

Physical activity and symptoms of depression and anxiety in children and adolescents

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Abstract

More and more children and adolescents have been facing mental health problems, especially depression and anxiety symptoms. Physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure, and it affects mental health at multiple levels and through different mechanisms.

The aim of this paper is to provide an overview of the relationship between physical activity and symptoms of depression and anxiety, with an emphasis on children and adolescents. An analysis of the available literature has been conducted and the results have shown that there is evidence that physical activity has a positive effect on overall mental health, especially on symptoms of depression. However, much research is still needed to prove exact mechanisms and directions of this relationship.

Keywords: adolescents; anxiety; children; depression; physical activity

Introduction

Childhood and adolescence are a critical period of life in general, as well as for the development of numerous mental health problems. The capabilities formed during this developmental stage are crucial for a person's mental health for the rest of their life (WHO, 2018b). Therefore, in this period of an individual's development, it is extremely important to respond to its specific needs in a timely manner, mitigate development risks and encourage positive development. Mental health of children and young people is a special focus of many experts, since it is estimated that mental health disorders affect around 35% of children in Europe (Cadenas-Sánchez et al., 2016; Rodriguez-Ayllon et al., 2018), i.e., that there is a high and increasing rate of mental health and behavioural problems in adolescents at population level in the WHO European Region (WHO, 2018b). It is very important to emphasize that mental health is not just an absence of different mental disorders, but it is a multidimensional state of well-being that includes both negative (e.g., depression, anxiety) and positive indicators (e.g., self-esteem, self-concept) (Dale et al., 2019).

Mental health difficulties – mental illnesses and negative consequences of poor mental health – are the highest public health priority, especially for children and adolescents (Dale et al., 2019). In this context, it is especially important to pay attention to depression and anxiety as they represent one of the most rapidly increasing global (public) health challenges – they are two of the most prevalent mental health problems in the modern age (WHO, 2017) and are among the top five causes of the overall disease burden (measured in terms of disability-adjusted life years (DALY)) (WHO, 2018a). An increasing number of children and adolescents suffer from depression and anxiety, and these two mental health problems are the main reasons for seeking professional help at this age (Polanczyk et al., 2015).

Therefore, it is important to review the effectiveness of existing prevention, early detection and treatment programs for childhood and adolescent depression and anxiety. Some of those programs include physical activity, which is a very interesting approach that should receive more attention. Physical activity is perceived as a non-stigmatising intervention with very limited side effects, and it can be used in promoting mental health and treating mental health problems, especially for children and young people who are generally more hesitant when it comes to seeking help (Pascoe et al., 2020).

The aim of this paper is to present the most important data on physical activity, depression and anxiety symptoms in children and adolescents, as well as to summarize some available data from the existing research.

Prevalence of depression and anxiety in children and adolescents

More and more children and adolescents face mental health issues. Recognizing these these problems and difficulties early allows for timely and effective intervention, potentially preventing more serious mental health problems in adulthood. However, early detection and timely intervention remain the main challenge – the signs and symptoms often go unnoticed by health, social, and educational experts, and services. This can lead to mental health problems that “continue, worsen or lead to mental illness” (WHO, 2018b).

According to the WHO (2022), 970 million people worldwide suffer from mental disorders, with 280 million suffering from depressive disorders and 301 million struggling with anxiety disorders. In the age group up to 19 years, that is, in childhood and adolescence, 4% of the population suffers from depressive disorders (age 5-19), and almost 10% deal with anxiety disorders (age 0-19). The incidence of both disorders in children and adolescents increases with age (see Table 1).

Table 1 Worldwide prevalence of mental disorders across age and sex, 2019 (WHO, 2022)

AGE (%)		All ages (millions)	<5	5-9	10-14	15-19
Mental disorders	970	3.0	7.6	13.5	14.7	
Depressive disorders	280	-	0.1	1.1	2.8	
Anxiety disorders	301	0.1	1.5	3.6	4.6	

For Croatia, the last available data on the prevalence of certain conditions classified by age (age groups) are for 2017 (Capak, 2022). The prevalence of mood disorders (affective disorders) in the Republic of Croatia is 6,602.9/100,000 inhabitants, that is, 6.6% of the total population. The prevalence of anxiety disorders is 12,655.1/100,000 inhabitants. This represents 12.7% of the total population (according to the population estimate of the CBS for 2017).

Tables 2 and 3 present prevalence data of affective and anxiety disorders for children and adolescents. A noticeable difference exists in the prevalence of both disorders between males and females. Starting from age 15, nearly twice as many females suffer from both affective and anxiety disorders. This trend also applies to other age groups, not only adolescents (Capak, 2022).

Table 2 Mood disorders in Croatia (affective disorders), F30 – F39, prevalence, children and adolescents (Capak, 2022)

Age group	Male	Female	Total
0-4	0	0	0
5-9	0	0	0
10-14	165	192	357
15-19	662	1216	1878

Table 3 Anxiety disorders in Croatia, F40 – F41, prevalence, children and adolescents (Capak, 2022)

Age group	Male	Female	Total
0-4	0	0	0
5-9	0	0	0
10-14	520	663	1183
15-19	1654	3144	4798

These data confirm the importance of timely intervention and a focus of all actors in the direction of empowering children and adolescents, preventing mental disorders and promoting mental health.

It is also important to note that the incidence of depressive and anxiety disorders in children and adolescents has increased during the COVID-19 pandemic (Racine et al., 2021), and will likely continue to increase in areas of various crises – security, environmental, economic.

In its Comprehensive mental health action plan 2013–2030, WHO emphasizes the importance of developing high quality and evidence-based mental health services. It is specifically noted that “children and adolescents with mental disorders should be provided with early intervention through evidence-based psychosocial and other non-pharmacological interventions based in the community, avoiding institutionalization and medicalization”. Additionally, the plan stresses the importance of focusing interventions not only to improve mental health, but also to “attend to the physical health care needs of children, adolescents and adults with mental disorders, and vice versa, because of the high rates of co-morbid physical and mental health problems and associated risk factors” (WHO, 2021a).

Importance of physical activity and its impact on mental health

Physical activity is crucial for one's overall health and balanced everyday functioning – both physical and mental. The most used definition of physical activity is the one by WHO (2020) – “physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure”. This definition goes beyond exercise which refers to planned and structured activity aimed at improving or maintaining one or more components of physical fitness. Physical activity includes all movements throughout the day, whether at work, during leisure time, in transport, at home. Any physical activity, not just exercise, has health benefits, while moderate and vigorous physical activity improves health (WHO, 2020).

In modern times, especially in developed countries where a sedentary lifestyle prevails, regular physical activity seems to have become a privilege. Fewer and fewer people manage to meet the minimum recommended amount of physical activity (according to the latest data, about 1 in 4 people did not meet the minimum recommendations globally, prior to the pandemic, but this number is higher for more developed countries) which brings numerous negative consequences for physical and mental health (WHO, 2020; Guthold et al., 2020). Even worse are the latest data according to which even 81% of adolescents between the ages of 11 and 17 are not active enough, i.e., do not meet the WHO global recommendations on physical activity for health (Guthold et al., 2020). These recommendations state that children under the age of 5 should be active for a minimum of 180 minutes daily, and that children older than 5 years and adolescents should have an average of 60 minutes of moderate to vigorous-intensity physical activity (mostly aerobic) per day or vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone, at least 3 days a week (WHO, 2020).

The data for Croatia mirrors the global trend. According to the latest publication “Croatia Physical Activity Factsheet 2021”, only 28% 11-year-olds, 24.6 % 13-year-olds, and 17.2% 15-year-olds achieve sufficient amounts of physical activity (WHO, 2021b). The differences between males and females are visible in Figure 1.

The low level of physical activity among children and adolescents is truly worrying, and modern trends such as the popularization of social networks, video games, and other sedentary activities further worsen this situation.

Estimated prevalence of sufficient physical activity levels



Levels of physical activity among adolescents were assessed in the [Health Behaviour of School-aged Children survey](#) in 2017/2018; data for adults aged 15-65+ were collected through the [European Health Interview Survey](#) in 2019.

Figure 1 Estimated prevalence of sufficient physical activity levels in Croatia (WHO, 2021b)

Biopsychosocial model in context of physical activity and mental health relationship

The biopsychosocial model was developed in the last century as a response to the dominant biological approach to an individual, its physical and mental health (Adler, 2009; Lugg, 2022). This multidisciplinary model emphasizes the interconnectedness of biological, psychological, and social (environmental) factors on an individual's health and starts from the assumption that these factors are interdependent (Fava & Sonino, 2007). Changes in one "domain" also affect the others, that is, they lead to changes in the system (or the individual) (Lugg, 2022). Given that physical activity is inherently a complex behavior with complex consequences, the connection of physical activity and its influence on numerous conditions of physical, mental, and social health should be explained through an equally complex model (John et al., 2020). Focusing solely on one mechanism can completely divert attention from other mechanisms that must by no means be neglected, that is, which can also have an important impact on the consequences that physical activity will have (John et

al., 2020). In accordance with the above, the biopsychosocial model can serve well to explain the relationship between physical activity and symptoms of depression and anxiety, as well as to understand the mechanisms of this relationship.

Mechanisms of influence of physical activity on mental health/symptoms of depression and anxiety

There are many pathways and mechanisms that can be used to explain an impact of physical activity on one's mental health and/or symptoms of depression and anxiety (Hwang et al., 2023). One of the most well-known is the biochemical mechanism, which explores the influence of physical activity on hormones and neurotransmitters. In this sense, the role of serotonin is most often mentioned. Serotonin, among other neurotransmitters, participates in creating a good mood (Marić et al., 2020; Wipfli et al., 2011). The level or secretion of serotonin is influenced by numerous factors and regulatory mechanisms, and physical activity is definitely among them. There are two mechanisms by which physical activity affects the increase in serotonin concentration – it increases the rate and frequency of serotonin secretion, but also increases the level of tryptophan in the brain (tryptophan is an amino acid that is used to produce serotonin) (Grošić & Filipčić, 2019; Hwang et al., 2023). By making serotonin more available, physical activity has a similar effect to antidepressants (Wipfli et al., 2011). Furthermore, it is also important to mention the role of the endorphins that cause one of the best feelings which occur after physical activity – a feeling of relaxation, satisfaction, and improved mood, known as a “runner's high” (Kern, 2016; Peluso & Andrade, 2005). Physical activity, especially vigorous one, affects the secretion of endorphins, but what is most interesting is that after several months of regular exercise, the body's sensitivity to these neuropeptides increases. This means that the endorphins produced in the blood remain in the bloodstream for a longer time, which greatly facilitates exercise, and the feeling of euphoria after exercise is prolonged (Grošić & Filipčić, 2019; Wipfli et al., 2011).

There are also other biological mechanisms through which physical activity can potentially affect mental health, such as neuroplasticity and stress and inflammation reduction (Hwang et al., 2023). The stress regulation mechanism is particularly interesting – engaging in physical activity briefly challenges the body's physiological system. However, when followed by adequate rest, the body develops reserves to better handle future stressors (Kern, 2016).

According to the biopsychosocial model, the impact of physical activity extends beyond the impact on our biological functioning. The impact on cognitive functions, self-perception (self-confidence and self-esteem) and the social component should not be ignored. The influence of physical activity on cognitive functioning

is especially important in the context of the children and adolescents' development. Cognitive development (perception, memory, intelligence) is crucial in this stage of development and can reduce the risk of common mental disorders (Cadenas-Sánchez et al., 2016). Many reviews showed that regular physical activity can lead to better brain functioning (Marić et al., 2020), and hence to improved cognitive and academic performance (Biddle & Asare, 2011).

Of all the effects of physical activity on mental health, the connection between physical activity and symptoms of depression, as well as self-esteem has been most often investigated (Rodriguez-Ayllon et al., 2019). Research has shown that physical activity can improve self-esteem, at least in the short term (Biddle & Asare, 2011; Lema-Gómez et al., 2021; Marić et al., 2020). Achieving some specific goals in sense of physical activity can be very encouraging – it provides a sense of success and control, especially if certain goals seemed impossible in the beginning (Kern, 2016). Interestingly, self-esteem was associated with muscular strength, as well as happiness and optimism, but negatively associated with stress, depression, and negative affect. This suggests an indirect influence of physical activity on symptoms of depression by increasing self-esteem (Rodriguez-Ayllon et al., 2019). Still, more research is needed to confirm and explain these connections and mechanism in detail. The question of “what came first” remains: do individuals with more self-esteem generally engage in physical activity more frequently, or does physical activity truly enhance self-esteem?

Another mechanism of the effect of physical activity on mental health is the improvement of the individual's ability to tolerate negative emotions or arousal, that is, strengthening an individual's resistance to stressful situations. Intense physical activity can create stimuli that “imitate” anxiety in a certain way. More specifically, during more intense physical activity, individuals experience certain stimuli in a controlled, non-threatening environment and thus strengthen their own tolerance to interoceptive sensations while simultaneously inhibiting escape reactions (Smith & Merwin, 2021). Also, physical activity can sometimes (in some individuals) produce certain “unpleasant” sensations. An individual needs to deal with these short-term “unpleasant” sensations to achieve long-term benefits, and this is exactly what can benefit one's impulse control skills (Smith & Merwin, 2021).

Finally, the social component of physical activity, particularly when done in a group setting, also plays a significant role in mental health. The social component of physical activity is very important for all people who participate in physical activity, especially children and adolescents, as well as for people with certain mental health problems (such as depression) and other at-risk groups such as people with disabilities, war veterans (Marić et al., 2020), refugees or other groups of underprivileged

positions. Many studies have shown that participation in group activities, mostly in informal group physical activity can be beneficial for mental health, especially in reducing depressive symptoms (Doré et al., 2016; McMahon et al., 2016). There is a definite advantage to the group cohesion in class-based programs or activities. People tend to encourage one another, share thoughts, emotions, and experiences all of which can be very beneficial for mental well-being (Doré et al., 2016; Kern, 2016). However, it is still not clear enough whether and to what extent physical activity itself improves mental health, and the extent to which it does so indirectly, through social well-being and cohesion. Many people that engage in solitary physical activity also report great benefits. Therefore, the social component is not mandatory in explaining the influence of physical activity on mental health. Further research is needed to determine in which situations and how the social component of physical activity specifically improves mental health (Kern, 2016).

Physical activity can be a great supplement to a regular medication and psychotherapy for different conditions, especially for mild-to-moderate depression (Fibbins et al., 2020). It also seems to be an effective mental health prevention and promotion strategy, and can significantly improve quality of life for all individuals (Pascoe et al., 2020, Peluso & Andrade, 2005).

On the other hand, it would be impossible to analyse the impact of physical activity on mental health and not emphasize that physical activity can sometimes be harmful. Overtraining syndrome can occur when training is continuously excessive and not followed by sufficient rest (Carrard et al., 2022; Kreher & Schwartz, 2012). Young athletes with overtraining syndrome face the same symptoms as adult athletes that include, among physical difficulties, mood and sleep disturbances, loss of appetite, shortness of temper, and decreased self-confidence (Winsley & Matos, 2010). These are all signs of impaired mental health, and depression and/or anxiety can even be symptoms of overtraining syndrome itself (Kreher & Schwartz, 2012).

In the context of physical activity for the purpose of improving mental health, it is important to note that moderate or moderate-to-vigorous intensity physical activity is generally recommended. Moderate physical activity has been emphasized since ancient times. Even Plato “advocated for moderate exercise to influence not only the health of the body, but also the mind and soul” and emphasized that excessive training can destroy the body and mind balance (Kern, 2016). While moderate physical activity positively affects the mood, intense and/or excessive exercise can lead to its degradation (Pascoe et al., 2020). Interestingly, research suggests that people who exhibit exercise addiction in terms of exercise start can experience symptoms of depression, anger, and fatigue during exercise withdrawal periods (Weinstein et al., 2017).

It is important to emphasize that the effects that physical activity has on mental health, specifically on the symptoms of certain mental difficulties such as depression or anxiety, vary from person to person, their characteristics and the type of physical activity itself. That is why it is crucial to understand the mechanisms of physical activity on mental health and to keep in mind how important it is to maintain a sufficient level of physical activity so that the effects of physical activity are long-term (Smith & Merwin, 2021). Also, in line with biopsychosocial model, these mechanisms do not operate separately. A “total” influence that physical activity has on one’s mental health and symptoms of depression and anxiety is a result of the interplay of all these mechanisms in varying degrees, not solely one mechanism.

Finally, it is important to note that the influence of physical activity on mental health is not a “one-way street”, but rather a bidirectional influence – people who are regularly involved in physical activity have better mental health, that is, those people who have better mental health are more likely to have a desire and ability to be physically active (Kern, 2016).

Exploring the complex interplay between physical activity and symptoms of depression and anxiety in children and adolescents in children and adolescents

In the realm of understanding the relationship between physical activity and mental health among children and adolescents, cross-sectional studies can shed light on diverse aspects of this intricate relationship. These investigations reveal a spectrum of findings, demonstrating both the positive impact of physical activity on mental health and the presence of significant limitations within certain studies.

Bélaire et al. (2018), Bell et al. (2019), Gunnell et al. (2016), Lema-Gómez et al. (2021), McMahon et al. (2016), Rodriguez-Ayllon et al. (2018), McDowell et al. (2017) and Tajik et al. (2017) are authors who have contributed valuable insights through their cross-sectional studies. Many of these studies underscore the positive impact of physical activity on at least one aspect of mental health in young individuals. Positive associations have been identified between physical activity and symptoms of depression and anxiety, although the specific manifestations vary among the studies.

Although many studies focused on the influence of physical activity on children and adolescent’s mental health in general, some authors reported their findings regarding symptoms of depression and anxiety. For example, Gunnell et al. (2016) delved into the bidirectional relationship between physical activity, screen time, and symptoms of anxiety and depression during adolescence. Their results revealed independent associations between symptoms of depression and anxiety with both screen time and physical activity. Interestingly, higher symptoms of depression at a specific

age predicted a reduced trajectory of physical activity over time, suggesting a complex interplay between mental health symptoms and physical activity patterns during adolescent development. Lema-Gómez et al. (2021) and McMahon et al. (2016) contributed to the subsequent evidence favoring the positive impact of physical activity on adolescent mental health. Cross-sectional studies conducted on respectable samples of adolescents consistently indicate a negative association between physical activity and symptoms of depression, as well as trait and state anxiety. The corroborating findings across diverse studies strengthen the case for the potential mental health benefits of engaging in regular physical activity during adolescence. Doré et al. (2016) bring a unique perspective by exploring the volume and social context of physical activity in relation to mental health among youth. Their results suggest that both physical activity volume and social context independently influence mental health outcomes, with moderate-to-vigorous physical activity inversely associated with anxiety and depressive symptoms. However, the absence of an association between team sports and these symptoms highlights the nuanced nature of these relationships, emphasizing the need for a deeper understanding of the impact of different types of physical activity. Another study on adolescent's sample, performed by McDowell et al. (2017) supports the positive impact of physical activity on the depression and anxiety symptoms, but, for example, in an adolescent's sample in the study by Soltanian et al. (2011), an association of minimal physical activity with reduced symptoms of anxiety, but not depression was found. In study by Philippot et al. (2019) a low-to-moderate exercise program was introduced to pre-adolescents and the results indicate the depression and anxiety symptoms reduction after the program. In the study by Flřtnes et al. (2011), results showed that physical activity is inversely associated with the risk for anxiety/depression in boys, but not in girls. Interestingly, a study on adolescents from one Chinese province showed no significant association of physical activity with either anxiety or depression (Zhu et al, 2021).

As previously stated, there are many papers that examine physical activity in correlation to mental health of children and adolescents in general, as well as their well-being. For instance, in the ActiveBrains project (Rodriguez-Ayllon et al., 2018), a cross-sectional study suggests that higher levels of physical fitness, particularly muscular strength, may yield significant psychological benefits for overweight or obese children. Notably, these benefits encompass the reduction of stress and negative affect, alongside an augmentation of optimism and self-esteem. This implies a potential pathway for targeted interventions to enhance mental well-being in specific populations of young individuals. The study by Arat and Wong (2017) widens the scope by examining the relationship between physical activity and mental health among adolescents in middle-income countries. This cross-sectional study reveals

that the impact of physical activity on mental health varies across different types of physical activity and is influenced by the socio-economic context of the country. This underscores the importance of considering cultural and contextual factors when assessing the relationship between physical activity and mental health in diverse populations.

Nevertheless, the reliability of these results comes under scrutiny due to notable limitations in certain research efforts. One of the most common limitations includes the physical activity measure, which is far from standardized and usually based on a self-report (Gunnell et al., 2016; McMahon et al., 2016; Zhu et al., 2021), with an exception in some studies such as the one by Rodriguez-Ayllon et al. (2018). On the other hand, Tajik et al. (2017) and McDowell et al. (2017), for instance, emphasize the constraints of their cross-sectional studies, highlighting the inability to ascertain causation between low physical activity levels and symptoms of depression, anxiety, and stress. This cautionary note prompts a deeper consideration of the temporal dynamics at play in the relationship between physical activity and mental health. The inclusion of longitudinal studies, such as that conducted by Bell et al. (2019), adds a layer of complexity to the narrative. Despite being unable to provide robust evidence establishing physical activity as a protective factor for overall mental well-being or mental health disorder symptoms in adolescents, Bell et al.'s (2019) findings hint at a potential pathway for mitigating emotional problems through increased physical activity levels. This perspective underscores the tangled relationship between physical activity and mental health, indicating that the impact may be context-dependent and multifaceted.

Reviews and meta-analysis

In the realm of children and adolescent's mental health, the intersection with physical activity has ignited an extensive field of study, marked by analyses, reviews, and meta-analyses. Reviews and meta-analyses that can be found in the literature do not obtain unequivocal results regarding the connection between physical activity and symptoms of depression and/or anxiety in children and adolescents either. Nevertheless, the majority of authors (Bailey et al., 2017; Biddle & Asare, 2011; Dale et al., 2019; Rodriguez-Ayllon et al., 2019; Pascoe et al., 2020; Wolpert et al., 2019) concluded that physical activity has a positive effect on depressive symptoms.

An important work by Biddle and Asare in 2011 laid the groundwork, exploring the synthesis of evidence on chronic physical activity and mental health in young demographics. Notably, their findings pointed to the robust impact of physical activity on self-esteem, asserting that more active individuals are less prone to mental health

issues. Large number of reviews/meta-analysis referred to this previously mentioned one (Biddle & Asare, 2011), and it seems that this is the first review of reviews in this specific area. The authors performed a literature search with an aim of synthesising evidence on chronic physical activity participation and mental health in children and adolescents mainly through a review of reviews. They found that the effects of physical activity are strongest for self-esteem, and that more active children and adolescents are less likely to have mental health issues. They also concluded that there are some promising results regarding the influence of physical activity on depression, but more research should be conducted. Also, it seems that if children and adolescents will gain significant benefits from engaging in physical activity, but it is important to notice that those effects will probably be more significant for those who have poorer mental health at baseline.

Bailey et al. (2017) in their systematic review and meta-analysis focused on all available randomised controlled trials “where physical activity was delivered as an intervention to participants aged 12–25 years, experiencing a diagnosis or symptoms of depression”. Although the confidence of their findings is limited due to the risk of bias within included trials and the low quality of the overall evidence, it seems that physical activity is efficient in reducing depression symptoms in adolescents and young adults experiencing a diagnosis or threshold symptoms of depression.

A very interesting review by Wolpert et al. (2019) was published in *The Lancet Psychiatry*. The authors examined the strategies to address or manage depression or anxiety in children and young people up to the age of 25 years that were not accompanied by a mental health professional and performed a scoping review of range and a systematic review of effectiveness. They analysed a total of ten studies on the impact of physical activity on symptoms of depression and anxiety and the results were mixed. The results of six studies showed that physical activity affects the reduction of depressive symptoms compared to no such intervention, but they were on average of low certainty. In addition, the results of four studies showed that physical activity has no effect on depressive symptoms, but even these results were on average low certainty.

Dale et al. (2019) conducted an umbrella systematic review of literature published since 2010 and found that physical activity has positive mental health outcomes on children and youth. They emphasized that there is strongest evidence for depression and/or depressive symptoms but concluded that all participants would likely benefit from physical activity. Still, the authors highlight the necessity of conducting more research for physical activity to become a recommended preventive and treatment option for anxiety.

In 2019, Rodriguez-Ayllon and colleagues conducted a study that looked at the impact of physical activity and sedentary behaviour on the mental well-being of preschoolers, children, and adolescents. Their findings indicated that exercise interventions had a modestly positive effect on the mental health of adolescents. Furthermore, they discovered that physical activity was linked to lower levels of psychological distress (such as depression, stress, and negative feelings) and higher levels of psychological well-being (including self-esteem, life satisfaction, and happiness). On the other hand, sedentary behaviour was associated with higher rates of depression but lower levels of life satisfaction and happiness in children and adolescents. Notably, the study highlighted that different types of physical activities had varying effects on the mental health of young individuals, particularly distinguishing between non-aesthetic and aesthetic activities. Additionally, participating in team sports during high school was linked to reduced levels of depression in early adulthood.

In their scoping review, Pascoe et al. (2020) also concluded that physical activity/exercise, has a positive impact on the mental health of children and adolescents, i.e., in mental health promotion and as an early intervention strategy. After analysing a total of 29 studies, they found that physical activity and exercise interventions at different levels of intensity may alleviate depression symptoms, with some indications suggesting that both moderate-to-vigorous-intensity and light-intensity interventions can also alleviate anxiety symptoms (Pascoe et al., 2020).

Cadenas-Sanchez et al. (2021) published a systematic review and meta-analysis of the association between physical fitness and mental health indicators in pre-schoolers, children, and adolescents. They noticed a modest to moderate positive connection between physical fitness and the overall mental well-being of young individuals, but emphasized that the majority of studies were cross-sectional, which reduces the possibility of making causal conclusions. However, their meta-analysis findings indicate the association between the higher fitness levels and better mental health in children and adolescents. These results are especially related to cardiorespiratory fitness.

Systematic reviews, literature reviews, and meta-analyses are vital in science as they consolidate existing knowledge, offering a comprehensive overview of research on specific topics. By synthesizing diverse studies, they reveal trends, identify gaps, and guide future research directions, ensuring the efficient use of resources. The conclusions that emerge from these studies should guide all future research. The limitations of the studies listed in the mentioned systematic reviews, literature reviews, and meta-analyses correspond to those previously described, and mostly refer to the uneven research methodology of the relationship between physical activity and mental health, i.e., symptoms of depression and anxiety, problems of measuring

physical activity (not using standardized measures), and the limitations arising from cross-sectional studies as well as from randomized-control trials.

Conclusion

In the modern world, especially in more developed countries, where a sedentary lifestyle prevails, it is very important to study the impact of movement and physical activity on mental health. And while a lot is known and investigated about the impact of physical activity on physical health, the impact on mental health somehow falls into the background. However, there are more and more studies dealing with this topic, and the findings are promising.

In this context, it is particularly important to consider the role that physical activity plays in preserving the mental health of children and young people. Mental health difficulties are increasingly affecting this age group, and symptoms of depression and anxiety are becoming more common.

The synthesis of existing studies paints a multifaceted picture of the complex relationship between physical activity and mental health (more specifically, symptoms of depression and anxiety) in children and adolescents. While the positive impact of physical activity on certain aspects of mental health is evident, the complexities introduced by study limitations, contextual factors, and the bidirectional nature of the relationship call for further exploration. The multifaceted nature of this relationship underscores the need for tailored interventions, considering individual differences, contextual factors, and the potential role of physical activity as a holistic approach to promoting mental well-being in the younger demographic. Additional efforts and scholarly contributions are required in this domain, particularly focusing on standardizing both research methods and the quality of research.

Physical activity as a relatively cheap, accessible, and non-stigmatizing activity should be considered as an option for preserving the (mental) health of children and adolescents, especially if we take into account the fact that fewer and fewer members of this population are sufficiently physically active.

It can also be concluded that the question may no longer revolve around whether exercise enhances well-being, but instead, it focuses on identifying the individuals for whom it is effective, the conditions under which exercise proves helpful or detrimental, methods to enhance the effectiveness of exercise interventions, and the mechanisms that link physical activity and mental health (Kern, 2016).

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Tjelesna aktivnost i simptomi depresije i anksioznosti kod djece i adolescenata

Sažetak

Sve više djece i adolescenata suočava se s problemima mentalnog zdravlja, posebice sa simptomima depresije i anksioznosti. Tjelesna aktivnost je svaki pokret koji proizvode skeletni mišići, a koji zahtijeva utrošak energije te utječe na mentalno zdravlje na više razina i putem različitih mehanizama.

Cilj je ovoga rada dati pregled odnosa tjelesne aktivnosti i simptoma depresije i anksioznosti, s naglaskom na djecu i adolescente. Provedena je analiza dostupne literature i utvrđeno je da postoje dokazi o pozitivnom utjecaju tjelesne aktivnosti na cjelokupno mentalno zdravlje, posebice na simptome depresije. Međutim, potrebno je još mnogo istraživanja kako bi se utvrdili točni mehanizmi i smjerovi te povezanosti.

Ključne riječi: adolescenti; anksioznost; depresija; djeca; tjelesna aktivnost