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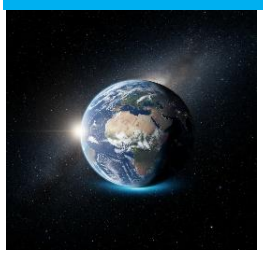

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Exercise Addiction Among Youth As a Behavioral Addiction – a narrative review

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Abstract

Background. Understanding behavioral addictions, including exercise addiction, is crucial to comprehend their consequences. The development of a behavioral addictions group suggests that current knowledge about dysfunctional activities is incomplete, especially in youth.
Aim. The aim of this review was to combine the existing evidence on behavioral addictions, especially exercise addiction, in youth, in the context of evolving classification and the growing trends promoting inappropriate forms of physical activity.
Material and methods. We analyzed 111 studies and reviews describing various aspects of exercise addiction in youth, prioritizing mechanisms of development, risk factors, diagnostic

and therapeutic methods, based on data from groups of adolescents or young adults.

Results. Findings of the review showed that the literature addressing exercise addiction among adolescents is limited. Common mechanisms can be recognized, including those related to personality traits, body self-awareness, and environmental influences. Many risk factors were identified and linked with the type of sport practiced, cultural impacts, and other mental disorders, mostly eating disorders and body image disturbance. Current diagnostic and therapeutic processes, although partially studied among youth, remain unstructured.
Discussion. Available sources are based primarily on adults. Due to the specification of adolescence, described findings are insufficient to clearly define the excessive exercise in youth. The development of a unified psychiatric approach, enabling early identification of high-risk individuals and prevention of addiction, is limited.
Conclusions. Exercise addiction and other behavioral addictions in youth are a promising topic that requires further research.

Key Words: exercise addiction; adolescence; youth; eating disorders; physical activity; behavioral changes

1.Introduction

Addictions have become a permanent part of the discourse on the problems facing today's youth. The challenges of the world impact young people's mental health and the development of behavioral patterns, including decision-making, emotions regulation or recognizing and satisfying inner needs. Addictions are a result of failures, even minor ones, in all these aspects of a child's development on the path to adulthood [1, 2].
One of the emerging trends observed among young people involves behavioral addictions associated with lifestyle and body image concerns [3, 4]. This includes exercise addiction, which is a remarkable example of how healthy, widely accepted, and praised habits evolve into a disorder, often leading to a breakdown in life, as well as a crisis for the entire environment of the addicted person [5, 6]. This review focuses on adolescents and young adults, a population that is particularly vulnerable to the long-term consequences of addictions, including behavioral ones.

1.1.The Development of the Adolescents Nervous System and Susceptibility to Addiction

Childhood and adolescence are a time of multiple neurobiological changes that have a real impact on daily functioning. Notably, up to 40% of adults with addictions report that the onset of their addictive behavior occurred between the age of 15–19 [2]. From the age of 12, the brain undergoes transformation, leading to the remodeling of its regions, as directly observed using functional magnetic resonance imaging (f-MRI) [2]. One of the last of these processes is the maturation of the prefrontal cortex, responsible for the proper assessment of the situation, its risk and consequences, as well as for deliberation and planning of actions. According to scientific research, full myelination of the prefrontal cortex occurs between the age of 23 and 25 [2]. This biological control point enables the inhibition of impulsive behavior, which appears to be crucial, especially in the development of addiction. While new neural pathways are being created, the adolescent brain is in a sensitive stage [3], more susceptible to actions that lead to the development of dependencies, regardless of the factor [2]. To quote research by Gladwin et

al. (2011): "The vulnerabilities of adolescents map onto what makes addictive substances harmful," – but not only substances [7]. Understanding the motivated actions, related to addiction onset in youth, is inseparably linked to perception of adjustment disorders, "leading to states of reflective and impulsive processing" [7].

Another part of the brain undergoing significant changes is the amygdala – the center of emotions, enabling accurate interpretation of one's own feelings and the reactions of others. The underdeveloped connections between the frontal lobe and the amygdala, and its incomplete maturity until the 20s, can result in situations when a teenager intellectually understands and has emotional reactions to them, yet these responses are unrelated [2]. Misinterpreting emotions and their accompanying experiences, and consequently making unwise decisions, are not only a characteristic of the younger age but also the key to comprehend the increased susceptibility of children and adolescents to develop addictions, particularly behavioral ones. The relationship between emotion regulation and addictive behaviors in adolescents and young adults has been confirmed for both substance-related and non-substance-related addictions [1]. Furthermore, some studies directly indicate that lower levels of emotional intelligence are associated with increased smoking, alcohol and drug use, and behavioral addictions [8].

Adolescence is also an important stage of hormonal changes. Among the most important hormones and neurotransmitters involved in these processes are oxytocin, vasopressin, serotonin, and dopamine [2]. Dopamine, which primarily influences the experience of pleasure, is the essential neurotransmitter of the reward system. Fluctuations in dopamine levels through adolescence may result in an enlarged need for stimulation to achieve similar intensity of pleasure as adults [2, 5]. Attempts to achieve euphoria may lead to more frequent engagement in activities requiring increased risk. This suggests a link between dopamine releases and addictive behaviors. Even ordinary activities, including physical activity, that bring a feeling of satisfaction, can become addictive through this mechanism, and more quickly than in adults [2]. The adolescent nervous system is a sensitive mechanism based on two pillars – resources and influences. This division allows for a shift from a "nurture versus nature" approach based on the equivalence of these two factors [2]. The studies have demonstrated the influence of many factors on the nervous system in adolescence, including physical activity, sleep, psychoactive substances, particularly alcohol and marijuana, social media and family difficulties [2]. However, all of these factors share a common ground – "the environment". It shapes not only moral values and behaviors but, above all, epigenetic changes that affect gene expression [2, 9]. Therefore, harmful external factors can indirectly influence the formation of inappropriate neural connections, resulting in brain function impairment, not only during development, but also in adulthood.

1.2.Behavioral Addiction and Its Varieties

1.2.1.Classification of Behavioral Addictions

Understanding specific examples of addiction, regardless of onset age, requires classifying them, and examining the similarities and differences in their mechanisms. Based on clinical observations, we can conventionally distinguish two groups of addictions – either related or not related to psychoactive substance use [5, 10]. Over the years, no consensus has been reached regarding the official inclusion of behavioral addictions, e.g., not related to substance use, in psychiatric diagnostic classifications [5, 11]. In the past, behaviors that are now considered addictive were primarily treated as compulsive [10]. Changing this approach and creating a new group of diagnoses required many years of scientific discussion, which is still ongoing.

The concept of "non-substance-related behavioral addiction" did not appear in either the DSM-IV-TR (Diagnostic and Statistical Manual of Mental Disorders) [12] or the ICD-10 (International Classification of Disease) [13]. The first official attempts to classify this group were made during the publication of the DSM-V [14], which included gambling disorder and (internet) gaming disorder as behavioral activities with addictive potential. The text revision of the DSM-V [15] maintained these assumptions, clearly emphasizing the connection between these activities and significant impairment or distress. Another breakthrough occurred earlier, in 2019, when ICD-11 was published, including the category of "disorders due to addictive behaviors" [16].

Gambling and (internet) gaming disorder were not only the first to be officially recognized as behavioral addictions but also became a model of the whole group [5, 10]. This pattern provides an example for further redefinition of existing diagnoses and expansion of the newly created group. Although behavioral addictions are not a uniform category of disorders, most authors currently advocate for inclusion of further potential behavioral addictions [11]. Other excessive behaviors that may most likely lead to behavioral addictions include social media use, exercise, shopping, internet browsing, sex and other activities [2, 5, 6, 17].

1.2.2.Substance Use Addictions vs. Behavioral Addictions

Behavioral and substance use addictions share common phenomenology, adverse consequences, abnormal behavioral patterns, comorbidity, and early onset, most often in adolescence or early adulthood. Many similarities have also been described at the neurobiological level, including similar responses to selected medications [4, 10, 18]. According to Noble (1998) and Holden (2001), behavioral addictions, by indirectly acting on neurotransmitters, including the dopaminergic system, can produce stimulation comparable to the effects of psychoactive substances [19, 20]. The numerous common features between these types of addictions are also explained by Peele's concept, which is based on the hypothesis that the patient is addicted to a specific set of experiences, not necessarily a specific substance. Following this reasoning, "behavior science experts believe that any source capable of stimulating an individual could become addictive" [5, 21]. The fundamental difference between the substance use and non-substance addictions is primarily the somatic response of drug addiction, or rather, in the case of behavioral ones, its absence [5].

However, the above diagnoses should not be strictly separated – a correlation between excessive substance use and abnormal behavioral activities has been confirmed [1, 18]. In a study conducted on teenagers (mean age 12.5 years) addicted to gambling, significantly higher rates of extensive alcohol drinking and nicotine addiction were observed [1]. Other research describing the relationship between "juvenile binge drinking" and later alcohol dependence highlight a general increase in the tendency to develop addictions, further confirming the likelihood of a common pathway of adaptive-behavioral disorders as the main problem of addicts [7].

1.2.3.Characteristics of Behavioral Addictions

The type of activity performed significantly influences the presentation of behavioral addiction and its course. Some authors suggest an unofficial classification of behavioral addictions distinguishing between passive (e.g., television) and active (e.g., physical exercise, computer gaming) [5]. The nature of the activity can be a valuable clue in identifying factors that induce

and reinforce the development of behavioral addiction in a given individual, facilitating further diagnostic and therapeutic processes [1].

As early as the 1990s, Goodman (1990), Brown (1993), and Griffith (1996) proposed criteria for general behavioral addictions [22, 23, 24]. These criteria are based on several common aspects as presented in Table 1.

Table 1. The main criteria of behavioral addiction [22, 23, 24].

Name of the criterion	**Description of the criterion**
Salience	Prioritizing addictive activity over other aspects of everyday life.
Euphoria	A feeling of fulfillment while performing the addictive activity.
Tolerance	The need to increase the intensity and/or duration of the addictive activity.
Withdrawal Symptoms	The effect of withdrawal or reduction in the addictive activity.
Conflict	The dominance of the addictive activity, leading to intra- and interpersonal conflicts.
Relapse and Reinstatement	A return to the addictive activity despite the negative consequences of the addiction.

Among other noteworthy symptoms, those authors also mention a feeling of loss of control during the activity, a lack of critical insight, and prolonged ruminations about the addictive activity. Additionaly, before performing the particular activity, a feeling of tension is observed. After performing it, pleasure, gratification, or relief occurs [10, 18]. Behavioral addictions, like other addictions, also result in progressive difficulties in everyday life, manifesting through neglect of interpersonal relationships, responsibilities, and basic functioning in favor of the addictive activity [5]. The psychopathological symptoms also presented in individuals addicted to specific activities, anxiety, affective and obsessive-compulsive disorders are most frequently observed [5]. Addicts show an isolating attitude or withdrawal from life roles and social interactions; they are described as "tired, depressed, lonely, bashful, and shy" [5]. Along with behavioral addictions, the risk of co-occurring other addictions also increases [6, 25]. In turn, attempts to stop engaging in an addictive activity may be associated with withdrawal-like symptoms such as general fatigue, sleep disturbances, irritability, or aggressive behavior, which are often the first to arouse concern, indicating a strong internal conflict [5].

1.2.4.Exercise Addiction – The Line Between Health and Disorder

The group of behavioral addictions continues to expand with new diagnoses. Other potentially addictive activities include excessive exercise [6, 26, 27], which is becoming an increasingly common problem, especially in adolescence and early adulthood. Widespread awareness of the positive health impact of physical activity can make it difficult to perceive excessive exercise as potentially threatening.

However, according to statistics from previous years, the prevalence of exercise addiction can be estimated from 3% to 42% depending on the population studied [28, 29, 30] and from 3% to 13% among adolescents [29]. An international analysis of the prevalence of addiction among youth found that exercise addiction was the second most common among 11 studied addictions [31]. Another research, examining a sample of Italian students, aged 11 to 20, found an 8.5% prevalence of exercise addiction [32]. A survey of sports science and psychology students participating in team sports or aerobics and gym classes, described that 3% of young adults exhibited symptoms of exercise addiction [33]. Other studies on student groups found rates of 6.9% (British) [34] and 14.9% (Spanish) [35] of excessive exercise in the surveyed sample.

This addictive activity is described by various terms, including exercise addiction, exercise dependence, obligatory exercise, compulsive exercise, and excessive exercise [36]. Nevertheless, addiction is the most accurate, due to the combination of a compulsive need to engage in physical activity and a dependence on the activity despite its negative consequences [36, 37].

Exercise addiction meets all the classic criteria for behavioral addiction – it is associated with a need to increase exercise intensity, experiencing negative effects of cessation of exercise, and devoting significant time to thinking about and preparing for exercise, performing it, and recovering after physical activity [4, 36, 38, 39]. Typically, excessive exercise persists despite the obvious negative effects of increased training intensity (e.g., physical injuries, psychological stress, loss of relationships) [2, 4, 40].

Missing a workout, usually for reasons beyond the addict's control, triggers a strong sense of guilt [25, 41]. Symptoms of physical activity limitation in addicted individuals, which appear on average within 24–36 hours of ceasing exercise, include general fatigue, headaches, depressed mood, sleep disturbances (primarily insomnia), loss of appetite, apathy, anxiety, restlessness, irritability, and aggression [41]. Short-term absences (up to 2 weeks) can also result in somatization disorders, chaotic thought processes, and a general decrease in vigor and motivation to perform daily activities [25].

Furthermore, it's also worth noting the somatic group of symptoms associated with exercise addiction. Among over-exercising young adults, the most common findings included a higher risk of complex and/or chronic injuries (sprains, dislocations, fractures or overuse injuries) [42], weakened immunity, hormonal changes, and falls from heights, depending on the type of sports practiced [6]. Knee injuries were one of the most frequently reported traumas among those surveyed at sport centers [43]. All of the above symptoms are a direct result of excessive training frequency and intensity without adequate recovery. They may also explain the lower results of the sports-dependent young adults in the measurement and identification of pain stimuli [42].

Due to persistent injuries and lack of rest, excessive exercise can result in decreased athletic performance, contrary to adolescents' expectations [44]. Overtraining syndrome (OTS) primarily manifests itself through persistent fatigue, increased risk of musculoskeletal injuries and decreased physical performance, despite continued training. It may also be associated with body weight loss, which is an important factor in the differential diagnosis with possible eating disorders [44]. Some authors suggest that OTS represents "the body's attempt to protect the physical health of a subject who exercises excessively" [45]. Another symptom complex, that can be linked to exercise addiction, is relative energy deficiency in sport (RED-S), characterized by "energy imbalance due to excessive training and inadequate nutrition," manifested by hormonal dysfunction, reduced bone density, and decreased performance in sport [36, 44].

Although most studies focus on the physical and social symptoms of excessive exercise, there are no reports describing the long-term cognitive effects of exercise addiction among

adolescents. According to a behavioral approach, the addiction process can also contribute to the development of other abnormal behavioral patterns, including impulsivity, compulsivity, and disturbances in emotion and attention regulation (Caponetto et al., 2021).

2.Research material and methods

This review is narrative and does not constitute a systematic meta-analysis; its aim was to qualitatively summarize the current state of knowledge on behavioral addictions among adolescents and young adults, with a particular emphasis on exercise addiction.
A total of 111 papers met the inclusion criteria and were involved in the present review. Relevant studies were identified through a search of two online databases: PubMed and Google Scholar. The following search strategy was conducted: (“excessive exercise” OR “exercise addiction” OR “behavioral addiction”) AND (“adolescence” OR “youth” OR “young adult”). A large majority of studies examined addictive exercise in relation to eating disorders (n = 30), body image disturbance (n = 30), other mental disorders, including anxiety (n = 28), depression and/or suicidal behaviors (n = 25), other addictions (n = 20) and sleep disorders (n = 10). Additional aspects of investigation embraced social impact (n = 30), personality and attachment development (n = 25), selection of amateur or professional sport (n = 40), gender (n = 15), and level of education (n = 5). Studied articles focused on clinical and non-clinical populations, primarily adolescents (< 18 years of age) and adults, but most frequently younger adults (< 30 years of age). The analysis was based on peer-reviewed, recommended scientific papers, most of which were available in open access. Articles in English, or translated from the native languages, were included. The analysed studies involved empirical and review studies from the years 1990-2026. In preparing this work, the authors used ChatGPT (OpenAI) for the purpose of language editing and grammar correction only.

3.Research results

3.1.The Mechanism of Excessive Exercise and Addiction

3.1.1.Self-conscious Emotions

Adolescence is a period of significant cognitive and psychological changes. This also includes learning to recognize and interpret one's own emotions and reflections. Strong feelings pose a challenge to the immature nervous system, which has not yet developed healthy coping mechanisms [2]. Some of the most challenging stimuli are those related to body awareness [46, 47]. Anatomical and physiological changes in adolescence, often preceding emotional maturity, can generate exceptionally high levels of stress [48], that need to be reduced in some way, even maladaptive.
Observing the strong connection between growing self-awareness of one's appearance and the persistent search for appropriate tools to change it, including through physical activity, Alcaraz-Ibañez et al. (2021) examined the vulnerability of specific groups of adolescents to the development of exercise addiction symptoms [49]. Based on the participants' reactions to changes in their bodies, they created four profiles: prideful (19.5%), low self-consciousness (31.7%), moderately high self-consciousness (29.2%), and shameful-guilty (19.6%). Interestingly, the prideful profile, more common in boys, was most strongly correlated with the occurrence of exercise addiction symptoms. It was also characterized by higher levels of salience and tolerance. Among girls, the shameful-guilty profile dominated, and was associated

with significantly lower levels of tolerance. This suggests significant gender differences in the process of body self-acceptance during adolescence and different paths to exercise addiction development – in boys, through a desire for self-improvement and achieving a "full image of masculinity," and in girls, through attempts to achieve satisfaction with one's appearance and, secondarily, through the development of other mental disorders [49].

3.1.2.Personality Traits

There is ample evidence of a strong association between selected personality traits and the development of addictive behaviors in sports [6, 50]. However, most of these concern adult groups. Although there is scarcely no research specifically targeting adolescents, a recently published study by Vítková et al. (2025) focused on the correlation between the presence of specific personality factors and the diagnosis of excessive exercise in Czech professional athletes in early adulthood [6]. A significant effect of neuroticism was demonstrated, confirming previous studies on other groups of athletes and students [51, 52]. Additionally, a relationship has been observed between the neuroticism accompanying exercise addiction and the activity of dopaminergic neuroblasts and brain reward circuits, which are involved in the development of both of these traits, resulting from emotional dysregulation [6].

Among other hypotheses, a correlation between narcissistic traits and the risk of exercise addiction in youth has also been confirmed. A study by Giancola et al. (2025), conducted on adolescents and young adults, indicates that excessive exercise is related to both grandiose and vulnerable narcissism [53]. Grandiose narcissism, associated with a sense of superiority and dominance and the need to be admired, may manifest itself through the pursuit of success, including in the areas of appearance and athletic achievement. In this case, physical activity is primarily associated with self-presentation and "building an image of an ideal body". Vulnerable narcissism, characterized by low self-esteem and the need for confirmation from others, as well as excessive sensitivity to criticism, is associated with compensating for feelings of inadequacy through constant exercise and appearance monitoring [53]. Above connections are also reinforced by "fit" content on social media, which promotes peer comparison, the pursuit of perfection, and achieving self-satisfaction through the body [53]. These findings are also confirmed by other studies, primarily in adult sample [42]. Additionally, individuals at high risk for exercise addiction were observed to have increased levels of excitement seeking or achievement striving, and low levels of straightforwardness and compliance [42]. In contrast, studies have shown the predictive value of agreeability in relation to excessive exercise in youth [51].

It has been also proven that athletes with high perseverance spend more time exercising than their peers [6, 46, 50]. Grit is associated with a constantly driven passion for achieving long-term goals, which may mediate the relationship between exercise addiction and restrictive eating [46]. The ability to continue one's resolutions often accompanies simultaneous control of diet and exercise. Perseverance in pursuing a goal, generally a positive trait, can become dysfunctional when it becomes inflexible and imposes excessively high standards. Individuals who combine significant grit with obsessive passion or a so-called "dark personality" are particularly at high risk for exercise addiction [46].

Perfectionism, which has been extensively studied in the context of excessive exercise, even among young one’s, is also a threat to the development of the addiction process [6, 36]. That personality profile is characterized by a certain rigidity of thinking and a tendency to exceed norms to achieve desired results [42]. Perfectionism is a trait that promotes overtraining to

achieve the best possible athletic performance, especially in an environment that places intense pressure on adolescents [6]. This trait is most often observed in individuals who develop exercise addiction secondarily (e.g. with primary eating disorders) [3, 54].
Another trait that may be associated with an increased risk of exercise addiction in adolescence is impulsivity [36] This is also confirmed by observations in adults [6, 41]. Impulsivity is characterized by a lack of appropriate emotional regulation and reduced frustration tolerance. These aspects often result in a significant increase in physical activity, a redirection of focus and habitual thinking towards sports, and a further buildup of suppressed, misdirected emotions, which can easily lead to addiction [1]. Furthermore, obsessive-compulsive tendencies have also been implicated in pathological pro-addictive processes [3, 6, 42]. In contrast, research by Rizk et al. (2020) does not show a relationship between obsessive-compulsive and addictive personality in the level of physical activity of children and adolescents suffering from anorexia nervosa, thus often also in secondary exercise addiction [55].
Personality profiles correlated with a more frequent occurrence of exercise addiction indicate also the role of anxiety [42], passion (a tendency to exert effort directed towards worthwhile activities), and engagement (harmless, pleasure-driven dedication) [6, 46]. Although extraversion is considered a trait linked with the risk of exercise addiction, research conducted by Mathers et al. (1999) did not demonstrate an association between it and the occurrence of dysfunctional physical activity in the surveyed students [56]. In turn, Hausenblas & Giacobbi (2004), among a group of students, determined that extraversion not only correlates with the frequency of exercise addiction but also serves as its predictor [51].

3.1.3.Attachment Styles

Attachment styles, as we call established patterns of thought and behavior in interactions, are shaped primarily in childhood, drawing on the bonds formed with family. Parent-child relationships are viewed as a key factor in further development, including the ability to cope with difficult situations [1]. Through their caregivers, children learn to compensate for negative emotions and anxiety in healthy ways, which strengthens emotional regulation. Therefore, a family with unresolved problems can also be a source of dysfunctional patterns, including a tendency toward risky behavior [1]. This leads to the main division of attachment styles into secure or insecure (preoccupied, fearful, and dismissive) [42]. There is a close link between developing addictive behaviors in adolescence and insecure attachment styles. Research on the more well-defined gambling and (internet) gaming disorders indicates that insecure attachment is a direct predictor [57, 58]. A correlation was also observed between these behavioral addictions and the adolescent-parent relationships (both father and mother) along with the adolescent-peer relationships [1, 57].
Analyzing the specific relationship between exercise addiction and attachment style, particularly among adolescents, is hampered by insufficient sources. Only a few reports exist based on samples of young adults. One study links insecure attachment style with its impact on disturbed eating patterns in athletes with eating disorders, who may exhibit characteristics of secondary attachment disorder; however, no association was found with primary attachment disorder [42]. In contrast, in a study by Blaydon et al. (2002) a correlation was observed between avoidant attachment style and exercise addiction, but not eating disorders symptoms [59].
Although direct evidence is scarce, the indirect relationships between dysfunctional attachment styles and the risk of excessive exercise occurs. The impact of interpersonal relationships may

influence the role of sports in an addict's life. A strong need to impress others and a desire for appreciation create a cycle of behaviors aimed solely at meeting others' expectations [6, 36]. This sense of obligation and guilt, accompanying exercise, often leads to the development of addiction, which may be attributed to the fact that internal pressure, rather than genuine pleasure, becomes the motivation for physical activity [6, 60].
Establishing exercise as the primary route to interpersonal satisfaction may also be associated with the development of a so-called sports identity [6]. This is characterized by a strong prioritization of sports among active adolescents, at the expense of other aspects of daily life. It involves neglecting other social roles in order to achieve self-acceptance through sports performance. Research suggests that a strong sports identity not only correlates with the risk of exercise addiction but also serves as a predictor [6].

3.1.4.Peer Pressure

Non-substance-related addictions in adolescents are directly linked to the need for satisfaction in peer relationships [1]. Addictive behaviors and the accompanying social conditioning are viewed as a maladaptive way of discovering one's identity and self-worth in a safer, more self-controlled environment [1]. This semblance of stability is especially valuable during the turbulent period of adolescence.
The main social factors influencing the risk of behavioral addictions, including exercise addiction, involve the level of competition, peer influence, and others' expectations [36]. Several patterns have been observed among youngsters, including that friends' social networks may influence physical activity behavior differently depending on gender. According to reports, "males' physical activity behavior was predicted by their friend group, whereas females' physical activity was predicted by their best friend" [61]. The structure of a social group has a significant impact on exercise motivation among young people – for boys, it is based more on group membership, and for girls, on strengthening closer relationships or daring to engage in public activity in a supportive company [3, 61, 62].
According to Montgomery et al. (2021), friends share similar physical activity habits, further emphasizing the connection between physical activity and socialization. The most common aspects linking exercise to these relationships were: "friendship formation through physical activity behavior, spending time with friends, negative influence from friends, and utilizing peer networks to encourage physical activity behavior" [61]. It is also worth mentioning their findings regarding how teenagers perceive other peers outside of close social circles in the context of physical activity. Adolescents' statements indicate that those actively participating in sports were, on the one hand, perceived as "more energetic" and "always really dedicated," but on the other hand, they "held themselves higher than everyone else," which was perceived as intimidating. Young people who did not participate in sports were most often described pejoratively (e.g., as "socially inept") [61].
All of the above factors value adolescents' motivation, to engage in or intensify physical activity, and participate in the process of developing exercise addiction [6, 63]. Excessive exercise is often extrinsically motivated, mainly through identified regulation (e.g., social status associated with recognition and recognition) [6]. In this way, external influence "significantly mediates the relationship between ego-inducing environments and exercise addiction" [6, 63]. Nevertheless, among the mechanisms of exercise addiction, the importance of introjected regulation (e.g., avoidance of negative feelings) has been confirmed, which, although driven by

intrinsic motivation, results from feelings of guilt and obligation that can lead to abnormal exercise behaviors [6, 64].
Moreover, as addiction progresses, the time devoted to exercise prevents the maintenance of healthy peer relationships, which become limited to those related to sports or even completely broken down. Thus, the desire for stability in a peer group leads to the opposite effect, accompanied by low mood, feelings of loneliness and misunderstanding, and a lack of new social experiences [5, 60].
The impact of the COVID-19 pandemic on the behavior of individuals with exercise addiction is also noticeable. Although these observations come primarily from studies in the adult population, they highlight the importance of social deprivation in disruptive behaviors related to physical activity. Due to health concerns and existing restrictions, the habits of exercise addicts had to change then [25]. This alteration from a physical activity pattern to one devoid of social functions led to negative consequences for the mental health of those exercising. Consequently, it was concluded that the limited contact and loneliness have further impacted the psyche of addicts, despite possible withdrawal symptoms, which may have occurred as a result of restrictions [25, 41].

3.1.5.Exposure to Exceeding the Ritual

Adolescents and young adults who train, especially at an elite level, and who are subjected to high personal demands along with a significant habituation to the rigid "sports routine", are more likely to expand their ritualistic behavior to risky levels [6]. The most commonly observed types of these irregularities include compensating for missed training sessions, but with significantly increased intensity, and continuing training despite injuries. In this way, an activity that initially combines passion, motivation, and pleasure becomes a pathological factor negatively impacting functioning [60].
Similar correlations were observed in adults during the COVID-19 pandemic. Individuals, who had not previously exercised regularly, engaged in physical activity during this period, most commonly using it as a way to relieve internal tension and fight with boredom. These practices led to the development of exercise addiction in some [41]. This may have been related to the maladaptive role of exercise as the only consistent, stereotypical activity at a time, when other daily tasks were suspended, which led to the development of new stress-reducing rituals. Pandemic-related restrictions also affected individuals who already exhibited signs of sports addiction, but in a different way [25]. Due to increased stress and forced abstinence, even partial, inflexible coping mechanisms of addicts emerged to cope with growing anxiety. It led to evolution of new ritualistic behaviors, compensating for the lack of a previous routine. Among those behaviors authors observed longer, more intense, and more frequent home workouts, or shorter outdoor training sessions, despite the restrictions, supplemented by additional at-home training [25].

3.1.6.The Influence of Regular Intense Physical Exercise

The health-promoting effects of physical activity are an undeniable fact, emphasized in every field of medicine. In the study by Żmijewski & Howard (2003), 87.2% of respondents reported improved well-being after physical exercise [65]. Studies using MRI to assess the relationship between aerobic exercise and cognitive abilities in adolescents (e.g., concentration, planning, problem-solving, linguistic comprehension, syntactic and orthographical skills and

inhibitory control) have been shown increased hippocampal volume and other pro-cognitive structural brain changes in individuals who exercise regularly [2, 41]. Moreover, a specific, positive effect of regular aerobic exercise on the cognitive skills of children with attention deficit hyperactivity disorder (ADHD) has been described by decreasing attention disorders, hyperactivity and social difficulties [41]. Physical activity has also proven therapeutic value for mild to moderate affective and anxiety disorders, reducing their symptoms [60, 66, 67]. However, regular, intense physical activity itself can also pose health risks. It is reported that "excessive exercise may lead to overtraining and generate psychological symptoms that mimic depression itself" [66]. This may result from general fatigue, muscle tension and pain, as well as secondary disorders moderated by immunological factors [6].

Additionally, reports have emerged that high school athletes are at greater risk for opioid abuse and dependence compared to less physically active individuals [68]. As described above, the mechanisms of substance and behavioral addiction share many common features, suggesting a link between regular, high-intensity physical activity and increased neurobiological vulnerability to addiction. In response to these reports, Lynch et al. (2022) presented the results of a study examining the correlation between the introduction and cessation of high-availability exercise during the prepubertal period and increased vulnerability to opioid use in late adolescence and/or adulthood [69]. This study was conducted using rats administered fentanyl with 24-hour access to a treadmill. Rats with access to unrestricted physical activity showed greater motivation to administer subsequent doses of opioid and “had an enhanced sensitivity to the reinstating effects of fentanyl-associated cues following extended, intermittent-access self-administration and protracted abstinence (14 days) compared to sedentary controls”.

3.2.Exercise Addiction Risk Factors

Adolescence is a time of developing habits, both healthy and unhealthy. Teenagers, physiologically exposed to harmful behaviors, experience a significant stress, related to increased decision-making and autonomy, coinciding with rising expectations and social pressures. These challenges can lead to mental disorders, including behavioral addictions, such as exercise addiction [49].

Although research describing the various risk factors for sports addiction focuses primarily on adults, some authors have also addressed this topic in adolescents. There are many factors predisposing to the development of excessive exercise. Numerous correlations have been found between exercise addiction and, among many things, the type of sport practiced, the level of professionalism, fitness content presented on social media, peer functioning, and other mental disorders, which will be described in more detail. A relationship with the amount of physical activity engaged in was also found in the context of body mass index (BMI), initial body weight, body fat percentage, and the presence of menstruation [55]. Addiction is such a complex concept that examining all the factors behind its development is virtually impossible. Nevertheless, it is worthwhile to expand our knowledge of selected aspects that can influence the adolescent psyche, resulting in inappropriate behaviors, in this case, exercise.

3.2.1.Culture of Healthy Lifestyle

The popularization of health care is a long-standing educational trend that aligns with the "prevention first" strategy prevalent in most medical fields. The scope of preventive measures, which includes not only mental but also somatic disorders, emphasize the importance of long-term, holistic perspective on the development of disease. This approach is particularly relevant to children and adolescents, whose health behaviors impact their entire lives [70].
However, the present concept of health and beauty is undergoing constant change, shaped primarily by mass media. Despite numerous government campaigns and health promotion institutions, in today's world dominated by online information transmission, social media creates the vision of a healthy lifestyle [3]. This content, sometimes subconsciously observed on popular online platforms, is gaining support for fitness culture, but in a self-imposed way. The above influence firstly affects pre-teenagers (11-12 years old), teenagers (10-19 years old) and young adults (20-24 years old), who are the most likely to use social media and are also the most susceptible to its manipulation [3, 71].
One of the health-related trends noticeable online is “fitspiration” (from the words "fit" and "inspiration"), often tagged "fitspo". This movement, originally created on Instagram, quickly spread to other social media platforms such as Facebook, Tumblr, TikTok, and Pinterest [3, 72, 73]. Users applying these hashtags primarily share photos of significantly fit bodies, often accompanied by “before-and-after” comparisons of implementing a "fit routine," which focuses on physical changes resulting from training, diet, and other health-promoting behaviors [3, 72]. A risk assessment of followers of these hashtags revealed that adolescents and young adults are most vulnerable to all the negative influences of the "fitspo" culture, with the highest exposure occurring among teenage girls, particularly those characterized by low self-esteem, perfectionism, and obsessive tendencies [3, 72]. Additionally, the high susceptibility of youngsters may result from an increased desire to be part of the "fit community".
An analysis of posts reflecting the "fitspiration" trend revealed that they typically depicted a toned and muscular ideal body, mainly female (63.7%), most often during a workout (25%) or promoting healthy eating (19%) [3, 74, 75]. Although less common, images of men also focused on portraying a muscular or hypermuscular ideal body [3, 72]. Notably, these posts were often commercial in nature and depicted exercising individuals, mostly women, in a more sexualized way, with a particular emphasis on arms, legs, and buttocks [3, 72]. Slogans associated with this movement included phrases such as "self-worth measured in centimeters" and "keep going unless you puke, faint, or die," which are highly threatening [3].
Due to their growing popularity, content tagged with the above terms was thoroughly examined and their potential impact was determined. Beyond the actual promotion of physical activity and healthy eating, negative consequences of exposure to "fitspo" content were discovered. These included: uncontrolled supplement intake, perceiving pain as pleasure, excessive control over eating habits, and body objectification [3, 76]. Individuals exposed to "fit" content on a regular basis, particularly young women, were at increased risk of developing mental health disorders, including anxiety, affective and eating disorders, as well as substance and behavioral addictions, along with exercise addiction [3, 76]. Reports by Raggatt et al. (2018) indicated that 10% of youth following "fitspiration" content had a higher risk of developing exercise addiction than the general population [73]. Holland & Tiggemann (2017) also observed the intensity of inappropriate physical activity behaviors correlated with engagement in the "fit" community [76]. That research indicates that a significant portion of "fitspo" posts advocated for treating exercise-related pain as a form of motivation and a source of satisfaction, suggesting

transforming it into pleasure in order to push one's limits.

Ultimately, health promotion is a movement aimed at improving the quality of life in society and building good habits that, introduced in childhood, will bring positive results in the future [70]. Among the surveyed teenagers, aged 13-18, a staggering 77% of them stated that they obtain information about a healthy lifestyle (nutrition, physical activity, weight management, sleep) primarily from websites and social media. However, as the Armstrong et al.'s (2021) study indicates, only "7% of the content was from health organizations, 10% from health professionals, and only 10% of the content was objective, and 14% was transparent," while "38% was produced by a commercial company" [77].

Nevertheless, a healthy lifestyle is not only affected by social media but also reflects values developed within the family. The research found that individuals who were strongly influenced during childhood by a physically active father were at increased risk of developing eating disorders and, consequently, inappropriate exercise behaviors later in life [55, 78]. Parental pressure to engage children in aesthetically or weight-oriented sports from an early age can also have similar effects [55]. The same risk applies to the time devoted to physical activity in childhood. Davis et al. (1997) found that adolescents with anorexia nervosa who exhibited characteristics of secondary exercise addiction had higher levels of physical activity in childhood (around 10–12 years of age) [78]. This finding is consistent with evidence from general population studies indicating that participation in sports during childhood and adolescence is a significant predictor of greater physical activity later in life [55]. However, developing healthy exercise habits is the responsibility of caregivers, who should, within reason, support their children in developing physical skills.

3.2.2.Amateur Sports

Physical activity is an essential part of everyday life during adolescence and a healthy way to spend free time, both individually and in groups. Although amateur sports may seem safer than non-amateur in terms of the risk of exercise addiction, reports indicate that young professional athletes participating in team sports presented better mood and quality of life than recreational athletes [62]. A 2018 study of teenagers attending a fitness center in Denmark revealed that up to 8.7% of them were addicted to exercise [44]. Meanwhile, among members of a student sports center in Bangkok, as many as 83.4% of respondents exhibited partial symptoms, and 9.1% showed full symptoms of exercise addiction [43]. A large study, including nearly 1,400 amateur fitness or soccer participants, found an overall prevalence of exercise addiction of 5.8% [79]. Although the results focused on the adult population, the risk of addiction was higher in younger individuals. Available sources indicate that most data on the prevalence of inappropriate behaviors related to physical activity concern recreational athletes, fitness center visitors, and eating disorder patients rather than professional athletes [80], further underscoring the prevalence of exercise addiction and the importance of the cultural and social elements of sport and their impact on the development of addiction.

One of the most popular sports, representing the current image of self-care, primarily in the context of urban communities, is running [81]. Jogging culture has also spread among younger age groups. However, it is not without reason that the term "runner's high" was coined, meaning feeling of euphoria after an intense exercise session [62]. Among adults, statistics indicate a high risk of addiction in the group of active runners, reaching up to 25% [82]. According to Modolo et al. (2011), in the late 1990s, some authors observed signs of addiction in 22% of the runners studied [62], while in a study by Lukács et al. (2019) it was found that as many as 53.6%

of surveyed individuals who had been running regularly for at least two years were characterized as “symptomatic non-addicted"[83].
The previously mentioned study by Živčić et al. (2023) also described a correlation between the risk of addiction and the use of dietary supplements, preferred run length, and injury frequency in runners. Injury frequency likely reflects difficulty maintaining recovery periods, while preferred run length may reflect the repetitive nature of a personal ritual [82]. These aspects are directly linked to the mechanisms of exercise addiction.

3.2.3.Professional or Competitive Sports

Professional athletes, often familiar with the pain of practice from early childhood, seem immune to the harmful processes of exercise addiction. However, one of the main mechanisms contributing to the development of excessive exercise in young athletes is the use of sport as a primary means of reducing internal tension and releasing negative emotions [46, 80]. The most common emotional states avoided through physical activity include guilt, low mood, irritability, and anxiety [6]. Australian researchers, looking for a psychosocial model for the development of exercise addiction, studied many young adults attending institutes and academies of sport. As many as 34% of respondents exhibited exercise addiction symptoms – these were mostly individuals with a higher BMI who reported strong social pressure for better athletic performance [84]. Professional sport, which requires participation in competitions and the evaluation of the results, increases the risk of expanding demands on athletic skills from a young age, resulting in numerous mental disorders (e.g., sports addiction, depression, anxiety disorders, sleep disorders, eating disorders) [36, 85, 86].
According to the study by Levit et al. (2018) among athletes exhibiting exercise addiction traits, professional athletes reported a more severely depressed mood than amateurs [55]. It was also observed in adolescent samples [36, 85]. They are also at significantly higher risk of developing excessive exercise than the general population [6, 87, 88], which is directly related to their lifestyle and time devoted to physical activity. Despite this apparent association, most scientific studies examining exercise addiction relationships focus on amateur sports [6, 80, 84]. Reports of the prevalence of this addiction among professional athletes are underestimated. Vitkova et al. (2025) found that among respondents, aged 18-30, only 2.3% showed no symptoms of sports addiction. While 76.7% of the sample had mild symptoms, 16.5% were in the highest risk group [6]. Although studies have shown even higher rates of excessive exercise [84, 89], these results are alarming.
The prevalence of exercise addiction among adolescent athletes is difficult to estimate, but a recent cross-sectional study by Mayolas-Pi et al. (2025) sheds light on the issue. This research included over 7,500 active adolescents, aged 11-19. They were divided into five categories: non-competitive athletes and competitive athletes at local, regional, national, and international levels. The authors found that exercise addiction symptoms were demonstrated in 6% of non-competitive athletes and 16% of competitive athletes, and this percentage increased with the level of competition they participated in [36]. Furthermore, individuals at higher risk of exercise addiction were more likely to experience problems related to sleep quality, well-being, nutrition, or overall life satisfaction. The researchers also indicated that the risk of excessive exercise increases in late adolescence, which may be related to rising expectations during the transition from junior to professional rank. This stage is also associated with more frequent pressure of decision-making (e.g., about training schemes) and the general developmental challenges of adolescence [36, 49].

Differences in exposure to exercise addiction have also been identified depending on the type of sport chosen. Professional athletes participating in individual sports have shown a higher risk of excessive exercise than team athletes in numerous studies [28, 36, 90]. As indicated by DiLodovico et al. (2019), specific sports disciplines may also constitute an additional risk factor [28]. According to them, the strongest exposure occurs in ball sports (10.4%), fitness (8.2%), and endurance sports (6.4%). Some studies indicate that endurance sports (e.g., running, cycling, swimming) are potentially the most addictive due to the high volume and intensity of training, rapid visibility of results and subjective assessment of improved physical performance, which facilitates the development of tolerance – one of the main elements of addiction [91]. However, those divisions and correlations are still subject of academic debate. The study by Vitkova et al. (2025), contrary to expectations, found no significant connections between exercise addiction among athletes and the selection of different disciplines (endurance, strength, and mixed) [6].

There is also much evidence suggesting that the development of excessive exercise in young athletes often occurs secondary to eating disorders, which may also be influenced by the special diets, sometimes required in professional sports. Lichtenstein et al. (2024) reported that among the Danish elite and sub-elite athletes (mean age 21 years), eating disorders were significantly more common in women and sub-elite groups. Importantly, athletes at this risk also had a higher incidence of exercise addiction and depression [92].

3.2.4.Body Image Disturbance

The relationship between body image disturbance and the risk of exercise addiction has been repeatedly noted by researchers from various institutions [4, 36, 62]. In one of the studies on a group of adults (mean age 25.7 years), as many as 71.5% of physically active people are motivated by a desire to change certain aspects of their appearance, not necessarily by health implications [62].

An important element linking body image disturbance with the development of exercise addiction and restrictive eating is social physique anxiety (SPA) [46]. The pursuit of social approval through changing one's appearance is often associated with dieting, subsequently supplemented by excessive exercise, especially if the set goals are not achieved through dietary changes. Fear of rejection also fuels the desire to belong to a group, which is easily achieved in sport participants [3]. Furthermore, SPA negatively impacts the maturation of coping skills and healthy motivation to act, which increases the risk of developing dysfunctional mechanisms, including excessive exercise [46].

Another factor contributing to adolescents' inaccurate body image is the prevalence of content related to the appearance that young people "should strive for". The previously mentioned online trend of "fitspiration" is based primarily on the idealization of a physique with pronounced musculature and the so-called "healthy body prototype" [3, 73, 76]. It has been demonstrated that teenagers imitating these models reported greater dissatisfaction with their appearance and poorer well-being, which correlated with the amount of time they spent viewing "fitspo" content [3].

The "fitspiration" trend was also compared to previously known online hashtags associated with the popularization of potentially harmful body shapes, such as "bonespiration" (content that idealizes the extremely thin body through the presentation of protruding bones) and "thinspiration" (content that inspires users to be thin through the presentation of extremely thin bodies) [74]. These have been heavily criticized for promoting excessively thin bodies, which

may escalate the risk of adolescent eating disorders, primarily anorexia nervosa [3, 74]. However, the aforementioned comparative analysis revealed that "fitspiration" also tends to popularize extremely thin bodies. In its own way, it poses an even greater threat, as it does so by invoking pro-health slogans that are more widely accepted [3, 74].
Body dysmorphic disorder also includes other subdisciplines, including muscle dysmorphia, also known as bigorexia nervosa [14]. The above diagnosis is characterized by a preoccupation with one's own physique, perceived as insufficiently muscular [47, 93]. This feeling leads to numerous attempts to achieve the "ideal body," which involves a significant increase in the intensity and frequency of physical activity. Therefore, this disorder, especially in young adults, was associated with a very high risk of excessive exercise [47]. According to a study by Babusa et al. (2015), the highest levels of exercise addiction were found in groups with bigorexia nervosa, and those individuals exhibited even longer and more intense training habits [94]. A correlation has also been noted between muscle dysmorphia and other disorders, including eating disorders and substance abuse [47]. Body dissatisfaction, specifically muscularity, leads to exercise addiction, especially among young men.

3.2.5.Eating Disorders

One aspect of “healthy culture," particularly promoted online, is diet. It is a constant element not only in the lives of professional athletes but also of those who declare themselves "fit" [3]. As the studies indicate, individuals exposed to this content, especially those with anankastic personality traits, are more likely to follow a healthy diet to the extreme, which can lead to eating disorders and, secondarily, sports addiction [4, 46, 54]. Athletes are also at greater risk of disordered eating (DE) attitudes accompanying exercise addiction, resulting from dissatisfaction with their appearance and the internalization of body ideals in certain sports [54, 60, 80].
The above elements appear to form a sequential cause-and-effect chain – from weight-related stigma, through body image disapproval, to excessive exercise [47]. Similar associations were identified in groups of adolescents and young adults, in the context of the mediating role of social physique anxiety (SPA) and personality tendencies (e.g., persistence) between restrained eating and exercise addiction [46]. The so-called chain mediation model described by Pan et al. (2025) connects these aspects within a continuum of self-regulatory processes, which consider exercise addiction as a coping mechanism in eating disorders [46]. Moreover, patients with anorexia nervosa who did not engage in excessive exercise had higher chances for somatization, anhedonia, and anxiety – dysfunctional physical activity reducing tension and negative emotions in individuals with eating disorders [55].
Eating disorders themselves lead to psychological and somatic distress, resulting in disorders that mediate the relationship between them and excessive exercise. Ahorsu et al. (2023), studying a group of teenagers, found a positive correlation between eating disorders, psychological distress, body image concerns, and exercise addiction traits. Observations indicate that an important factor is the unrestrained pursuit of goals, which, in the context of sports, can result in overuse injuries and pain [4]. Notably, this feature applies to both eating disorders and exercise addiction [42]
At this point, the concept of so-called “athletic anorexia”, or exercise addiction, which is a consequence of eating disorders in individuals who use medications, dietary regimes, and vomiting to lose weight is important [60]. The complex relationship between maladaptive behaviors related to physical activity and eating disorders leads to the identification of two

groups: primary and secondary exercise addiction. The primary condition occurs without additional motivation (exercise is the main goal), and the secondary is accompanied by another thinking dysfunction, most often associated with eating disorders [46, 54, 86]. However, the above division is not definite – some researchers believe that these diagnoses should not be considered separate, as exercise addiction is inextricably linked, e.g., to body image [4, 42].
Nevertheless, there is more evidence that body image interpretation mediates between DE and excessive exercise, supporting the concept of secondary exercise addiction. Cunningham et al. (2016) note differences in the nature of behaviors between primary and secondary sports addiction, with primary activities rated as more addictive and secondary as more compulsive [95]. The same study also provides information on gender differences. According to the authors, men are more prone to primary mechanisms of excessive exercise, while women more often show secondary characteristics. Moreover, young women suffering from secondary exercise addiction manifested higher scores on anxiety, social dysfunction, and depression than the primary group [4, 42].
Concerning the association between exercise addiction and eating disorders, Johnston et al. (2011), who examined young women's experiences of physical activity, found overlap between participants' perceptions of normal exercise, problematic exercise, and exercise addiction, in the context of co-occurring eating disorders . Excessive exercise was considered by the respondents to be a "more acceptable alternative to eating disorders" [40]. Even in animal models, rats on a low-calorie diet increased their physical activity levels [62]. As indicated by Davis et al. (1997) a significant increase in physical activity can be observed in the year prior to anorexia nervosa recognition [78]. As many as 31% to 80% of patients with this diagnosis report high levels of exercise, even during the course of the illness [55]. Furthermore, excessive exercise in patients with anorexia nervosa is correlated with early onset, poorer treatment outcomes, and a greater probability of relapse or chronicity [55, 96].
Another informal eating disorder diagnosis, orthorexia nervosa, is worthy of special mention. According to statistics collected in German fitness clubs, 2.3% of participants met criteria for both orthorexia nervosa and exercise addiction, suggesting a positive correlation between these disorders [97]. Moreover, a research of students with orthorexia nervosa observed that severity of its symptoms correlates with increased physical activity and all other excessive exercise traits [98]. These young adults were primarily motivated to exercise by a desire to improve their psychosomatic health, which is a common core issue with exercise addiction. To sum up, the links between eating disorders and excessive exercise remain complex and require further consideration [80].

3.2.6.Other Mental Disorders

The complexity of abnormal behaviors and the numerous areas affected by this dysfunction make comorbidity of mental disorders inevitable in a significant percentage of cases. A study by Meyer et al. (2021) (mean age 27.9 years) found that as many as 75% of young adults diagnosed with exercise addiction suffer from at least one other mental disorder [99]. In addition to body image disturbance and eating disorders, which, from the perspective of excessive physical activity, appear most closely related to its mechanisms, we observe a diverse range of connections between other disorders and exercise addiction, also in adolescence.
According to the study by Wyszomirska et al. (2021), the relationship between physical activity and depressive symptoms in young adults is confirmed and considered bidirectional [25]. Depression can develop secondary to exercise addiction, but reports indicate that excessive

physical activity often serves as a coping mechanism with primary depression or anxiety [39, 60, 99]. These observations, again, concerned both recreational and professional athletes. Additionally, tension and feelings of depression, confusion, and anger, appearing after exercise or while waiting for the next training, are negative emotional states that may increase dependence on sports [39, 60]. Similar associations, centered around severe psychological distress, were observed among adolescents with co-occurring exercise addiction and eating disorders. Those teenagers had significantly increased risk of developing further mental disorders, including depression [4, 44]

The possible correlation between excessive exercise and suicidal tendencies also seems interesting. Although, to our knowledge, these aspects have not been studied in adolescents, Rogers et al. in 2019 constructed an online survey that analyzed the correlations between exercise dependence, capability for suicide, and past suicidal behavior. The results of this study showed that individuals who had attempted suicide and were capable of doing so were more likely to continue excessive exercise and abandon subsequent activities in favor of sports, despite the observed negative consequences [100].

Another group of mental disorders that can co-occur with exercise addiction includes sleep disorders, primarily insomnia. However, assessing these symptoms as a separate diagnosis rather than a component of addiction itself, can be difficult. A study by Ahorsu et al. (2023), attempting to demonstrate a correlation between excessive exercise and insomnia in adolescents, indeed reported an increase in the prevalence of sleep disorders with growing exercise intensity. In the same sample, the co-occurrence of excessive exercise and insomnia was also a strong risk factor for secondary eating disorders [4].

Continuing the review of other potential diagnoses closely related to exercise addiction, this group also includes personality disorders and obsessive-compulsive traits [6, 99]. Rizk et al. (2020) also observed an increased frequency of dysfunctional behaviors related to physical activity among adolescents in the high-risk group for developing obsessive-compulsive disorder [55].

A relationship between the diagnosis of exercise addiction and the development of other behavioral addictions, such as sex addiction, has also been confirmed, but almost all evidence comes from adult samples [4, 6, 7]. According to Sussman et al. (2011), 15% of exercise addicts have as well comorbid addiction to nicotine, alcohol, or drugs [101]. Polish research, covering the COVID-19 pandemic period, analyzed the behavior of sports addicts during time of physical activity deprivation and found that 19.5% of respondents reported increased alcohol consumption and other abnormal conditions (e.g., lower mood, growing anxiety and insomnia, and deterioration of somatic health) [25]. A study of young professional athletes with characteristics of exercise addiction also found a higher incidence of future psychoactive substance addiction (15-25%), particularly in those using cocaine or amphetamine [4, 6].

3.2.7.Gender

Gender is one of the most frequently studied variables, not only in the case of mental disorders. According to research on behavioral addictions among adolescents, aged 13-21, young men are more susceptible to addictive behaviors, including gambling and (internet) gaming [1]. Exercise addiction is also more common in this group [36, 43]. The culturally entrenched image of the male body – more massive and muscular than female – directly influences the motivation to exercise among young men, which is primarily related to social factors, elements of competition, and sexual self-acceptance [1, 47].

Among excessively exercising female adolescents, the goal of intense physical activity is primarily to achieve a lower body weight, which may involve incorporating additional weight-loss strategies, such as diets [46]. These observations also align with the higher incidence of anorexia nervosa and other eating disorders in the female population, including younger women [62].

All of the gender differences observed above disappear at higher levels of competition, which applies to both adolescents and young adults practicing professional sports [36, 102]. Furthermore, in the study by Modolo et al. (2011), among teenagers with exercise addiction, a similar incidence of negative symptoms of addiction and reduced quality of life were observed in both genders. As the same research emphasizes, there are no reports regarding gender differences among excessive exercisers during periods of physical activity abstinence [62].

3.2.8.Level of Education

Although, as mentioned, the cognitive consequences of sports addiction are not well understood, some studies have observed correlations between the occurrence of this behavioral addiction and education level. According to the research by Lukács et al. (2019), respondents studying at higher-ranking universities or high schools were less likely to develop exercise addiction than those with poor education [83]. These observations are also confirmed by Menczel et al. 's (2016) investigation in a group of adults, which showed that higher level of education actually serves as a protective factor against excessive exercise [103]. The authors attribute these relationships to better coping with emotional stress and the development of more adaptive problem-solving strategies in the better-educated group [1, 103].

3.3.Diagnostic Process of Exercise Addiction

Over 20 years ago, a primary psychometric tool for diagnosing excessive exercise in adults was developed. The Exercise Addiction Inventory (EAI) is a questionnaire designed to identify individuals affected by exercise addiction or at increased risk for its manifestation [33, 44, 104]. This questionnaire was based on criteria models for behavioral addictions. It consists of 6 elements – salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse – and questions firstly address the frequency and intensity of exercise. Responses are dependent on a 5-point Likert scale (from "strongly disagree" to "strongly agree") [44]. According to Lichtenstein et al. (2014), in their study, the EAI achieved acceptable reliability with a Cronbach's alpha of 0.66. The authors also evaluated the criterion-related validity of the EAI with respect to 3 variables related to exercise addiction (exercise frequency, continuation despite injuries, and personal perception of addiction), which was confirmed [79]. Additionally, the EAI has a solid theoretical foundation and a clear cut-off point, which allows for the differentiation of groups at high and low risk of exercise addiction [6, 104, 105]. Furthermore, the EAI was validated for languages other than English, to account for potential linguistic and cultural inconsistencies [35, 79, 105]. A study conducted by Sicilia et al. (2013) in a group of Spanish-speaking students supported the factor structure of the EAI model, which was invariant across genders [35]. There are indications that the EAI may be a good screening tool for groups at risk of exercise addiction, such as athletes [79].

Although EAI provides valuable information, it is also susceptible to measurement inaccuracies. Studies on adolescents have shown that concepts such as "increased training time" or "resuming training volume after a pause" can be interpreted differently, particularly among

professional athletes [36]. This misunderstanding is probably related to the similarity between the above-mentioned phrases and the description of the normative behavior of high-achieving athletes who do not exhibit pathological tendencies.

Most tools developed for diagnosing behavioral addictions among adolescents address officially recognized diagnoses—gambling and (internet) gaming disorder. However, the EAI, although originally directed for adults, has been adapted for the group < 18 years old. The Exercise Addiction Inventory for Youth (EAI-Y) was positively validated in 2018 by Lichtenstein et al. in a group of over 400 adolescents, aged 11 to 19. The version for adolescents was linguistically and culturally verified to better reflect the realities of the younger age. Its reliability and construct validity were also confirmed. According to the mentioned research, this questionnaire is currently the recommended tool for assessing the risk of exercise addiction in adolescence [44].

Besides the EAI and EAI-Y, there are other tools, although less popular than the aforementioned questionnaire. These include, e.g., Exercise Dependence Scale [6, 51], Obligatory Exercise Questionnaire [6], and Negative Addiction Scale [62]. Müller et al. (2014) compared Exercise Dependence Scale questionnaire results with clinical data from interviews, but found only moderate correlations between quantitative and qualitative methods [106]. Specific tools also exist for different sports, such as the Negative Addiction Scale to Running Practice , however, they have less diagnostic significance [62].

3.4.Types of Therapeutic Intervention for Exercise Addiction

3.4.1.Psychotherapy and Pharmacotherapy for Behavioral Addictions

Well-researched psychotherapeutic interventions, mostly described in the adult population, are increasingly applied to the therapeutic process of younger patients. Although specific, RCT-based treatment recommendations for adolescent patients with exercise addiction are currently insufficient, the approach is based primarily on methods used in related, better-understood behavioral addictions. These include a motivational approach and cognitive-behavioral therapy (CBT) [5, 107, 108]. CBT focuses on thoughts and behaviors related to addictive activities, such as excessive exercise. The main goal of psychotherapy is to develop healthy coping mechanisms that, when properly verified, can consciously stop being repressed through addictive behavior. Therapeutic work also encompasses general issues related to the difficulties of adolescence and the specific problems associated with exercise addiction [5, 107, 108]. These methods are also applicable to the treatment of substance-related addictions and eating disorders, also in youth. Addiction therapy, regardless of the type, is based on common principles such as prior individual psychopathology, differential reinforcement, maladaptive cognitions, and social support networks [5].

A therapeutic attitude, that helps modifying cognitive bias, is analyzing and attempting to utilize information regarding the "control systems" of the adolescent brain [7]. The previously mentioned dual-process model, which describes the lack of coordination between the cognitive and the motivational-impulsive system, provides a source of knowledge not only for eliminating dysfunctional behaviors but also for transforming the cognitive mechanisms that sustain them. The behavioral interventions proposed by Gladwin et al. (2011), which could be beneficial in the treatment of adolescent patients, are based on several elements [7]. These include working memory and executive control training, aiming to strengthen the control system, which may enable the suppression of impulses associated with addictive behavior. Another approach is response delay training, which involves performing "stop and think"

exercises. That practice extends the time between the appearance of a harmful impulse and the initiation of a maladaptive action. The last proposed method, successfully studied in young adults, focuses specifically on changing automatic tendencies rather than on control systems. So-called “approach-avoidance training” supports the treatment process, firstly through consciously repelling stimuli linked to addiction [7].

Due to the neurobiological basis of behavioral addictions, pharmacotherapy is also a possible intervention to support treatment. Successful attempts have been made to introduce selective serotonin reuptake inhibitors (SSRIs) into the therapy of addicted adolescents [5]. However, this effect may be related to the frequent co-occurrence of affective and anxiety disorders, as well as other diagnoses, whose treatment is largely based on antidepressants.

Finally, concurrent therapy seems particularly important for adolescents struggling with both exercise addiction and other mental disorders, especially eating disorders. According to Rizk et al. (2020), an association was found between problematic physical activity and hospitalization discontinuation in young patients with anorexia nervosa. This manifested itself by a higher number of daily steps and moderately intense physical activity [55]. However, Kostrzewa et al. (2013) did not confirm this assumption in their sample of adolescents. The authors reported only a decrease in activity levels at one year of follow-up in those with successful treatment [96]. Other observations indicate that interventions limited to nutritional therapy, dietary and psychopharmacological interventions targeting eating-related behaviors were insufficient in patients with co-occurring exercise addiction. The lack of simultaneous treatment for excessive exercise and eating disorders led to situations in which adolescents, despite changing their eating habits, continued to suffer from dysfunctional physical activity, which prevented them from achieving further milestones [60].

Secondary exercise addiction, most often associated with eating disorders, poses a challenge for those involved in the therapeutic process and the environment of young patients. Early interventions, including correcting unhealthy eating patterns and developing self-regulation strategies, can effectively counteract the escalation of emotional stress associated with anxiety, which leads to compensatory behaviors in eating disorders, including excessive exercise [46]. Furthermore, it seems crucial to avoid over-emphasizing certain personality traits, such as perseverance and perfectionism, to foster flexible thinking processes. Mentalization-based methods appear to be the most important approach in the treatment of patients with co-occurring exercise addiction and eating disorders [54].

3.4.2.Abstinence from Exercise and Its Impact on the Recovery Process

Another therapeutic approach used in behavioral addictions utilizes measures that limit access to the addictive activity. Depending on the severity of the abnormal behavior, it is advisable to gradually limit the pathological activity, aiming for its complete exclusion from the adolescent's daily life. A systematic review by Fernandez et al. (2020) describes the effects of short-term abstinence in the case of 6 behavioral addictions (exercise, gambling, gaming, mobile phone use, pornography use, and social media use). This analysis showed that "across all behaviors, exercise demonstrated the clearest pattern of withdrawal-related symptoms, mainly related to mood disturbances," which may facilitate therapeutic monitoring of physical activity deprivation periods in addicts. Although, as the findings indicate, short-term, "protected” abstinence from exercise or other addictive activities could be a promising approach in the treatment of behavioral addictions, the negative effects of deprivation (e.g., rebound effects and

compensatory behaviors) are insufficiently understood, which, at least for now, limits the usefulness of this intervention [17].

3.4.3.Psychoeducation

A crucial element of treating all mental disorders is psychoeducation, both for the addicts and their environment. In the case of behavioral addictions, including exercise addiction, caregivers of the addicted adolescents play a unique role in the therapeutic process [5, 36]. Families and coaches, especially those of teenagers participating in organized sports, should be educated about the risks associated with excessive exercise and other secondary mental disorders that it can contribute [5]. For prevention, behavioral health professionals can highlight the mechanisms of inappropriate behavior in sports to both caregivers and the adolescents who exercise. This is essential to educate youth about the negative effects of overtraining, preventing complications, and seeking help for mental health issues [82].

4.Discussion

4.1.Characteristics of Exercise Addiction

Excessive exercise, although still not recognized as an official diagnosis of abnormal behaviors, is an increasingly common problem, particularly among adolescents. Not all intense physical activity is classified as exercise addiction. For the purposes of this distinction, exercise can be divided into four categories – recreational, risky, problematic, and addictive. These levels of exercise engagement are associated with corresponding changes in mood, self-esteem, and the occurrence of other mental disorders [4, 110]. Recreational exercise is a widely promoted tool for naturally stimulating the release of endorphins and catecholamines, which positively impact well-being and self-perception and alleviate symptoms of depressive or anxiety disorders [4, 24]. Risky exercise corresponds to a progressive increase in the amount of time devoted to physical activity, which is not balanced by other sources of pleasure and stimulation [39]. The problematic phase is associated with establishing exercise as the primary goal of daily life and the appearance of the first visible symptoms of its harmful effects. The transition to addiction is associated with neglecting interpersonal relationships, responsibilities, and basic functional elements in favor of physical activity [4, 40]. It is the presence of the neuroadaptation process, associated with progressive tolerance and dependency, that indicates the pathology of exercise habits [25].

Symptoms of sports addiction, apart from specific somatic features, completely correspond with the criteria for behavioral addictions [4, 36, 38, 39]. One of the main problems of exercise addiction is the neglect of interpersonal relationships and basic functioning in favor of the addictive activity [5]. These mechanisms can more often lead to long-term consequences such as committing illegal acts [18], which in children and adolescents can falsely lead to a diagnosis of conduct disorder. Difficulties at school or in a peer group, especially suddenly, should always alert adults in the adolescent's environment, with an emphasis on observation for various types of addictions, not just those related to psychoactive substances. Another misleading symptom

that can accompany abnormal behavior is concentration problems [41]. They may result less from difficulty focusing attention, and more from growing internal anxiety caused by not engaging in an addictive activity.
The other element of exercise addiction is the feeling of tension before performing the addictive activity replaced with pleasure, satisfaction or relief after it is completed [10, 18]. These feelings are egosyntonic in nature, resembling the well-known mechanisms of substance-related addictions [10, 18]. Additionally, this feature can be used to differentiate from egodystonic obsessive-compulsive disorder. However, those relations may change during the addiction, which is associated with a decrease in euphoria and the impact of positive reinforcement in favor of negative reinforcement (e.g., a feeling of relief due to a reduction in internal tension) [10, 18].
According to a study by Sicilia et al. (2020), conducted among 13- to 17-year-olds, the most important variables related to the health of adolescents with exercise addiction are exercise characteristics (e.g. frequency and intensity), depression, body image (e.g. appearance self-acceptance and social physique anxiety), and eating disorders. Based on all of the above factors, 3 categories of symptom severity can be distinguished – low-risk, high-risk with conflict, and high-risk without conflict. In the above study, "the low-risk profile emerged as the least problematic; this increased in the high-risk without conflict and even more so in the high-risk with conflict profiles. Nevertheless, individuals belonging to the high-risk without conflict profile showed similar body appreciation scores but lower social physique anxiety scores than those belonging to the low-risk profile". This division is not only an attempt to characterize the individual stages of the process of exercise addiction in adolescents, but mostly provides guidance for therapists who begin treatment at different stages of patients' initiation into the pathological mechanisms of behavioral addictions [111].

4.2.The Mechanism of Excessive Exercise and Addiction

Due to the limited research on exercise addiction in adolescents, similar mechanisms to better-defined behavioral addictions, such as gambling and (internet) video gaming, are generally assumed to underlie the induction of these disorders [1, 5, 44]. However, many authors believe that numerous factors contribute to the transformation of risky exercise into addiction, including both neurobiological and psychosocial aspects. An example of multidisciplinary efforts to understand the mechanisms responsible for the emergence of abnormal thinking processes leading to behavioral addictions is the Adolescent Cognitive Development (ABCD) study [11]. However, these projects are still limited to individual countries, which prevents a broad-based analysis. In adults, studies linking an increased risk of exercise addiction with the presence of certain gene polymorphisms, including DRD2 and BDNF, are still inconclusive [67]. Furthermore, research examining both psychosocial and sociodemographic factors do not demonstrate such significant correlations, which notably emphasizes the primary role of psychological determinants [6, 42, 95].

4.2.1.Self-conscious Emotions

Exercise addiction in young people is not only related to exposure to the challenges of adolescence but is closely linked to becoming aware of one's emotions and body image, which can be difficult for many teenagers [4, 36, 62]. The young brain, not yet skilled to cope with these challenges, seeks out various options. One of them is sport, which can enhance reward,

social support, and stress-relief mechanisms, while also impacting the adolescent body [39, 110]. Certainly physical activity is a principal part of adolescents' routine. Sport is a way to embrace their changing bodies and cope with confusing emotions, including those stemming from interpersonal relationships [2]. But in individuals with higher risk of addiction, exercise can become the primary means of strengthening self-esteem and compensating for deficiencies in other areas of life [6, 49]. Hence, there is a need to change young people's focus from potentially negative motivations related to sport to more adaptive ones, such as entertainment, healthy competition, and other factors independent of physical appearance.

4.2.2.Personality Traits and Attachment Styles

As stated in numerous findings, excessive exercise in youth also depends on specific personality traits and attachment styles, which support the maladaptive, addictive behaviors related to sports. As Bircher et al. (2017) emphasize, "neuroticism reflects the frequency with which an individual experiences negative emotions, the presence of inappropriate stress reactions, and a low frustration threshold," which also describes the challenges faced by children entering adolescence [50]. Other studies confirm that in this mechanism, excessive exercise becomes a pathological form of stress reduction, as well as an immature way of escaping unwanted thoughts and emotions [6, 39, 41, 50, 80]. Similar conclusions can be drawn from studies linking excessive physical activity with narcissism [42, 53].

According to Caponetto et al. (2021), the group of personality traits associated with exercise addiction can be expanded by avoidance, self-directivity, immaturity and especially, persistence or grit [41]. This suggests that "can-do" psychological resilience and beliefs can intensify dysfunctional thinking, ultimately leading to addiction. Another profile linked with exercise addiction risk is perfectionism [3, 6, 36, 54]. This pursuit of flawlessness through excessive training, and often diet, is primarily driven by socially imposed perfectionism. It focuses on concern for the evaluation of others, rather than the more adaptive self-oriented perfectionism that involves striving for high but realistic goals based on healthy standards, which should be promoted [54].

Further impulsivity and compulsivity has been connected with excessive exercise in youth. Inadequate emotional regulation and obsessive thinking constitutes an exceptionally dangerous combination. A teenager who desires to look fitter or achieve even better athletic results, yet is unable to critically assess their abilities and attitudes, becomes frustrated by failures, impatient for outcomes and easily falls into a spiral of rumination [6, 55, 99]. Also anxiety [42], passion, engagement [6, 46] and extraversion [51] are correlated with higher risk of exercise addiction occurrence. Due to inconsistencies in the current literature and mutually exclusive reports, the importance of extraversion in this disorder is difficult to evaluate [56].

A promising aspect of assessing the relationship between personality traits and behavioral addictions, including exercise addiction, is the possibility of introducing the so-called five-factor model, which predicts the likelihood of future behaviors based on personality characteristics. The model consists of the following elements: neuroticism (sensitive/nervous vs. secure/confident), extraversion (outgoing/energetic vs. solitary/reserved), openness (inventive/curious vs. consistent/cautious), agreeableness (friendly/compassionate vs. cold/unkind), and conscientiousness (efficient/organized vs. easy-going/careless). It has been

successfully used to describe personality in other behavioral addictions, including shopping addiction, gambling disorder, and eating disorders [42, 51]. Although the five-factor model has not been used in research on exercise addiction, its ability to identify specific personality traits associated with the risk of excessive exercise would certainly be useful.

The interpersonal relations forming throughout life are a “product” of the relationships that served as a model for social learning, which corresponds to attachment styles, another aspect linked with creating a maladaptive way of exercise [6, 36, 59]. This correlation could be explained by attachment theory, which states that early exposure to negative relationships contributes to the development of a pessimistic self-image. Addictive behavior, such as exercise, may constitute a form of compensation, resulting from an attempt to avoid facing negative self-esteem and a basis for gaining acceptance in a group, mostly through desire for a sense of belonging to the group [1, 3].

Another aspect of connection between dysfunctional attachment and exercise addiction is creating strong sports identity, based on establishing physical activity as the most important life activity [6]. Perceiving oneself primarily as an athlete may therefore result in exclusive dedication to the discipline and a reduced sense of personal fulfillment, which negatively impacts these individuals' overall mental well-being. That way of thinking should be monitored and moderated, especially among young professional athletes.

4.2.3.Peer Pressure

Social pressure and the constant search for acceptance can also directly influence the development of exercise addiction symptoms. To truly understand the importance of environmental influences on adolescents, neurobiological foundations need to be analyzed. A new consensus on the physiology of decision-making indicates that two main systems participate in that process: the socio-emotional (limbic and paralimbic structures) and the cognitive control (prefrontal and parietal cortex) [2]. During adolescence, the above systems are still developing, leading to disruptions in the coordination of these mechanisms. This imbalance results in emotional dysregulation, which in turn leads to enhanced susceptibility to peer influence, a desire for faster gratification, and increased risky behaviors. This phenomenon, called the "maturity gap," is a way to understand the true relationships among adolescents, including the power of peer pressure [2].

The study conducted by Montgomery et al. (2021) also points to important social factors that are based on the perception of athletic people by other teenagers as more attractive. These observations may lead to conclusions about the potential mechanisms shaping social norms and expectations related to sport and appearance. They construct a fraction within the youth community – those who actively exercise are better perceived, accorded greater respect and admiration, while those who do not exercise are less well-judged and often fall victim to unrealistic visions of attractiveness. These findings may provide a basis for linking the strong need to use physical activity as a tool for achieving acceptance with the further destructive process of addiction. On the other hand, research has not found a clear relationship between popularity, sociability and exercise, which may indicate a more significant influence of intrapersonal motivations [61].

4.2.4.Exposure to Exceeding the Ritual and The Influence of Regular Intense Physical Exercise

The role of physical activity in childhood and processes based on expanding the ritual of exercise are also significant. Sport, especially professional, requires adherence to a specific routine. Usually, the trainee is guided by a well-developed schedule and a set of selected exercises at appropriate intervals [6, 60]. This type of training, related to compulsive routines, is another starting point for developing an exercise addiction [25]. Importantly, training patterns based on regularity and stereotypes are most often expanded, not reduced. In this way, a rigid exercise schedule leads to limitations in other areas of life unrelated to sports [6]. Despite the well-known positive aspects of physical activity in everyday life [4, 24, 70], especially in youth, there are reports suggesting that excessive exercise in childhood may lead to sports addiction later in life through various mechanisms [66, 68, 69]. Considering the limited literature describing the above-mentioned relationships, further reports in this area should be monitored, mainly longitudinal studies. These considerations could demonstrate that even well-understood factors, well-established in socio-scientific discourse, can have different effects than expected in situations of increased exposure and sensitivity, which include childhood and adolescence.

4.3.Exercise Addiction Risk Factors

4.3.1.Culture of Healthy Lifestyle

Exposure to inappropriate behaviors promoted under the banner of a healthy lifestyle, through trends like “fitspiration”, “bonespiration” or “thinspiration”, is a threat that influences adolescents online [3, 74]. Many studies analyzing fitness-related content on social media platforms point to its negative impact on youth mental health [3, 72, 73]. "Fitspiration," which calls for excessively intense training and overcoming discomfort regardless of limits, is a disturbing trend gaining popularity [73, 76]. Such slogans can lead to the perception of pain as a positive experience and an excessive pursuit of an ideal figure through maladaptive increases in exercise intensity and frequency, which constitutes a risk factor for exercise addiction [3]. Combining elements of a vastly thin physique with pronounced muscularity, exposing more followers to body images that represent a relatively small population, frequently promoted as the "healthiest," may have a similar impact on teenagers as images of emaciated individuals [74], such as reinforcement of dysfunctional behaviors related to eating and physical activity. It can be also assumed that the risk of dysfunctional exercise mainly stems from the popularization of unrealistic bodies, which influence the development of unattainable standards of attractiveness, and the promotion of excessive exercise as a tool solely for changing appearance, rather than for health care [3, 73, 76].

Social expectations shaping youth's goals and behaviors not only lead to the prevalence of mental disorders related to physical activity but also result in a generalized social restructuring. According to Lichtenstein et al. (2018) a large group of teenagers, without symptoms of exercise addiction, "reported feelings of guilt when they did not exercise (45%), feelings of being fat even though others think they are thin (40%), exercising despite pain/injury (32%), and food dominates life (27%)" [44]. The above observations indicate that the concepts of health and beauty are intertwined, and that the present sense of attractiveness and self-esteem in teenagers depends on factors whose negative impact we might not expect. Considering the statistics on the sources of knowledge about a healthy lifestyle among young people, the influence of social media is unlimited [77]. These results should encourage governments and

health organizations to focus on educationally targeting younger age groups using resources that capture their imagination. This would facilitate the development of healthy behaviors among young people, guided by reliable sources.

4.3.2.Amateur and Professional or Competitive Sports

The type of sport practiced by adolescents and the level of competition they participate in are also important in the development of exercise addiction in youth. Considering that currently most of the research on excessive exercise has taken place in amateur athletes, it seems that professionals should be surveyed more frequently [6, 80, 84]. Although non-professionals reported more negative symptoms affecting mental health, these symptoms were more severe among elite athletes [55, 62]. There's a reason for that coexistence of high sporting expectations and symptoms of exercise addiction. It was primarily linked to insistence from coaches and teammates, and also accompanied by a sense of low social support during this crisis [84]. Those conclusions show the importance of mechanisms related to social pressure, particularly from authority figures who also possess a sports' identity. Based on research, the group at greatest risk of developing exercise addiction and other mental disorders are sub-elite athletes [92], and therefore systematic screening for this individual should be considered.
However, the potentially negative impact of recreational exercise on young adults should not be underestimated. The most common example of a hobby sport with strong addictive properties is running [62, 81, 82]. As an individual activity, it can be a way to cope with loneliness and anxiety, which fuels a maladaptive spiral of dependence [83]. Running is a readily available discipline with growing popularity, and also a high-risk factor of addiction, especially in individuals with other mental health conditions. This risk should be considered when using sport as a therapeutic intervention.

4.3.3.Body Image Disturbance and Eating Disorders

Excessive focus on appearance, which changes rapidly during adolescence, can have an impact on mental health, sleep, and eating habits in young people. Increasing body self-awareness, sensitivity to peer evaluation, and emotional dysregulation connect the developmental challenges of adolescence and pathology [3]. The trio "body image disturbance–eating disorders–exercise addiction" perfectly illustrates the closely intertwined threats facing teenagers. Preoccupation with appearance, the desire to improve one's figure, and often to lose body weight, naturally combines with a search for maladaptive ways to achieve these goals, like improper diet and abnormal physical activity. Fear of weight gain or the body changes during puberty, can be a direct source of compensatory behaviors such as vomiting or excessive exercise [4]. This is also related to negative psychological symptoms associated with physical activity, changes in body image, metabolic disorders, and an increased exploration for opportunities to intensify exercise [62].
Another example of a strong link between body image disturbance and exercise addiction is muscle dysmorphia, or bigorexia nervosa, associated with subjective dissatisfaction with one's muscularity [14]. The highest rates of excessive exercise, identified in this group of adolescents and young adults, particularly highlight how standards of sexual attractiveness and sociocultural demands influence the development of dysfunctional self-beliefs that lead to addiction [47, 93].

A lot of evidence indicates that people who exercise excessively are more likely to exhibit pathological eating patterns, which is associated with the perception of abnormal behaviors related to physical activity as an alternative technique for controlling body weight [54, 60, 80]. It is then certain that eating disorders are strongly related to the occurrence of exercise addiction [4, 44]. Some authors claim that eating disorders themselves constitute an example of behavioral addiction [4, 44, 46]. This hypothesis is supported by similar health outcomes and neurobiological mechanisms [4]. Common features can also be found in emotional regulation activities – lower self-control leads to a greater propensity for dysfunctional behaviors, including exercise, even when they reduce stress in eating disorders [4].

Referring to the self-defeat theory, it is assumed that self-control can lead to the exhaustion of limited cognitive resources, which promotes the emergence of maladaptive behaviors [46]. In this perspective, exercise addiction can be understood as a consequence of impaired self-regulatory processes resulting from a reduced ability to maintain control over one's own behavior, preceded by maladaptive eating habits. In these conditions, extreme behaviors and the development of addictive mechanisms are easily induced.

Among the young athletes surveyed, eating disorders and co-occurring sports addiction, both primary and secondary, were associated with greater body dissatisfaction [54, 60, 80]. The above elements appear to form a sequential cause-and-effect chain – from weight-related stigma, through body image disapproval, to excessive exercise [47]. Similar relationships were identified in groups of adolescents and young adults, in the context of the mediating role of social physique anxiety (SPA) and personality tendencies (e.g., persistence) between restrained eating and exercise addiction. The so-called chain mediation model described by Pan et al. (2025) connects these aspects within a continuum of self-regulatory processes, which consider exercise addiction as a coping mechanism in eating disorders [46]. Moreover, patients with anorexia nervosa who did not engage in excessive exercise had higher chances for somatization, anhedonia, and anxiety – dysfunctional physical activity reducing tension and negative emotions in individuals with eating disorders [55].

The spectrum of maladaptive behaviors related to exercise occurring in people with eating disorders is very extensive. So-called problematic use of physical activity (PPA) includes: hyperactivity, compulsive exercise, driven exercise, unhealthy exercise, motor restlessness, over-exercise, overactivity, hard exercise, drive to exercise or drive for activity [55]. While not all of the above concepts equate to exercise addiction, their amount demonstrates the inseparable link between exercise and weight loss efforts. Apart from anorexia nervosa, informal types of eating disorders, such as orthorexia nervosa, also show a strong association with abnormal physical activity patterns and indicate a strong role of exercise in various traits of unhealthy eating.

4.3.4.Other Mental Disorders

Behavioral addictions, including exercise addiction, like most other diagnoses, typically do not occur in isolation. Some of the most common co-ocurring diagnoses are depression, anxiety disorders, and suicidal thoughts and/or intentions. As indicated by many authors a correlation has been demonstrated between excessive exercise and the presence of those conditions among athletes. These disorders affected both amateurs and professionals [6, 26, 36, 60, 85].

Studies have confirmed bidirectional relationships between depression and exercise addiction in young adults, indicating the possibility of developing both primary and secondary conditions in relation to each other [25, 39, 60, 99]. The situation, in which exercise addiction occurs

secondary to low mood, seems more understandable. Considering the abundant evidence of the therapeutic effects of physical activity, supporting the treatment of depression and anxiety [60, 66], this topic still needs to be explored. According to Weinstein et al. (2015), a possible cause of this causal chain could be a lack of control over the accelerating addictive behavior and the depressive effect of withdrawal symptoms [26]. Although limited, evidence indicating a correlation between suicidal behavior and excessive exercise may suggest that impaired impulse control may be the cause of both phenomena [100], which is also indicated by the connections of exercise addiction with obsessive-compulsive disorder [6, 55, 99].
Maladaptive behaviors related to physical activity are also associated with sleep disorders, most commonly insomnia, which has also been studied in adolescents. Nevertheless, the explanation is not simple – sleep and exercise appear to be parts of a greater mechanism, extending beyond the topic of addiction itself. Both intensity and duration, time of day, and/or environment of exercise can influence sleep, and sleep disorders can influence exercise capacity [4]. Young people addicted to sports are also at risk of developing other types of addictions, including behavioral ones [4, 6, 7, 101]. Considering their limited coping strategies, excessive exercisers, when unable to engage in physical activity, often seize in so-called "substitute behaviors" that temporarily improve their well-being, also in youth [25].

4.3.5.Gender and Level of Education

Among other general risk factors for excessive exercise, gender also stands out. Exercise addiction is significantly more common in young adult men, and the motivations for physical activity differ from those of women [46, 62]. These relationships can be explained by higher values in the male vigor dimension and specific requirements for masculinity attributes [62]. Women striving for a socially acceptable figure, unlike their male peers, are more susceptible to judgment from others, which can lead to body image disturbance and eating disorders linked with excessive exercise [61, 62]. A higher incidence of exercise addiction was also observed in youth with a lower level of education , regardless of gender [83, 103], however, this information is rarely studied and is not the main topic in the current discourse.

4.4.Diagnostic Process of Exercise Addiction

Excessive exercise, like other behavioral addictions, poses an increasingly serious threat to youth. Although that condition is best described in adults, even among them, exercise addiction is more common in the younger group (mean age 28). It is also characterized by much greater intensity than in older adults [42]. However, the younger age of onset of exercise addiction is associated not only with other developmental difficulties but also with specific diagnostic challenges.
The classifications of mental disorders have clearly established diagnoses for only two behavioral addictions – gambling and (internet) gaming disorder. Exercise addiction is still not recognized as an official diagnosis [1, 10, 39]. Nevertheless, even in the case of confirmed clinical conditions related to behavioral addictions, there are no divisions focusing solely on individuals < 18 years of age, which take into consideration the developmental context and differences in some observations [15, 16]. Only further clinical and epidemiological studies can drive changes in the official diagnosis of behavioral addictions in youth, emphasizing the distinctive psychopathological characteristics of this age group.

Diagnosing exercise addiction, especially in young people, is difficult, but there are proven tools for assessing that disorder in adolescence and early adulthood. According to numerous reports, the Exercise Addiction Inventory (EAI) is characterized by high reliability and validity [6, 104, 105]. Other diagnostic tools assessing the risk of excessive exercise were more time-consuming, and their interpretation was not straightforward [6, 62, 106], in turn EAI is a simple tool that could be used in everyday medical practice [44, 79]. Due to difficulties in assessing the exercise addiction in the group of athletes, it can be concluded that the risk analysis should be supported by additional tools that would reduce the risk of false classification and confusion between healthy engagement and dysfunction [6]. Clinical interviews could be used for this purpose, providing a good basis for understanding the deeper motivations and mental states of the participants. This analysis could also be expanded by validated tools for evaluation of body image, eating habits, mood, anxiety, personality traits, and other aspects examined in the context of exercise addiction's occurrence at every stage of development [36, 62]. Despite these assumptions, there are many indications that the EAI and its equivalent for younger age groups (EAI-Y) are currently the best choice for evaluation of exercise addiction risk, especially when combined with additional mental health assessment methods [44].

4.5.Types of Therapeutic Intervention for Exercise Addiction

4.5.1.Psychotherapy and Psychoeducation for Behavioral Addictions

In the present, exercise addiction has no established therapeutic protocols. However, based on better described in the literature methods used in official behavioral addictions (e.g., gambling and (internet) gaming disorder), it is assumed that in excessive exercise, similar interventions should be used. This approach includes primarily motivational approach and cognitive-behavioral therapy (CBT) along with the psychoeducation of the system [5, 107, 108]. Developing alternative, healthy coping mechanisms and identifying triggers leading to risky behaviors are important elements of recovery that patients can achieve through CBT. These psychological techniques, utilizing neurocognitive training, appear promising, primarily as a consequence of understanding the physiological changes in adolescence and their impact on behavior [5, 107, 108]. Among the preferred forms of psychotherapy, individual therapy is the most commonly chosen, but group sessions and family-based therapy are also recommended [108, 109]. Combining these types of interventions has a higher therapeutic success rate, observed among the more researched internet or computer gaming addiction in adolescence. The behavioral approach also helps understand the mechanisms of the disorder and sometimes reincorporates former activities, like exercise, into the teenagers' lifestyle, but in a healthy way [107]. Therefore, all of these interventions not only result in transformation of beliefs about the role of exercise in everyday life, but above all, address the needs of adolescents holistically.
The second foundation of the therapeutic process for young people with exercise addiction is systemic psychoeducation. Parents of adolescents at increased risk of sports addiction or with active symptoms should carefully organize the time spent together with their child, thus helping them to self-monitor the period spent on physical activity and finding other forms of stimulation that provide them with satisfaction. Whenever possible, they should supervise children' athletic activities, especially if teenagers have a history of risky behavior [36]. For prevention, behavioral health professionals could highlight the mechanisms of inappropriate behavior in sports to both caregivers and the adolescents who exercise [5] to better understand the process of addiction and how to manage it.

4.5.2.Other Therapeutic Interventions for Behavioral Addictions

The other basic aspect of patient care is treating the underlying causes of all mental disorders diagnosed simultaneously with exercise addiction [5]. Direct psychological and psychiatric interventions that holistically support patients are not only a component of primary exercise addiction therapy but also a preventative measure for the development of secondary exercise addiction (e.g., in eating disorders) [46, 54, 55, 60]. Pharmacotherapy, including SSRIs, is currently only an addition to treatment [5]. Other innovative approaches, such as short-term, controlled abstinence, are presently being studied, but the negative effects of deprivation are insufficiently understood, so it is not widely used, especially in adolescents [17].
Dysfunctional physical activity remains an extensive research topic, particularly among children and adolescents, who are undergoing significant changes under the influence of ongoing psychosocial factors [3, 49]. The lower age of diagnosis along with the increasingly extensive spectrum of substances and activities that constitute the cause and core of addiction, require expanding knowledge in this field, particularly in the context of further therapeutic interventions. Therefore, there is a need to expand activities on this topic by investing in projects that explain the hypothetical differences between excessive exercise among adults and youngsters.

5.Conclusions

Although exercise addiction has not been formally classified as a separate diagnosis, available evidence indicates that it represents a clinically significant behavioral health problem among adolescents and young adults. Excessive exercise in youth is associated with a complex interaction of psychosocial factors, including emotional dysregulation, body image disturbance, maladaptive personality traits, and co-occurring psychopathology.
Despite diagnostic challenges, validated screening tools enable early identification of high-risk teenagers. Currently, cognitive-behavioral interventions and psychoeducation constitute the primary treatment approaches, although age-appropriate therapy protocols have not been structured. Future research should focus on understanding the specific developmental mechanisms and effectiveness of intervention strategies among adolescents and young adults.

Disclosure

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