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Physical Activity and Mental Health: A Narrative Review

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ABSTRACT

Background. Mental health disorders represent a major public health challenge worldwide. Depression and anxiety are among the most prevalent psychiatric conditions and are associated with substantial social and economic burden. In recent years, increasing attention has been directed toward non-pharmacological interventions supporting prevention and treatment. Physical activity has emerged as a promising strategy due to its availability, safety, and multidimensional health benefits.

Aim. The aim of this study was to review current scientific literature on the impact of physical activity on mental health, with emphasis on its role in the prevention and treatment of selected mental disorders.

Materials and methods. A narrative literature review was conducted using the PubMed, Scopus, and Web of Science databases. Publications examining the relationship between physical activity and mental health outcomes were analyzed. The review included randomized controlled trials, cohort studies, systematic reviews, and meta-analyses, focusing on clinical outcomes, biological and psychosocial mechanisms, and exercise-based interventions.

Results. Evidence indicates that regular physical activity is associated with a reduction in symptoms of depression and anxiety and with improvements in psychological well-being. Exercise also positively influences cognitive functions such as memory, attention, and executive functioning. Proposed mechanisms include increased neurotrophic factors, modulation of neurotransmitter systems, reduced systemic inflammation, and improved self-esteem and social functioning.

Conclusions. Physical activity represents an important component supporting mental health and may serve as an effective adjunct to standard treatments. Incorporating regular exercise into preventive and therapeutic programs may improve quality of life and reduce burden on healthcare systems.

Keywords: physical activity; mental health; depression; anxiety disorders; exercise; health prevention

1. Introduction

1.1. Mental Health Disorders as a Public Health Challenge

Mental health disorders constitute a major public health challenge affecting millions of people worldwide. Depression and anxiety disorders are among the most frequently diagnosed psychiatric conditions, and their global prevalence has been steadily increasing [1]. This results in a significant social and economic burden, including healthcare costs, work absenteeism, and reduced productivity [2].

Symptoms of depression, such as low mood, loss of interest, and fatigue, significantly impair social and occupational functioning. Anxiety disorders, including generalized anxiety disorder and panic disorder, further increase the risk of somatic complications and deterioration in quality of life. Despite advances in pharmacotherapy, many patients experience recurrent symptoms or adverse effects associated with medications [3]. Access to psychotherapy also remains limited due to cost and availability of services.

Consequently, there is growing interest in non-pharmacological interventions that are accessible and safe. Physical activity represents a promising strategy both in the prevention and treatment of mental disorders while simultaneously providing systemic health benefits. Its potential to reduce symptoms of depression and anxiety has been confirmed in numerous systematic reviews and meta-analyses, making it an attractive complement to standard psychiatric care [4,5].

1.2. Physical Activity as a Component of Lifestyle Medicine

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure above resting levels. It includes both spontaneous activities of daily living and planned, structured exercise performed for health, recreational, or sports purposes. In clinical contexts, exercise interventions are increasingly recognized as an important component of lifestyle medicine, which integrates behavioral modifications with conventional medical treatments. The World Health Organization recommends regular physical activity as a key element in the prevention of chronic diseases, including mental disorders [6].

In recent years, the concept of “exercise as medicine” has gained prominence. This approach treats physical activity as a therapeutic intervention with documented effectiveness and clearly defined parameters of dosage. Similar to pharmacological therapy, exercise prescriptions should be individualized according to the FITT principle (frequency, intensity, time, and type). Meta-analyses increasingly demonstrate that appropriately structured training programs can

produce clinically meaningful reductions in depressive symptoms, with effect sizes comparable to some psychological interventions in mild to moderate depression [7].

An important argument for incorporating physical activity into standards of care is its beneficial impact not only on mental health but also on somatic parameters, including cardiorespiratory fitness, metabolic profile, and reduction of inflammatory processes. The comprehensive nature of these effects makes physical activity a therapeutic tool with broad preventive and clinical potential, particularly in populations burdened by both somatic and psychiatric comorbidities [8].

2. Methods

This study was conducted as a narrative literature review examining the impact of physical activity on mental health and its potential role in the prevention and treatment of mental disorders. Scientific publications available in the PubMed, Scopus, and Web of Science databases were analyzed.

Various types of high-quality scientific publications were included in the review, such as randomized controlled trials (RCTs), cohort studies, systematic reviews, and meta-analyses. Selected review articles addressing biological and psychosocial mechanisms linking physical activity with mental functioning were also considered.

The literature search was conducted using combinations of keywords and Boolean operators, including:

“physical activity”, “exercise”, “mental health”, “depression”, “anxiety”, “schizophrenia”, “bipolar disorder”, “cognitive function”, “exercise therapy”, “randomized controlled trial”, “systematic review”, and “meta-analysis”.

The selection of publications was based on the analysis of titles, abstracts, and full texts in terms of their relevance to the topic of the review. Studies examining the effects of physical activity or structured exercise interventions on symptoms of mental disorders, cognitive functioning, and overall psychological well-being in adult populations were included.

Publications that did not meet basic methodological quality criteria, purely descriptive papers without empirical data, and studies focusing exclusively on pediatric populations were excluded. Only articles published in English were included in the review.

The analysis of the literature had a qualitative character and involved the synthesis and interpretation of research findings as well as the identification of common conclusions regarding the effectiveness of physical activity in the context of mental health. The results were organized thematically according to the type of mental disorder, type of exercise intervention,

and potential biological and psychosocial mechanisms responsible for the observed clinical effects.

3. Clinical Effects of Physical Activity

3.1. Depressive Disorders

Depressive disorders represent one of the most extensively studied areas in the context of the therapeutic application of physical activity. Over the past two decades, numerous randomized controlled trials (RCTs) and meta-analyses have demonstrated that regular physical exercise leads to a clinically significant reduction in depressive symptoms both in individuals diagnosed with major depressive disorder (MDD) and in populations with subthreshold symptoms [7]. After accounting for the risk of publication bias, the therapeutic effect remains statistically significant, although its magnitude is moderately reduced. This confirms the stability of the observed phenomenon and suggests a moderate overall effect size of the intervention.

One of the most frequently analyzed intervention models is moderate-intensity aerobic training. Programs typically lasting 8–12 weeks and performed several times per week show a clear reduction in symptom severity assessed using standardized scales such as the Hamilton Depression Rating Scale (HDRS) and the Beck Depression Inventory (BDI) [4]. These effects have been observed both in outpatient settings and in hospitalized populations. Comparative analyses have suggested that supervised, structured exercise programs may achieve effect sizes comparable to those observed in pharmacotherapy and certain forms of psychotherapy, particularly in mild to moderate depressive episodes. However, this interpretation should be approached with caution due to methodological heterogeneity across studies [4,7].

Increasing attention has also been given to resistance training as an alternative form of intervention. A meta-analysis including a broad range of age groups demonstrated that resistance training is associated with a significant reduction in depressive symptoms regardless of participants' baseline physical health status [9]. These effects were also observed with moderate training volumes, suggesting that even relatively simple resistance programs may provide clinically meaningful benefits.

In recent years, comparative analyses of different exercise modalities have been conducted. A network meta-analysis including several hundred randomized trials showed that aerobic exercise, resistance training, high-intensity interval training (HIIT), and mixed exercise interventions all lead to significant clinical improvement in depressive symptoms [10]. Differences between specific forms of activity were relatively small, indicating that regularity and appropriate adjustment of the exercise program to the patient's capabilities may be more

important than the specific modality itself. In this context, HIIT may represent a particularly attractive therapeutic option due to the shorter duration of individual sessions while maintaining comparable effectiveness, which increases the time efficiency of the intervention.

From the perspective of primary prevention, data concerning the risk of developing a first depressive episode are also important. A meta-analysis of prospective studies demonstrated that higher levels of physical activity are associated with a reduced risk of developing depression in the general population, independent of age and geographic region [5]. These findings suggest that regular physical activity may function as a protective factor in the long-term maintenance of mental health.

The mechanisms responsible for the observed effects include increased expression of neurotrophic factors, particularly brain-derived neurotrophic factor (BDNF), modulation of the hypothalamic–pituitary–adrenal (HPA) axis, improved regulation of monoaminergic neurotransmitter systems, and reduction in low-grade systemic inflammation. Experimental studies have also shown that aerobic training may lead to increased hippocampal volume and improvements in cognitive function, which constitutes an important component of the neurobiological model underlying the antidepressant effects of exercise [11]. At the same time, physical activity influences psychosocial factors such as increased self-efficacy, structuring of daily routines, and enhanced social integration, all of which play a significant role in the recovery process.

In summary, available scientific evidence indicates that physical activity represents an effective, safe, and relatively low-cost adjunctive intervention in the treatment of depressive disorders. Aerobic exercise, resistance training, and interval-based interventions demonstrate comparable clinical effectiveness, and their integration into comprehensive psychiatric care models appears justified from both clinical and public health perspectives.

3.2. Anxiety Disorders and Chronic Stress

Anxiety disorders, including both generalized anxiety disorder (GAD) and panic disorder, represent some of the most common mental health conditions and frequently co-occur with depression and other chronic diseases [12]. These disorders are characterized by persistent tension, excessive vigilance, difficulties with concentration, and somatic symptoms of anxiety, all of which significantly reduce quality of life and impair social functioning [13]. Despite the availability of pharmacological and cognitive-behavioral therapies, many patients experience recurrent symptoms or a limited response to treatment, which has increased interest in non-pharmacological interventions, including physical activity [14].

Research indicates that regular physical activity may significantly reduce anxiety symptoms in individuals with GAD and panic disorder. A meta-analysis of randomized controlled trials demonstrated that moderate-intensity aerobic training (e.g., walking, running, cycling) performed 3–5 times per week for 8–12 weeks leads to a significant reduction in anxiety symptom severity compared with control groups [14]. At the same time, these effects have been observed both in clinical populations and in individuals with subclinical anxiety symptoms, suggesting a broad potential of physical activity interventions in both primary and secondary prevention [15].

The mechanisms responsible for anxiety reduction associated with physical activity are multidimensional. Moderate-intensity exercise influences the regulation of the stress response through modulation of the hypothalamic–pituitary–adrenal (HPA) axis and a reduction in cortisol secretion in response to psychological stressors [16]. Furthermore, physical activity improves the functioning of the autonomic nervous system, including the balance between the sympathetic and parasympathetic systems, which contributes to stabilization of heart rate and a reduction in excessive autonomic arousal [17]. This effect is particularly important in individuals experiencing chronic stress, in whom hyperactivity of the HPA axis and elevated cortisol levels may contribute to the persistence of anxiety symptoms.

In addition to neurobiological mechanisms, psychosocial factors also play an important role. Regular exercise strengthens self-efficacy, autonomy, and perceived control over stress, while also promoting social integration through participation in training groups or recreational activities [18]. These psychosocial effects may enhance long-term adherence to interventions and contribute to the maintenance of beneficial therapeutic outcomes.

The literature also indicates that the effects of physical activity interventions may depend on exercise intensity. Moderate intensity is most commonly recommended due to the optimal balance between safety, accessibility, and effectiveness in reducing anxiety symptoms [19]. Very high-intensity interventions may lead to a short-term increase in tension and undesirable somatic reactions in individuals with heightened sensitivity to stress, suggesting the need for individualized adjustment of exercise programs.

In summary, available scientific evidence indicates that physical activity, particularly moderate-intensity aerobic training, represents an effective intervention supporting the reduction of symptoms associated with anxiety disorders and chronic stress. The mechanisms of action include both the regulation of neurobiological stress responses and beneficial psychosocial influences. The integration of such programs into standard care may increase

access to therapy, improve patients' quality of life, and contribute to the prevention of symptom recurrence.

3.3. Psychotic Disorders and Bipolar Disorder

Physical activity is increasingly investigated as an adjunctive therapeutic component in psychotic disorders, particularly schizophrenia, as well as in bipolar disorder (BD). Individuals with schizophrenia exhibit significantly increased mortality compared with the general population, primarily due to somatic causes, including cardiovascular diseases [20]. At the same time, this population is characterized by low levels of physical activity and reduced cardiorespiratory fitness, which constitutes a potentially modifiable risk factor.

In the context of schizophrenia, the most well-documented effects of physical exercise relate to cognitive functioning. A meta-analysis conducted by Firth et al. (2017) [21], including randomized controlled trials, demonstrated a significant improvement in global cognitive functioning following exercise interventions. The observed effects were particularly evident in working memory, executive functions, and processing speed. The authors also indicated a dose–response relationship, suggesting that a greater volume of training is associated with stronger cognitive improvements.

An important indicator of physiological effects is aerobic capacity ($VO_2\text{max}$). A meta-analysis by Vancampfort et al. (2015) [22], focusing on the impact of exercise on cardiorespiratory fitness in schizophrenia, demonstrated a significant increase in $VO_2\text{max}$ in intervention groups compared with control groups, with a moderate effect size. These findings confirm that exercise programs lead to a measurable improvement in physical fitness in this population. Although this study did not directly analyze neurobiological mechanisms, improvements in aerobic capacity are often associated with beneficial functional changes in the central nervous system, which may partially explain the observed cognitive effects.

In the case of bipolar disorder, the evidence base remains limited. A systematic review by Melo et al. (2016) [23] indicates that available studies are relatively few and heterogeneous; however, they suggest potential benefits in terms of reducing depressive symptoms as well as improving quality of life and psychosocial functioning. The authors emphasize the need for cautious interpretation of these findings and highlight the necessity for further randomized studies. In clinical practice, individualized adjustment of exercise intensity is recommended, particularly during periods of elevated mood, when excessive activation may be detrimental.

In summary, physical activity has solid empirical support as an adjunctive intervention in schizophrenia—particularly in the context of improving cognitive functioning and increasing

VO₂max. In bipolar disorder, the evidence is less conclusive but suggests potential benefits regarding depressive symptoms and quality of life, provided that appropriate clinical caution is maintained.

3.4. Primary and Secondary Prevention

Physical activity plays an important role in the primary prevention of depressive disorders in the general population. A meta-analysis of prospective cohort studies including more than 260,000 participants demonstrated that higher levels of physical activity are associated with a significantly lower risk of developing depression in the future [5]. Individuals with the highest levels of physical activity had a substantially lower risk of developing depression compared with those who were the least physically active. These findings confirm a clear inverse relationship between the level of physical activity and the risk of incident depression.

The dose–response relationship was examined in greater detail in a more recent meta-analysis using standardized calculations expressed in MET-hours per week [24]. The authors identified a nonlinear association in which the greatest relative reduction in risk occurred when individuals moved from no physical activity to a low level of activity. Approximately 4–5 MET-hours per week—corresponding to roughly half of the minimum recommendations of the World Health Organization (WHO)—was already associated with a significant reduction in the risk of depression. Further increases in activity produced additional benefits, although the effect curve gradually plateaued at higher levels of physical activity. This indicates that even activity below the recommended 150 minutes of moderate physical activity per week has a protective effect.

In the context of secondary prevention, the available evidence comes primarily from intervention studies conducted in clinical populations. A randomized trial with long-term follow-up demonstrated that an exercise program used as part of treatment for individuals experiencing a major depressive episode was associated with a lower risk of relapse compared with the absence of continued exercise [25]. These findings suggest that maintaining regular exercise may support the maintenance of remission, although the number of long-term studies remains limited.

In summary, physical activity is a well-documented protective factor in the general population, with a clear dose–response relationship and significant benefits even below the level recommended by the World Health Organization (WHO). In secondary prevention, the available evidence is more limited but indicates a potential role for regular exercise in reducing the risk of depression relapse.

4. Mechanisms of Action of Physical Activity

4.1. Neuroplasticity and Neurotrophic Factors

One of the key biological mechanisms linking physical activity with improvements in mental health is its influence on neuroplasticity, including the regulation of neurotrophic factors. A particularly important role is played by brain-derived neurotrophic factor (BDNF), which supports neuronal survival, neuronal differentiation, and synaptic plasticity. A meta-analysis of intervention studies demonstrated that both a single session of physical exercise and long-term training lead to a significant increase in peripheral BDNF concentrations in humans [26]. This effect is considered one of the main mediators of the beneficial impact of exercise on cognitive functioning and mood regulation.

Preclinical models have shown that regular physical activity stimulates neurogenesis in the hippocampus, particularly in the dentate gyrus, which is associated with increased BDNF expression and improved memory performance [27]. The hippocampus is a structure particularly sensitive to stress and plays an important role in the pathophysiology of depression. Increased neurogenesis and enhanced synaptic plasticity may counteract the structural changes observed in the course of affective disorders.

Evidence in humans also indicates that long-term aerobic training may lead to structural changes in the brain. A randomized controlled trial demonstrated an increase in hippocampal volume after a one-year program of moderate physical exercise in older adults, accompanied by an increase in serum BDNF levels [11]. These findings suggest that physical activity may partially reverse the age-related decline in hippocampal volume. Functional changes have also been observed in the prefrontal cortex, a structure crucial for emotional regulation and executive functions.

In summary, through modulation of BDNF, stimulation of hippocampal neurogenesis, and its influence on prefrontal brain structures, physical activity represents an important biological factor supporting brain plasticity and potentially modifying the course of mental disorders.

4.2. Modulation of Neurotransmitters

Physical activity influences the functioning of key neurotransmitter systems involved in the regulation of mood, motivation, and cognitive functioning. Aerobic exercise increases the availability of serotonin, dopamine, and norepinephrine in the central nervous system, which partially overlaps with the mechanisms of action of antidepressant medications. A review of preclinical and clinical data indicates that regular training may lead to adaptive changes in

receptor regulation and synaptic sensitivity within monoaminergic systems, particularly in the prefrontal cortex and limbic structures [28]. These effects may contribute to improved emotional regulation and a reduction in depressive symptoms.

The endocannabinoid system also plays an important role. Acute sessions of moderate to vigorous exercise lead to an increase in plasma levels of anandamide, which correlates with improved mood and reduced anxiety [29]. This mechanism is considered one of the biological basis of the phenomenon commonly referred to as the “runner’s high.” Endocannabinoids modulate the activity of the hypothalamic–pituitary–adrenal axis and interact with dopaminergic systems, thereby enhancing the subjective experience of reward.

It is important to distinguish between acute and chronic effects. A single session of exercise induces a transient increase in neurotransmitter release, whereas regular training leads to long-term neurochemical adaptations, including regulation of the expression of enzymes involved in monoamine synthesis and postsynaptic receptors [30]. These adaptive changes may be of key importance for the long-term antidepressant effects of physical activity.

4.3. The Hypothalamic–Pituitary–Adrenal (HPA) Axis

Dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis is one of the best-documented biological mechanisms associated with the pathophysiology of depression and anxiety disorders. Chronic hyperactivation of the HPA axis leads to increased cortisol secretion, disruptions of the circadian rhythm, and weakening of feedback mechanisms, which may negatively affect the functioning of the hippocampus and the prefrontal cortex [31].

Physical activity induces a transient increase in cortisol levels in response to acute physiological stress; however, regular training leads to adaptation of the stress-response system. It has been demonstrated that physically active individuals exhibit more efficient regulation of the cortisol response and a faster return to baseline levels after exposure to stressors [32]. This adaptation is interpreted as an increase in “stress resilience,” which may represent one of the protective mechanisms against the development of affective disorders.

Thus, although physical exercise constitutes a stressor in the short term, regular engagement in physical activity promotes normalization of HPA axis functioning and improves neuroendocrine regulation.

4.4. Inflammatory and Immunological Mechanisms

An increasing body of evidence indicates that mental disorders—particularly depression—are associated with chronic low-grade inflammation. Elevated levels of pro-inflammatory

cytokines, such as interleukin-6 (IL-6), tumor necrosis factor- α (TNF- α), and C-reactive protein (CRP), have been observed both in patients experiencing depressive episodes and in populations at increased risk [33]. These mechanisms may influence tryptophan metabolism, neuroplasticity, and the functioning of the HPA axis.

Physical activity exhibits immunomodulatory effects, the outcome of which depends on the intensity and nature of the exercise. Regular moderate training leads to reductions in inflammatory markers and improvement in cytokine profiles, whereas prolonged high-intensity exercise may temporarily increase the inflammatory response [34]. This relationship is often described as a J-shaped relationship, in which moderate physical activity provides the greatest immunological benefits.

In the context of mental health, it has been suggested that the reduction of chronic inflammation constitutes one of the key mechanisms underlying the antidepressant effects of physical activity, particularly in individuals with elevated inflammatory markers.

4.5. Psychosocial Mechanisms

In addition to neurobiological mechanisms, psychosocial factors also play an important role in mediating the effects of physical activity on mental health. One of the key constructs is self-efficacy. A review of mechanisms linking physical activity with mental health in adolescents indicates that increases in self-efficacy constitute an important mediator of improved mood and a reduction in internalizing symptoms [35]. The authors also emphasize the role of social support and social skills developed through participation in physical activity.

In adult populations, studies indicate that physical-activity-based interventions are associated with improvements in self-esteem, body image, and social functioning, which may represent one of the mechanisms underlying the reduction of depressive symptoms [36]. Participation in group activities additionally enhances social integration and a sense of belonging, counteracting social isolation—an important risk factor for mood disorders.

Psychosocial mechanisms do not operate independently of biological processes but rather reinforce one another. Improvements in sense of agency, social relationships, and self-perception may increase motivation to maintain physical activity, thereby supporting the persistence of both psychological and neurobiological benefits.

5. Types of Physical Activity Interventions

5.1. Aerobic Training

Aerobic training is the most extensively studied form of physical activity in the treatment of depression. A meta-analysis of randomized controlled trials demonstrated that exercise leads to a significant reduction in depressive symptoms compared with control groups, and this effect persists even after accounting for potential publication bias [7]. These findings confirm that physical activity constitutes an effective adjunctive intervention in the treatment of depressive episodes.

Across the analyzed studies, the most commonly used intervention was moderate-intensity aerobic training, including activities such as walking, running, or cycling. Although the meta-analysis does not clearly identify optimal exercise parameters, programs involving moderate intensity and regular training frequency were most often associated with beneficial clinical outcomes.

The mode of intervention delivery is also important. A meta-regression conducted as part of a Cochrane review showed that greater therapeutic effects were observed in studies in which training was supervised, compared with unsupervised programs [4], although the authors emphasized the heterogeneous methodological quality of the included studies. Supervision may improve adherence, ensure appropriate exercise intensity, and increase safety, particularly in individuals with more severe depressive symptoms.

In summary, regular aerobic training, performed systematically and—whenever possible—under supervision, represents a well-documented and safe adjunctive intervention in the treatment of depression.

5.2. Resistance Training

Resistance training is an effective intervention for reducing depressive symptoms. A meta-analysis of randomized controlled trials demonstrated that resistance training is associated with a significant reduction in the severity of depressive symptoms, and this effect was independent of participants' age, health status, and baseline symptom severity [9]. These findings suggest that resistance training may serve as an effective complement to standard treatment, and its effectiveness is not limited solely to clinical populations.

In addition to psychological effects, resistance training provides significant metabolic benefits, including improved insulin sensitivity, reduction in adipose tissue, and an increase in lean body mass. A meta-analysis of intervention studies confirmed the beneficial impact of resistance training on glycemic control and metabolic parameters, particularly among individuals with

metabolic disorders [37]. This is clinically relevant, as somatic comorbidity is common in populations with depression.

In practice, progression of training load is of key importance—gradually increasing intensity as the body adapts. This approach ensures adequate physiological stimulation while also strengthening the sense of competence and personal agency. Programs performed two to three times per week and involving multi-joint exercises may represent a safe and effective alternative or complement to aerobic training.

5.3. High-Intensity Interval Training (HIIT)

High-intensity interval training (HIIT) is a form of physical activity characterized by alternating periods of high-intensity effort and short periods of rest or low-intensity activity. Due to the shorter duration of sessions compared with traditional continuous exercise, HIIT has gained popularity as an efficient method for improving physical fitness and as a potential strategy for supporting mental health.

A recent systematic review and meta-analysis including 34 randomized controlled trials demonstrated that HIIT is associated with a moderate reduction in the severity of depressive symptoms compared with inactive control groups (SMD = -0.40) and shows greater effects when compared with inactive controls (SMD = -0.53), although these effects were smaller when compared with other forms of exercise [38].

Clinical studies also suggest that HIIT may be effective in specific patient populations. A randomized trial conducted among individuals diagnosed with schizophrenia showed that a 12-week HIIT program led to a greater reduction in depressive symptoms compared with a control activity, and improvements in cardiorespiratory fitness ($VO_2\max$) were correlated with changes in mood [39].

Due to the high intensity of exercise, HIIT requires appropriate medical screening and tailoring to the individual's capabilities. In individuals with cardiometabolic diseases, low exercise tolerance, or during a severe depressive episode, initiating training with moderate-intensity exercise may be more appropriate, with the possibility of gradual progression toward interval training.

In summary, although the literature on HIIT in depression is still developing, the available evidence indicates potential clinical benefits and time efficiency of this training approach, provided that appropriate supervision and individualization of the program are ensured.

5.4. Combined Interventions

Combined interventions, integrating aerobic and resistance components within a single therapeutic program, represent a rational approach in the adjunctive treatment of depressive disorders. The integration of different forms of exercise allows simultaneous effects on cardiorespiratory, metabolic, and neuromuscular systems, which may promote a more comprehensive improvement in overall physical and psychological functioning. Aerobic training primarily influences aerobic capacity and the regulation of the stress axis, whereas the resistance component supports metabolic adaptations, improvements in body composition, and a sense of personal agency associated with progressive increases in training load.

A meta-analysis of randomized controlled trials has demonstrated that exercise programs—including aerobic training, resistance training, and their combinations—lead to a significant reduction in depressive symptoms compared with control groups, with a moderate effect size [7]. The authors emphasize that the effectiveness of the intervention is not limited to a single type of exercise, which supports the use of combined training programs.

From a clinical perspective, combined interventions facilitate the personalization of therapy. The selection of exercise components, intensity, and frequency should take into account the patient's somatic condition, preferences, previous experience with physical activity, and the current severity of symptoms. A flexible program structure may increase adherence and long-term maintenance of physical activity, which is crucial for sustaining therapeutic effects.

6. Applications in Special Populations

6.1. Children and Adolescents

Physical activity in children and adolescents is of particular importance in the context of dynamic neuroplastic processes occurring in the developing brain. Adolescence is associated with extensive remodeling of limbic structures and the maturation of cortico-subcortical connections responsible for emotional regulation and executive functions. Therefore, behavioral interventions, including physical exercise, may represent an important factor modulating emotional functioning in this age group.

A meta-analysis of randomized controlled trials conducted by Carter et al. (2016) [40] demonstrated that physical exercise leads to a significant reduction in depressive symptoms among adolescents, with a moderate effect size. These findings indicate a clinically meaningful role of physical activity as a component of adjunctive therapy.

Another meta-analysis including both intervention and observational studies confirmed a significant, although small to moderate, association between the level of physical activity and

the severity of depressive symptoms in children and adolescents [41]. From a practical perspective, programs implemented in school settings may increase access to interventions and support regular participation, although this analysis was not directly focused on evaluating school-based programs.

6.2. Older Adults

Late-life depression represents a significant clinical problem, often co-occurring with chronic diseases, functional decline, and social isolation. In this population, physical activity may influence both affective symptoms and factors associated with the loss of independence.

A meta-analysis of randomized controlled trials involving individuals aged ≥ 60 years demonstrated that exercise-based interventions lead to a significant reduction in the severity of depressive symptoms compared with control groups, with effect sizes ranging from small to moderate [42]. The analysis included both individuals diagnosed with depression and participants with elevated depressive symptoms, which enhances its clinical relevance in the context of late-life depression.

From a geriatric perspective, resistance training and balance exercises are of particular importance. Resistance training counteracts the age-related loss of muscle mass and strength, while balance exercises reduce the risk of falls and help maintain functional independence. Improvements in physical fitness may indirectly influence quality of life and the sense of autonomy, which are important determinants of psychological well-being in older age. Intervention programs should be individualized, initiated at low or moderate intensity, and—especially in the presence of comorbidities—implemented under appropriate supervision.

6.3. Patients with Chronic Diseases

Depression frequently co-occurs with chronic diseases, particularly cardiovascular diseases, type 2 diabetes, and cancer, negatively affecting prognosis and quality of life. In these populations, physical activity may play a dual role: influencing the pathophysiological mechanisms of the underlying disease while simultaneously reducing the severity of depressive symptoms.

A meta-analysis of randomized controlled trials demonstrated that exercise interventions in individuals with chronic diseases, including cardiovascular and metabolic conditions, lead to a significant reduction in depressive symptoms compared with control groups, with effect sizes ranging from small to moderate [43]. In patients with cardiovascular disease and diabetes, improvements in cardiorespiratory fitness and metabolic control may additionally contribute to

reductions in inflammation and improved regulation of the stress-response axis, which may in turn influence affective symptoms.

In patients with cancer, physical exercise has also been shown to have beneficial effects on depressive symptoms and quality of life. A meta-analysis involving cancer patients confirmed that exercise programs lead to significant improvements in mood and reductions in depressive symptoms [44].

In clinical practice, the individualization of the exercise program is crucial, taking into account the stage of the disease, exercise tolerance, and medical contraindications. Interventions should be implemented in collaboration with the therapeutic team to ensure safety and optimize both somatic and psychological outcomes.

6.4. Women During Key Reproductive Stages

Periods of significant hormonal changes, such as pregnancy and menopause, are associated with an increased risk of experiencing depressive symptoms. Fluctuations in estrogen and progesterone levels, metabolic changes, and psychosocial factors may influence mood regulation and the reactivity of the hypothalamic–pituitary–adrenal (HPA) axis. During these periods, physical activity represents a potentially safe and non-pharmacological form of support. A meta-analysis of randomized controlled trials demonstrated that physical exercise during pregnancy and the postpartum period leads to a significant reduction in depressive symptoms compared with standard care, with effect sizes ranging from small to moderate [45]. The interventions mainly included moderate-intensity aerobic training performed several times per week.

During menopause, regular physical activity may additionally alleviate vasomotor symptoms, improve sleep quality, and support body weight regulation, which indirectly contributes to psychological well-being. Exercise programs should be tailored to the woman's health status, the course of pregnancy, or the presence of cardiometabolic risk factors.

7. Implementation in Clinical Practice

7.1. The Exercise Prescription Model

The exercise prescription model treats physical activity as a therapeutic intervention with clearly defined parameters: frequency, intensity, duration, and type of exercise (the FITT principle). In the context of depressive disorders, implementing this model requires systematic patient assessment, including evaluation of symptom severity, somatic comorbidities, fitness level, and potential medical contraindications. Stratification of cardiovascular risk prior to

initiating a program of moderate or high intensity is also of key importance. The updated guidelines of the American College of Sports Medicine describe in detail the algorithms for preparticipation health screening and emphasize the need for individualized training recommendations depending on the patient's clinical profile [46].

In psychiatric practice, the exercise prescription model should be implemented within an interdisciplinary framework. The psychiatrist evaluates the stability of the patient's mental state and therapeutic indications, the primary care physician or specialist conducts the medical assessment, and a physiotherapist or clinical exercise specialist is responsible for implementing the program and ensuring the safe progression of training loads.

Most studies indicate that demonstrating significant reductions in depressive symptoms involved structured programs conducted within structured intervention settings [7]. This highlights the importance of a planned and supervised approach to exercise therapy, although the meta-analysis itself did not directly compare supervised and unstructured programs as separate clinical categories.

7.2. Barriers and Facilitating Factors

The effective integration of physical activity into the treatment of mental disorders depends not only on training parameters but also on psychosocial factors that determine patient engagement. Individuals with depression often experience barriers that hinder participation in exercise programs, including low energy, reduced motivation, fear of negative social evaluation, and persistent symptoms of anhedonia, which decrease both the initiation and maintenance of activity. Environmental factors, such as limited access to exercise facilities or lack of social support, may also significantly reduce levels of physical activity.

A systematic review focused on identifying barriers and facilitators indicates that determinants of participation in physical activity among adults with depression can be analyzed at multiple levels: individual (motivation, symptom severity), interpersonal (social support), environmental (access to exercise facilities), and cultural (attitudes and social norms) [47].

Facilitating factors include positive experiences with physical activity, access to organized forms of exercise, and the incorporation of elements of social or group support. In clinical practice, improving adherence may require the use of behavioral strategies, tailoring the type of activity to the patient's preferences, and creating a safe and supportive training environment. Intervention programs are most effective when they integrate motivational components, structured guidance, and access to resources, which together support the long-term maintenance of physical activity.

7.3. Integration with Standard Treatment

Physical activity should be considered a component of combined treatment in the management of depression rather than an alternative to pharmacotherapy or psychotherapy. Contemporary clinical approaches are based on a multimodal model in which biological, psychological, and behavioral interventions complement one another. Within this framework, physical exercise may serve as a structured adjunct to standard treatment, simultaneously influencing neurobiological mechanisms, psychosocial functioning, and the patient's somatic condition.

A Cochrane systematic review including randomized controlled trials demonstrated that physical exercise leads to a significant reduction in depressive symptoms compared with no intervention or passive control groups [4]. The analysis included studies in which physical activity was applied both as a stand-alone intervention and as an adjunct to usual care; in practice, however, most programs were implemented as an adjunct to standard treatment.

In light of the available evidence, physical activity may be incorporated into a comprehensive therapeutic plan as a supportive element, provided that coordination with other forms of treatment and monitoring of clinical outcomes are maintained.

8. Limitations of Current Evidence

Despite the growing number of studies indicating the beneficial effects of physical activity in reducing depressive symptoms, the current evidence base remains subject to significant limitations. One of the most important issues is the considerable heterogeneity in interventions. Studies differ in the type of exercise (aerobic, resistance, combined), intensity, frequency, program duration, and level of supervision. This variability makes it difficult to precisely determine the optimal “dose” of training and limits the possibility of directly comparing results. Additionally, the studied populations are heterogeneous, including both individuals diagnosed with depression of varying severity and participants with elevated levels of depressive symptoms without a formal diagnosis [4].

Another important limitation is the relatively short follow-up periods. Most randomized controlled trials last several to a dozen weeks, which allows for the assessment of short-term effects but does not provide sufficient data regarding the durability of improvement, the risk of relapse, or long-term adherence. Long-term follow-up data are limited, and conclusions regarding the persistence of therapeutic effects remain uncertain [4].

The literature also rarely directly addresses the issue of individualized training programs. Many studies rely on standardized protocols, with limited data regarding modifications of interventions according to patient preferences, fitness level, or comorbidities. Consequently,

the question of personalization remains an insufficiently explored area requiring further investigation.

Finally, although randomized controlled trials represent the gold standard for evaluating effectiveness, exercise interventions pose specific methodological challenges. These include the impossibility of fully blinding participants, the risk of bias, and variable quality of reporting. The review indicated that after accounting for the methodological quality of the studies, the observed effect size decreased, highlighting the need for further rigorous research designs [4].

9. Future Research Directions

Despite the well-established role of physical activity as an intervention with documented antidepressant efficacy, further progress in this field requires more precise and methodologically advanced research. One of the key directions is the development of personalized approaches. Existing meta-analyses indicate a significant but heterogeneous clinical effect of exercise, suggesting the presence of individual moderators of therapeutic response [7]. The identification of biomarkers of treatment response—including inflammatory markers, neurotrophic parameters (e.g., BDNF), and metabolic profiles—could enable better tailoring of the type and intensity of exercise to individual patient characteristics.

Another important area is long-term research with follow-up periods exceeding 12 months. It is necessary to determine the durability of the antidepressant effect, the influence of regular physical activity on relapse risk, and the factors that determine long-term adherence over several years. Current literature focuses primarily on short-term interventions, which limits the ability to formulate recommendations regarding strategies for secondary prevention.

Head-to-head studies directly comparing the effectiveness of exercise with pharmacotherapy (e.g., SSRIs) and cognitive behavioral therapy also represent an important research direction. Although some studies suggest comparable effectiveness of exercise interventions in selected populations, the number of high-quality direct comparisons remains limited [4]. Such research designs would allow for a more precise determination of the role of physical activity within treatment algorithms.

Finally, implementation studies examining the possibility of systematically integrating “exercise prescription” into healthcare systems are needed. These include evaluations of cost-effectiveness, models of interdisciplinary collaboration, and organizational barriers within real-world clinical practice. The integration of physical activity into routine psychiatric care requires not only clinical evidence but also structural solutions at the systemic level.

10. Conclusions

The present literature review confirms that physical activity represents an effective intervention supporting the treatment and prevention of mental health disorders. The strongest evidence concerns depression—meta-analyses of randomized controlled trials have demonstrated a clinically significant reduction in symptoms [4,7], while prospective data indicate that higher levels of physical activity are associated with a lower risk of developing depression in the general population [5]. At the same time, available systematic reviews suggest that clinical benefits extend to other areas of mental health, including the reduction of anxiety symptoms, improvements in quality of life and functioning in schizophrenia, and positive effects on cognitive functioning [48].

The mechanisms underlying the effects of physical activity are multidimensional and align with the biopsychosocial model. At the biological level, they include modulation of the stress axis, effects on inflammatory pathways, and enhancement of neuroplasticity. At the psychological level, key factors include increased self-efficacy, improved emotional regulation, and reductions in rumination and anxiety-related tension. In the context of psychotic disorders, improvements in physical fitness and social functioning are also relevant. At the social level, physical activity promotes social integration, counteracts isolation, and strengthens interpersonal support.

From the perspective of clinical practice, physical activity should be considered a component of an integrated therapeutic model that complements pharmacotherapy and psychotherapy. The incorporation of structured exercise programs into standards of psychiatric care requires appropriate patient assessment, safety monitoring, and interdisciplinary collaboration.

In the context of the growing burden of mental disorders, the promotion of physical activity represents an intervention of major public health importance, combining therapeutic potential with somatic and social benefits.

Disclosure

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