneficence of vigorous physical activity. *Med Sci Sports Exerc* 1985;17(1):94-100.
- Morgan WP. Negative addiction in runners. *The Physician and Sports Medicine* 1979;7(2):57-70.
- Müssigbrodt A, Weber A, Mandrola J, van Belle Y, Richter S, Döring M, Arya A<sup>1</sup>, Sommer P, Bollmann A, Hindricks G. Excess of exercise increases the risk of atrial fibrillation. *Medicine and science in sports* 2017;27(9):910-917.
- Naylor H, Mountford V, Brown G. Beliefs about Excessive Exercise in Eating Disorders: The Role of Obsessions and

- Compulsions. *Eur Eat Disord Rev* 2011;19(3):226-236.
- Ogden J, Veale DM, Summers Z. The development and validation of the Exercise Dependence Questionnaire. *Addiction Research* 1997;5(4):343-355.
- Pasman L, Thompson JK. Body image and eating disturbance in obligatory runners, obligatory weightlifters, and sedentary individuals. *Int J Eating Disorders* 1988; 7(6):759-769.
- Pate RR, Pratt M, Blair SN, et al. Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 1995;273(5):402-407.
- Peluso MAM, Guerra de Andrade LHS. Physical activity and mental health: the association between exercise and mood. *CLINICS* 2005;60(1):61-70.
- Rosa DA., De Mello MT, Negrao AB, de Souza-Formigoni ML. Mood changes after maximal exercise testing in subjects with symptoms of exercise dependence. *Percept.Mot. Skills* 2004;99(1):341-353.
- Scully D, Kremer J, Meade MM, Graham R, Dudgeon K. Physical exercise and well-being: A critical review. *Br. J. Sports Med.* 1998;32(2):111-120.
- Spano L. The Relationship between Exercise and Anxiety, Obsessive-Compulsiveness, and Narcissism. *Personality and Individual Differences*, 2001;30(1):87-93.
- Stahl SM. *Stahl's Essential Psychopharmacology: Neuroscientific Basis and Practical Applications*, 3rd ed.; Cambridge University Press: New York, NY, USA, 2008.
- Steinberg H, Sykes EA, LeBoutillier N. Exercise Addiction: Indirect Measures of "Endorphins"? In J. Annett, B. Cripps and H. Steinberg (Eds.), *Exercise addiction: Motivation for participation in sport and exercise*. Leicester: The British Psychological Society, 1995:6-14.
- Sun LN, Li XL, Wang F, Zhang J, Wang DD, Yuan L, Wu MN, Wang ZJ, Qi JS. High-intensity treadmill running impairs cognitive behavior and hippocampal synaptic plasticity of rats via activation of inflammatory response. *J Neurosci Res.* 2017;95(8):1611-1620.
- Sussman, S., Lisha, N., Griffiths, M. Prevalence of the addictions: A problem of the majority or the minority? *Eval. Health Prof.* 2011;34(1):3-56.
- Szabo A, Frenkl R, Caputo A. Deprivation feelings, anxiety, and commitment to various forms of physical activity: A cross-sectional study on the Internet. *Psychologia* 1996;39(4):223-230.
- Szabo A. *Addiction to exercise: A symptom or a disorder?* New York, NY: Nova Science Publishers 2010.
- Szabo A. The impact of exercise deprivation on wellbeing of habitual exercisers. *Australian J Sci Med Sport* 1995;27(3):68-75.
- Taranis, L., Touyz, S., & Meyer, C. Disordered eating and exercise: Development and preliminary validation of the Compulsive Exercise Test (CET). *European Eating Disorders Review* 2011; 19, 256-268. doi: 10.1002/erv.1108
- Terry A, Szabo A, Griffiths M. The exercise addiction inventory: A new brief screening tool. *Addict. Res. Theory* 2004;12(5):489-499.
- Thompson JK, Blanton P. Energy conservation and exercise dependence: A sympathetic arousal hypothesis. *Med Sci Sports Exerc* 1987;19(2):91-99.
- Thoren P, Floras JS, Hoffmann P, Seals DR. Endorphins and exercise: Physiological mechanisms and clinical implications. *Med Sci Sports Exerc* 1990;22(4):417-428.
- Thornton EW, Scott SE. Motivation in the committed runner: Correlation between self-report scales and behavior. *Health Promot. Int.* 1995;10(3):177-184.
- Veale D. Does primary exercise dependence really exist? In J. Annett, B. Cripps, & H. Steinberg (Eds.), *Exercise addiction: Motivation for participation in sport and exercise*. Leicester: The British Psychological Society 1995.
- Wagemaker H, Goldstein L. The runner's high. *J Sports Med.* 1980;20(2):227-229.
- Weinstein A, Weinstein Y. *Exercise Addiction - Diagnosis, Bio-Psychological Mechanisms and Treatment Issues*. *Current Pharmaceutical Design* 2014;20(25):4062-4069.
- White J, Halliwell E. Examination of a sociocultural model of excessive exercise among male and female adolescents. *Body Image* 2010;7(3):227-233.
- Yager Z, O'Dea J. A controlled intervention to promote a healthy body image, reduce eating disorder risk and prevent excessive exercise among trainee health education and physical education teachers. *Health Educ Res.* 2010;25(5):841-852.
- Yates A. *Compulsive exercise and the eating disorders: Toward an integrated theory of activity*. NY: Brunner/Mazel, 1991.
- Yates A, Edman JD, Crago M, Crowell D. Using an exercise-based instrument to detect signs of an eating disorder. *Psychiatry Research* 2001;105(3):231-241.
- Young S, Rhodes P, Touyz S, Hay P. The relationship between obsessive-compulsive personality disorder traits, obsessive-compulsive disorder and excessive exercise in patients with anorexia nervosa: a systematic review. *J Eat Disord* 2013;1:16.
- Zmijewski CF, Howard MO. Exercise addiction and attitudes toward eating among young adults. *Eat. Behav.* 2003;4(2):181-195.
- \*\*\*. American Psychiatric Association: *Diagnostic and Statistical Manual of Mental Disorders*, Fifth edition. Arlington, VA, American Psychiatric Association, 2013.
- \*\*\* American Psychiatric Association. *DSM – 5. Manual de diagnostic si clasificare statistica a tulburarilor mintale*, Editura Medicala Callisto, 2016.
- \*\*\*. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders (Text Revision)*, 4th ed. American Psychiatric Association: Washington, DC, USA, 2000.
- \*\*\* American Psychiatric Association. *Manual de Diagnostic si Statistica a Tulburarilor Mentale (Editia a patra revizuita) DSM-IV-TR*, Editura Asociația Psihiatrilor Liberi din România, București, 2003.