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Exercise and Depression: The Role of Physical Activity in Mental Health

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ABSTRACT

Depressive disorders represent a major global health burden and are associated with significant impairment in quality of life and increased risk of comorbid conditions. Despite the availability of conventional treatments, a substantial proportion of patients do not achieve full remission, highlighting the need for complementary therapeutic strategies. In recent years, physical activity has emerged as a promising and accessible intervention for both the prevention and treatment of depression.

This narrative review aims to summarize current evidence on the role of physical activity in mental health, with particular emphasis on the underlying biological and psychological mechanisms. Exercise has been shown to influence multiple pathways implicated in the pathophysiology of depression, including modulation of inflammatory processes, regulation of the hypothalamic–pituitary–adrenal axis, enhancement of neuroplasticity, and effects on neurotransmitter systems. In addition, psychological mechanisms such as improved self-

perception, stress reduction, behavioral activation, and increased social interaction contribute to the antidepressant effects of physical activity.

Evidence from observational studies and meta-analyses indicates that regular physical activity is associated with a reduced risk of developing depression and may significantly alleviate depressive symptoms in affected individuals. Furthermore, physical activity represents a low-cost, widely accessible intervention with minimal side effects, making it a valuable component of both clinical practice and public health strategies.

In conclusion, physical activity plays a multidimensional role in the prevention and management of depression and should be considered an integral part of comprehensive mental health care. These findings highlight the importance of incorporating physical activity into comprehensive treatment strategies for depression.

Keywords: depression, physical activity, exercise, mental health, inflammation

Introduction

Depressive disorders represent one of the leading causes of disability worldwide and constitute a major public health concern (Otte et al., 2016). They are associated with significant personal, social, and economic burden, as well as reduced quality of life and increased risk of comorbid conditions. Despite the availability of pharmacological and psychological treatments, a substantial proportion of patients do not achieve full remission, highlighting the need for complementary and alternative therapeutic approaches (Otte et al., 2016).

In recent years, increasing attention has been directed toward lifestyle-related factors as important determinants of mental health. Among these, physical activity has emerged as a particularly promising and accessible intervention. Evidence suggests that lifestyle factors, including physical inactivity, play a significant role in the development and persistence of depressive symptoms (Lopresti et al., 2013). Moreover, regular physical activity has been associated with improved mental health outcomes and a reduced risk of depression.

The relationship between physical activity and depression is complex and involves multiple interacting mechanisms. Biological pathways, including modulation of inflammatory processes, dysregulation of the hypothalamic–pituitary–adrenal axis, and alterations in neurobiological functioning, have been proposed to explain the association between depression and underlying physiological processes (Miller & Raison, 2016; Stetler & Miller, 2011). In particular, a

growing body of evidence indicates that low-grade inflammation may contribute to the pathophysiology of depressive disorders (Osimo et al., 2019).

In addition to biological mechanisms, psychological and behavioral factors also play an important role. Physical activity may improve mood through enhanced self-perception, better stress coping, and increased social interaction. Importantly, sedentary behavior has been identified as a modifiable risk factor for depression, emphasizing the importance of lifestyle interventions in mental health promotion (Lopresti et al., 2013).

The aim of this narrative review is to summarize current evidence on the role of physical activity in the prevention and treatment of depressive disorders, with particular emphasis on the underlying biological and psychological mechanisms, as well as practical implications for health promotion.

Physical activity and depression

A substantial body of evidence indicates that physical activity plays a significant role in both the prevention and treatment of depressive disorders. Prospective cohort studies have shown that individuals who engage in higher levels of physical activity have a lower risk of developing depression compared to those with sedentary lifestyles (Schuch et al., 2018). This protective effect appears to be dose-dependent, suggesting that even moderate increases in physical activity may contribute to improved mental health outcomes.

In addition to its preventive role, physical activity has been widely investigated as a therapeutic intervention for individuals with established depression. Meta-analyses of randomized controlled trials demonstrate that exercise interventions are associated with significant reductions in depressive symptoms, particularly in patients with mild to moderate depression (Schuch et al., 2016; Cooney et al., 2013). Importantly, exercise has been shown to produce clinically meaningful reductions in depressive symptoms, particularly when performed regularly and sustained over time. Various forms of physical activity have been shown to exert beneficial effects on mental health. Aerobic exercise, such as walking, running, or cycling, is the most extensively studied and consistently associated with improvements in mood and reductions in depressive symptoms. Resistance training has also been demonstrated to produce positive psychological outcomes, including improvements in self-esteem and reductions in symptom severity. Notably, both moderate and vigorous intensities of physical activity appear

to be effective, indicating that exercise interventions can be adapted to individual preferences and physical capabilities.

The relationship between physical activity and depression is not limited to structured exercise programs. Everyday physical activity, including active transportation and recreational movement, may also contribute to mental well-being. Conversely, sedentary behavior has been associated with an increased risk of depressive symptoms and may play a role in the maintenance of depressive states (Lopresti et al., 2013). These findings highlight the importance of reducing sedentary time alongside promoting regular physical activity.

Overall, current evidence supports the role of physical activity as a safe, accessible, and cost-effective strategy for both the prevention and management of depression. Integrating physical activity into routine clinical practice and public health strategies may therefore represent an important component of comprehensive mental health care.

Biological mechanisms of exercise in depression

The beneficial effects of physical activity on depression are mediated by a range of complex biological mechanisms involving interactions between the immune, neuroendocrine, and central nervous systems (Kandola et al., 2019). One of the most widely studied pathways is the modulation of inflammatory processes. Increasing evidence suggests that depression is associated with a state of chronic low-grade inflammation, characterized by elevated levels of pro-inflammatory cytokines and acute-phase proteins (Osimo et al., 2019). Chronic inflammation has been increasingly recognized as a contributing factor in the pathophysiology of depression (Furman et al., 2019; Osimo et al., 2020). Exercise has been shown to exert anti-inflammatory effects, including reductions in circulating inflammatory markers and improved regulation of immune responses, which may contribute to its antidepressant properties (Kandola et al., 2019). Exercise-induced reductions in inflammatory markers, including C-reactive protein and interleukin-6, may play a key role in mediating its antidepressant effects (Dowlati et al., 2010; Khandaker et al., 2014). The heterogeneity of depressive disorders suggests that subgroups of patients may particularly benefit from interventions targeting inflammatory pathways (Milaneschi et al., 2020; Strawbridge et al., 2015).

Another important mechanism involves the regulation of the hypothalamic–pituitary–adrenal (HPA) axis. Dysregulation of the HPA axis is commonly observed in individuals with

depression and is associated with prolonged stress responses and elevated cortisol levels (Stetler & Miller, 2011). Regular physical activity may help normalize HPA axis function, leading to improved stress resilience and reduced vulnerability to depressive symptoms (Kandola et al., 2019).

In addition to its effects on inflammation and neuroendocrine regulation, physical activity has been shown to influence neuroplasticity and brain function. Exercise is associated with increased expression of neurotrophic factors, particularly brain-derived neurotrophic factor (BDNF), which plays a key role in neuronal growth, synaptic plasticity, and mood regulation (Erickson et al., 2013). These neurobiological changes may underlie improvements in cognitive function and emotional well-being observed in physically active individuals.

Furthermore, physical activity may affect neurotransmitter systems involved in the pathophysiology of depression, including serotonin, dopamine, and norepinephrine pathways (Kandola et al., 2019). By modulating these systems, exercise may enhance mood regulation and contribute to the reduction of depressive symptoms.

Overall, the antidepressant effects of physical activity are likely the result of multiple interacting biological mechanisms. The combined influence on inflammatory processes, neuroendocrine function, neuroplasticity, and neurotransmission highlights the role of exercise as a biologically plausible and effective intervention in the management of depression.

Psychological mechanisms of exercise in depression

In addition to biological pathways, the beneficial effects of physical activity on depression are also mediated by a range of psychological and behavioral mechanisms (Kandola et al., 2019). Exercise may contribute to improvements in mood through enhanced self-perception, an increased sense of achievement, and greater perceived self-efficacy. Engaging in regular physical activity allows individuals to set and accomplish goals, which may positively influence their confidence and overall psychological well-being (Lopresti et al., 2013).

Another important factor is the role of physical activity in stress reduction. Exercise has been shown to decrease perceived stress levels and improve coping strategies, which may reduce vulnerability to depressive symptoms (Kandola et al., 2019). Participation in physical activity can also provide a distraction from negative thoughts and rumination, which are common features of depression.

Social interaction represents an additional mechanism through which physical activity may influence mental health. Group-based exercise and participation in organized physical activities can enhance social support and reduce feelings of loneliness and isolation (Kandola et al., 2019). These social aspects are particularly important in individuals with depression, who often experience withdrawal and reduced interpersonal engagement.

Furthermore, regular physical activity may contribute to the establishment of structured daily routines, which can be beneficial for individuals with depressive symptoms. The incorporation of exercise into daily life may promote behavioral activation, a key component of many psychological treatments for depression (Kandola et al., 2019). This structured engagement in meaningful activities may help counteract inactivity and avoidance behaviors associated with depressive disorders.

Overall, the psychological effects of physical activity complement its biological impact, highlighting the multidimensional role of exercise in the prevention and treatment of depression.

Practical implications of physical activity in depression

The growing body of evidence supporting the role of physical activity in the prevention and treatment of depression has important implications for clinical practice and public health strategies. Incorporating exercise into routine care may provide a feasible and cost-effective adjunct to conventional treatments, including pharmacotherapy and psychotherapy (Schuch et al., 2016; Cooney et al., 2013).

Current evidence suggests that various forms of physical activity, including aerobic exercise, resistance training, and combined modalities, may be beneficial in reducing depressive symptoms. Regular physical activity appears to be beneficial, although the optimal type, frequency, and intensity of exercise may vary depending on individual characteristics and clinical conditions (Schuch et al., 2016).

Adherence to exercise interventions remains a key challenge in individuals with depression. Symptoms such as low motivation, fatigue, and anhedonia may reduce engagement in physical activity. Therefore, individualized exercise programs that take into account patient preferences, baseline fitness levels, and potential barriers are essential for improving adherence and long-term outcomes (Kandola et al., 2019).

In addition, supervised or group-based exercise interventions may enhance motivation and provide social support, further contributing to improved mental health outcomes. Integrating physical activity into multidisciplinary treatment approaches may facilitate more comprehensive and patient-centered care (Cooney et al., 2013; Kandola et al., 2019).

From a public health perspective, promoting physical activity may contribute to reducing the global burden of depression and improving overall population health. Given its accessibility, low cost, and broad range of benefits, physical activity should be considered a key component of preventive strategies and mental health promotion programs (Schuch et al., 2018).

Conclusions

Physical activity represents a promising and accessible strategy in both the prevention and treatment of depressive disorders. A substantial body of evidence indicates that exercise exerts beneficial effects on mental health through multiple interacting biological, psychological, and behavioral mechanisms. These include modulation of inflammatory processes, regulation of the hypothalamic–pituitary–adrenal axis, improvements in neuroplasticity, and positive effects on mood, self-perception, and stress coping.

Importantly, physical activity is associated with relatively low cost, minimal side effects, and broad applicability across different populations, making it a valuable component of comprehensive mental health care. However, individual differences in clinical presentation, motivation, and physical capacity should be taken into account when designing exercise interventions.

Future research should focus on identifying optimal exercise parameters, including type, intensity, and duration, as well as exploring personalized approaches tailored to specific subgroups of patients with depression. Further investigation into the underlying mechanisms may also contribute to a better understanding of how physical activity can be effectively integrated into clinical practice.

Overall, physical activity should be considered an important element of multidisciplinary strategies aimed at improving mental health outcomes and reducing the global burden of depression.

Author Contributions

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Natalia Piasecka: Conceptualization, Methodology, Supervision, and Writing – Review & Editing.

Izabela Rafalska: Literature Search and Investigation, including synthesis of evidence on physical activity and mental health.

Martyna Kaim: Literature Search and Investigation, with contribution to data synthesis regarding exercise and depressive symptoms.

Magdalena Bochenek: Investigation and contribution to the analysis of clinical and practical aspects of physical activity in depression.

Wiktoria Siewiera: Investigation and literature analysis related to psychological mechanisms of exercise in depression.

Joanna Bober: Investigation and Data Curation.

Jakub Smagoń: Investigation and contribution to interpretation of findings.

Daria Wojcieszak: Formal Analysis and contribution to manuscript preparation.

Natalia Kornacka: Data Curation and Literature Review.

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