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Physical activity and depression

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Abstract

INTRODUCTION: This article aims to present the significance of physical activity as a key element in the prevention and therapy of depressive disorders. Through a review of the latest scientific research findings, the article focuses on the role of regular physical activity in reducing the risk of depressive disorders and its effectiveness in the therapeutic process. Various aspects of physical activity are analyzed, such as the type and intensity of training, their impact on neurobiological and psychosocial functions. The article discusses the benefits of physical activity, including mood improvement, reduction of depressive symptoms, and overall well-being enhancement. Furthermore, attention is drawn to the biological mechanisms that may underlie the positive impact of physical activity on mental health. In a

therapeutic context, the article examines how physical activity can be an effective complement to traditional methods of treating depression, both pharmacological and psychotherapeutic. The importance of adapting training programs to individual needs and preferences of patients is also emphasized. As a result, the article provides a comprehensive overview of current knowledge regarding the role of physical activity in the prevention and therapy of depressive disorders, with the hope of inspiring further research and refining intervention strategies in the field of mental health.

MATERIALS & METHODS: PubMed, Google Scholar, and publicly available databases of scientific articles on the Internet were used for data collection.

SUMMARY: Physical activity is a significant factor influencing mental health. Research indicates that regular exercise can play a preventive role in depressive disorders and support the therapy of individuals with existing mental health issues. The pursuit of personalized exercise programs, considering individual differences, and ongoing research into biological mechanisms are valuable for enhancing the effectiveness of depression therapy through physical activity.

KEYWORDS: physical activity, depression, personalized approach, therapeutic programs.

PHYSICAL ACTIVITY AS PREVENTION

Research spanning several decades has built a compelling case for the role of physical activity in mental health, particularly in preventing and managing depression. Starting with the landmark 1965 Alameda County study and extending to modern research, we've seen consistent evidence that regular physical activity can significantly impact mental wellbeing, with particularly strong benefits for younger populations[1]. The protective effect of exercise appears to work through multiple mechanisms. For instance, intense physical activity has been shown to be especially effective in reducing depressive symptoms among younger individuals. This aligns with the earlier Alameda County findings, but modern research has helped us understand that the intensity of exercise might be a crucial factor - suggesting that vigorous activities might offer additional mental health benefits beyond those provided by light or moderate exercise. What's particularly noteworthy is how these findings build upon each other. While the Alameda County study showed that becoming sedentary after being

active increased depression risk, newer research has demonstrated that maintaining consistent physical activity is especially beneficial for mental health[2].

This suggests that the relationship between exercise and mental wellbeing isn't just about being active at one point in time - it's about sustaining that activity over the long term. The implications for preventive mental health strategies are significant. Given that younger individuals seem to benefit particularly strongly from intense physical activity, this could inform how we approach mental health prevention in schools and universities. For example, incorporating regular vigorous exercise programs might serve as a powerful preventive measure against depression in young populations. When we consider this alongside the genetic research showing that physical activity can help protect even those with genetic predisposition to depression, we see a more complete picture emerging. Physical activity appears to act as a kind of buffer against depression, potentially through multiple pathways - from direct biochemical effects to indirect benefits like improved self-esteem and social connection. This comprehensive body of evidence suggests that physical activity should be considered not just as a general health recommendation, but as a crucial component of mental health prevention strategies, particularly for younger populations. The challenge now lies in translating these findings into practical, sustainable programs that can effectively engage people in regular physical activity, especially considering that those who might benefit most (people at risk of or experiencing depression) might also find it most difficult to initiate and maintain an exercise routine [3,4].

There is a significant body of empirical research suggesting that prolonged exposure to stress may impact behavioral and neuronal deficits in adulthood, which, in turn, are associated with heightened anxiety and the occurrence of depression[5]. Studies based on an animal model have shown that regular physical activity can serve as a protective factor against the harmful effects of chronic stress on the structure of the prefrontal cortex [6].

Particularly interesting are the observations indicating that aerobic exercise has a positive morphological impact on neurons in the prefrontal cortex in individuals who have not been exposed to chronic stressors. These findings provide significant evidence that regular physical activity, especially during prepubescence, may serve as an effective protection against neuronal and behavioral disorders resulting from chronic stress.[7]. It is worth emphasizing that these studies shed light on potential mechanisms through which physical activity may impact brain structure and mental functions, especially in the context of earlier experiences of stress. Therefore, promoting physical activity at a young age may be of

significant importance for mental health in adulthood, preventing potential negative consequences of chronic stress[6].

Additionally, it has been demonstrated that aerobic exercise has the ability to modify the volume of the hippocampus, which is smaller in individuals with depressive disorders compared to healthy individuals. Extensive research suggests that exposure to chronic stress may result in the inhibition of signaling associated with neuronal remodeling processes, especially the production and action of BDNF (brain-derived neurotrophic factor). As a result, a weakening of structural plasticity involving neurogenesis and dendritic remodeling in the hippocampal region is observed[8,9]. It is worth noting that there is specific evidence indicating the possibility of lasting neuronal damage in the hippocampus associated with prolonged and increased release of cortisol in response to psychological stress. Particularly crucial are the structural areas regulating the functioning of the hypothalamus–pituitary–adrenal axis, where excessive stimulation of this axis is correlated with cognitive impairments and an exacerbation of depressive symptoms. Simultaneously, the activation of biochemical processes influenced by skeletal muscle activity may serve as an effective form of compensation for the negative effects of stress by increasing the production of the neurotrophic factor BDNF[10]. Research has shown that BDNF plays a crucial role in stimulating cell differentiation, supporting repair processes, and stimulating neuronal activity. Additionally, BDNF has a positive influence on the formation of memory pathways, contributing to the improvement of affective, cognitive functioning, and the daily activities of the patient[11].

Moreover, it has been observed that an abnormal level of BDNF, dysfunction of the Trk-B receptor, and disruptions in BDNF–Trk-B signaling are associated not only with depression but also constitute a significant risk factor in the context of schizophrenia, epilepsy, and Alzheimer's and Huntington's diseases[12]. From the collective analysis conducted by the team led by Beserry and other researchers, it appears that aerobic exercises performed five times a week demonstrate the highest effectiveness. This meta-analysis suggests that regular aerobic activity, carried out at the pace of five training sessions per week, yields the most favorable effects in the context of various health goals. The significance of this training schedule is highlighted in achieving positive outcomes, both in terms of improving overall physical fitness and beneficially impacting mental health. Aspects related to stress reduction and cognitive function improvement also seem to be better achieved with the regularity of five training sessions per week. Confirmation of the effectiveness of this frequency of aerobic

exercises can provide valuable guidance for individuals planning their training programs with the aim of achieving optimal health results[13].

Research focused on examining the relationship between physical activity, hippocampal volume, and mood, conducted on a sample of 4,191 children aged 9-11, provided significant insights. Regardless of gender, participation in sports activities was positively correlated with hippocampal volume. Particularly interesting was the additional correlation observed in boys between hippocampal volume and well-being, with hippocampal volume acting as a mediator in the relationship between physical activity and mood[3].

In the context of the significance of physical activity in the prevention of depressive disorders, research conducted on a representative group of 6,497 children born between 2000 and 2002 in the United Kingdom emphasizes the importance of this aspect. However, it is worth noting that the intervention, which included daily moderate to intense exercises for 60 minutes, yielded positive effects in only 10% of the participants during the five-year observation period[14].

Research focused on the prevention of postpartum mood disorders has confirmed the beneficial impact of physical activity undertaken during pregnancy. The aim of this research was to verify whether physical activity during pregnancy could serve as a protective factor against the occurrence of mood disorders in the postpartum period. The meta-analysis considered the results of various empirical studies that assessed the influence of different forms of physical activity undertaken during pregnancy on the occurrence of depression symptoms in the first year after childbirth. Seventeen studies, involving a total population of 93,676 women, were subjected to analysis[15].

The research indicates that older individuals who regularly practice yoga experience a significant increase in cognitive functions. In the case of patients with recurrent headaches, changes in the frequency, intensity, and duration of discomfort were observed after engaging in yoga. Those with Parkinson's disease noticed benefits such as increased muscle strength, reduced muscle tremors, improved well-being, and a reduction in depressive symptoms. Yoga proves effective for various mental health conditions, confirming its impact on anxiety levels, depressive symptoms, and stress. It is noteworthy that each of the conducted analyses not only demonstrated the benefits of yoga practice in alleviating mental pain and improving well-being but also raised no doubts about potential side effects of this form of physical activity[16].

PHYSICAL ACTIVITY AS A KEY ELEMENT OF DEPRESSION THERAPY

Research focused on the relationship between physical activity and mental health confirms that greater physical effort is associated with a lower risk of experiencing symptoms characteristic of depression, especially among young individuals. There is also substantial empirical evidence indicating that prolonged exposure to stress during childhood may result in behavioral and neuronal deficits in adulthood, which, in turn, are associated with an increased sense of anxiety and the occurrence of depression[6,17,18].

Among cancer patients who have undergone chemotherapy, there is a risk of cognitive impairment and the emergence of depressive symptoms. However, research indicates that moderate and intense aerobic exercise can significantly reduce this risk. This form of activity, alongside psychotherapy, becomes an effective non-pharmacological method for treating depressive symptoms in this patient group. These interventions open new perspectives in caring for individuals who have undergone chemotherapy, emphasizing the benefits of regular physical activity as a support for the mental healing process. The obtained data seem crucial in the context of the mental health of oncology patients, especially considering that they are typically less physically fit before starting treatment compared to their peers. During chemotherapy and up to five years after its completion, their physical activity falls below the norm, often associated with the occurrence of depressive disorders. This may make physical exercises perceived as challenging and exhausting, subsequently reducing the likelihood of their regular engagement. Significant correlations between physical activity and mental health have been confirmed in studies, such as those involving women after breast cancer surgery, particularly among those exhibiting increased depression symptoms. In comparison to women without symptoms characteristic of depressive disorders, patients diagnosed with major depression showed a greater increase in effort (assessed using the Borg Scale). Nevertheless, no significant differences were observed in heart rate. These findings underscore the significant role of mental health in shaping the physical activity of oncology patients, suggesting the need to consider psychological aspects when developing rehabilitation plans[19].

Observational studies conducted among youth undergoing treatment for multiple sclerosis confirm the benefits of physical activity for mental health. Over four years of observation involving 182 individuals, it was revealed that regular physical activity is inversely proportional to the intensity of depressive symptoms and fatigue resulting from the disease experienced by the youth. These findings underscore the positive impact of physical

activity on the mental health of youth dealing with multiple sclerosis, suggesting that regular exercise can be a significant element of support in alleviating symptoms of depression and disease-related fatigue[20].

Similar conclusions arise from the results of a meta-analysis conducted by Herring et al. According to its findings, aerobic training contributes to reducing the severity of depressive symptoms in adults undergoing treatment for multiple sclerosis. Importantly, the achieved effect depends on the perceived fatigue during exercise. In the case of excessive fatigue, a decrease in the positive impact of physical exercise on the mental health of the participants was observed. This suggests that proper control and adjustment of the intensity of training to the individual capabilities and comfort of patients may be a crucial factor in maximizing the health benefits of physical activity in the case of multiple sclerosis[21].

In a study conducted among 52 patients aged over 80 diagnosed with early-stage Parkinson's disease, linear regression analysis, accounting for variables such as gender, age, and education level, revealed that daily physical activity among seniors, measured using an accelerometer, remained at a very low level. Importantly, no association was observed between this low level of activity and the severity of symptoms characteristic of depressive disorders in the participants. This suggests that in patients aged over 80 with early-stage Parkinson's disease, physical activity may not be directly linked to the severity of depressive symptoms, emphasizing the importance of an individualized approach to therapy in this age group[22].

The post-six-month evaluation revealed that the intensity of depressive symptoms, assessed using the Patient Health Questionnaire-9 (PHQ-9), was lower among the project participants compared to the control group. It is worth emphasizing that the prevalence of analyzed symptoms in the intervention group was 6.3%, while in the control group, it reached 24.6%. These results indicate that the intervention based on regular text message reminders, supporting motivation for physical activity, can effectively contribute to reducing depressive symptoms in patients with ischemic heart disease after completing the cardiac support program[23].

Research conducted by Hanssen and colleagues explored two distinct exercise modalities: an intensive interval-based protocol and a moderate steady-state training approach. The intensive protocol incorporated brief, high-intensity intervals performed at 80% of maximal oxygen consumption, with participants completing 25 thirty-second bouts. In

contrast, the moderate protocol involved sustained aerobic activity at 60% of maximal oxygen consumption for 20 continuous minutes. Both interventions followed a three-sessions-per-week schedule over a four-week period. While both protocols demonstrated significant efficacy in reducing depression severity measures, the high-intensity interval approach showed superior outcomes. These findings contribute to our understanding of exercise prescription optimization in mental health treatment, suggesting that brief, intense exercise sessions might offer enhanced therapeutic benefits compared to traditional moderate-intensity approaches [24].

An examination of comprehensive meta-analytic research reveals conflicting evidence regarding the optimal parameters of exercise interventions for Major Depressive Disorder (MDD). Some systematic analyses highlight the superior efficacy of structured programs incorporating moderate-intensity aerobic activities, particularly when implemented under professional supervision. These findings suggest that previous research syntheses may have underestimated exercise's therapeutic potential due to methodological limitations in publication practices. However, this perspective faces challenge from alternative research findings that indicate the antidepressant effects of physical activity may be independent of specific exercise parameters. These contradictory findings suggest that the relationship between exercise characteristics and therapeutic outcomes in depression treatment may be more complex than initially theorized. This divergence in research findings highlights a significant area of ongoing investigation in exercise psychiatry. The contrast between studies advocating for specific exercise parameters and those suggesting a more generalized benefit underscores the need for continued research to elucidate the precise mechanisms through which different forms of physical activity influence depressive symptoms. The implications of these conflicting findings extend to clinical practice, where the optimal approach to exercise prescription for depression treatment remains a subject of scientific debate. This suggests that individualized approaches, taking into account patient preferences and capabilities, might be as important as specific exercise parameters in achieving therapeutic benefits [25,26].

THE PSYCHOLOGY OF EXERCISE MOTIVATION

A critical challenge in clinical practice centers on implementing effective motivational strategies for patients with depression who maintain sedentary behaviors, particularly regarding their initiation into structured physical activity programs. The integration of evidence-based motivational frameworks has emerged as a fundamental approach to

addressing this complex therapeutic challenge. Current clinical evidence supports a multifaceted methodology incorporating motivational interviewing principles, action planning protocols, and the transtheoretical model of health behavior change. The empirical foundation of this approach emphasizes the paramount importance of systematic assessment of patients' readiness to engage in physical activity interventions [27]. Implementation protocols typically involve structured evaluation methods, including both qualitative assessment through open-ended clinical inquiry regarding physical activity patterns and quantitative measurement utilizing validated instruments such as the American College of Sports Medicine's two-component vital sign assessment. This dual approach to patient evaluation facilitates comprehensive assessment of exercise readiness and potential barriers to engagement. The systematic assessment of patient readiness serves as a foundation for targeted motivational interventions. When patients demonstrate preliminary receptiveness, clinicians can proceed with evidence-based educational interventions regarding exercise benefits, followed by structured evaluation of patient responses to this information. This methodological approach enables the development of individualized intervention strategies aligned with patient-specific motivational states and behavioral readiness [28].

Healthcare providers play a critical role in transforming exercise from a mere prescription to a sustainable behavioral pattern. Regular monitoring and follow-up appointments serve as essential components in reinforcing physical activity adherence. The absence of consistent provider engagement in patients' exercise progress may inadvertently diminish the perceived significance of physical activity as a therapeutic intervention. Clinical observations demonstrate a noteworthy psychological transformation in patients who successfully maintain regular exercise routines. Initially, patients typically approach physical activity with an instrumental mindset, focusing primarily on quantifiable outcomes such as improved physical fitness parameters or health indicators. However, through consistent engagement, a fundamental shift occurs in their relationship with exercise. This evolution transitions from an externally motivated, outcome-focused approach to an intrinsically rewarding behavior pattern where physical activity becomes inherently valuable and self-sustaining. This transformation represents a crucial milestone in therapeutic success, marking the point where external medical oversight can gradually decrease as internal motivation becomes the primary driver of continued exercise adherence. Understanding and facilitating this psychological shift should be considered a key objective in exercise-based interventions for optimal long-term outcomes [29].

In practical implementation, the strategy focuses on establishing microtasks that patients confidently identify as manageable within their current psychological and physical capacities. Rather than prescribing standardized exercise protocols, healthcare providers should collaborate with patients to identify activity levels that feel attainable, even if these fall significantly below conventional exercise recommendations. For instance, a brief daily walk around one's residence may constitute an appropriate initial goal. This incremental approach aligns with contemporary physical activity guidelines that acknowledge the cumulative benefits of brief activity periods. The paradigm shift from predetermined exercise quotas to personalized, achievable targets represents a more nuanced understanding of behavior modification in clinical populations. Each successful completion of these modest goals strengthens the patient's confidence, gradually building a foundation for increased activity levels. By prioritizing psychological success through attainable goals, practitioners can help patients develop a positive relationship with physical activity, ultimately facilitating the progression toward more substantial exercise engagement. This method recognizes that sustainable behavioral change often emerges from a series of small, consistent achievements rather than dramatic lifestyle modifications [29].

Regular clinical monitoring represents a crucial component in transforming prescribed physical activity into sustained behavioral patterns. Healthcare providers must establish consistent follow-up protocols that extend beyond initial exercise recommendations. The absence of systematic monitoring may inadvertently communicate to patients that physical activity holds secondary therapeutic importance, potentially undermining adherence to exercise interventions. Clinical observations reveal a significant psychological transformation in patients who maintain consistent exercise routines. The initial phase typically reflects an instrumentally-motivated approach, where patients primarily focus on quantifiable outcomes such as cardiovascular fitness improvements or mortality risk reduction. However, continued engagement often facilitates a fundamental shift in motivation patterns. This evolution manifests as a transition from externally-driven goals to intrinsic motivation, where physical activity becomes inherently rewarding rather than merely serving as a means to achieve specific health outcomes [30].

Clinical evidence indicates a threshold effect in exercise intensity's impact on depressive symptomatology. While both moderate and vigorous exercise protocols demonstrate therapeutic efficacy in treating moderate depression, interventions utilizing very low-intensity activities fail to produce significant clinical improvements. This suggests that

achieving a minimum intensity threshold may be crucial for activating the neurobiological mechanisms underlying exercise's antidepressant effects. These findings carry important implications for exercise prescription in clinical practice, suggesting that incorporating higher-intensity activities might optimize therapeutic outcomes through enhanced neurotrophic factor production. However, the intensity threshold required for clinical benefit appears to lie within the moderate-to-vigorous range, with low-intensity activities falling below the necessary threshold for meaningful symptom improvement [31].

CONCLUSIONS

The analysis of recent scientific research on the role of physical activity in the prevention and treatment of depressive disorders yields important conclusions. Regular physical activity is widely recognized as an effective method for preventing and managing depression. Despite this, several challenges remain unresolved. One key issue lies in the diversity of exercise regimens and assessment methods used across various studies, which complicates the development of standardized approaches. To address these gaps, future research should focus on designing high-quality studies that establish consistent exercise protocols, compare different therapeutic approaches, and evaluate the effectiveness of combined treatments. Additionally, extended follow-up periods are necessary to assess the long-term benefits of exercise for depression. However, to reap the full benefits, exercise should be regarded as a complement to traditional therapeutic methods such as pharmacotherapy or psychotherapy, especially considering the coexistence of depression with other somatic conditions.

The underlying mechanisms through which exercise alleviates depression also require further investigation. Another significant barrier is the low motivation among many patients to engage in exercise-based interventions. This is compounded by uncertainties surrounding the feasibility of maintaining regular exercise routines at home with minimal supervision. Promising strategies to boost motivation and adherence include integrating behavioral activation techniques, leveraging mobile applications, and promoting shorter, more manageable physical activity sessions. Group-based or supervised exercise programs have also been shown to foster greater commitment and participation.

Research on the impact of physical activity on mental health is still evolving, and new discoveries may lead to further refinement of recommendations regarding the role of exercise in the prevention and treatment of depression. While current scientific reports unequivocally

point to the significant role of physical activity in mental health care, ongoing research may clarify recommendations for clinical and therapeutic practice.

Advancements in the field of neurobiology enable the exploration of increasingly complex aspects of the interaction between physical activity and the nervous system. Neurobiological research can identify specific mechanisms related to the reduction of depression symptoms under the influence of physical activity. Understanding these mechanisms may lead to more precise therapeutic strategies.

For individuals with severe depression, initiating treatment with antidepressants may be more appropriate, as these medications can stabilize symptoms and provide a foundation for integrating exercise as part of a comprehensive treatment plan.

Future studies may focus on identifying neurobiological biomarkers associated with the response to physical activity, opening the door to the development of new therapies tailored to individual patient needs. Further investigation into the interaction between physical activity and other forms of therapy, such as pharmacotherapy or psychotherapy, is also possible.

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