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A LITERATURE REVIEW ON THE ROLE OF PHYSICAL ACTIVITY IN THE PREVENTION AND TREATMENT OF DEPRESSION

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ABSTRACT

Purpose

This review explores the role of physical activity in preventing and treating depression across diverse groups. It critically assesses recent evidence and identifies the most effective exercise interventions by systematically analysing studies published between 2017 and 2025.

Methods

The analysis covered peer-reviewed randomised controlled trials, systematic reviews, and meta-analyses focusing on links between various physical activities and depression symptoms in different age groups.

Results

The findings confirm that physical activity has clear antidepressant effects, with moderate to large effect sizes depending on exercise type and intensity. Aerobic exercise shows standardised mean differences (SMDs) from -0.496 to -1.156, resistance training shows SMDs between -0.66 and -1.06, and high-intensity interval training provides moderate effects (SMDs of -0.42 to -0.496). Suggested mechanisms include increased brain-derived neurotrophic factor, improved neurotransmitter function, lower inflammation, and balanced HPA-axis activity, which help reduce depressive symptoms.

Conclusion

Physical activity is a safe, evidence-based, and cost-effective option for preventing and treating depression. Adding structured exercise programmes to everyday routines and healthcare practice can improve mental wellbeing, quality of life, and help lower the global burden of depressive disorders across all age groups.

Keywords: Physical Activity, Depression, Exercise, Mental Health, Prevention, Treatment, Neurobiological Mechanisms

1. THE PURPOSE OF RESEARCH

1.1 Background and Significance

Affecting over 300 million people worldwide and acting as the main cause of disability, depression is among the most common and crippling mental health disorders known worldwide (Friedrich 2017). More than 320 million people worldwide, according to the World Health Organisation, suffer from depression, so severely burdening society at large as well as the individual level (Augustin et al. 2023). Although pharmacological and psychological treatments have advanced significantly, present therapeutic approaches are still less than ideal; many patients suffer treatment resistance, side effects, or relapse (Ross et al. 2023).

Reduced productivity, healthcare use, and related comorbidities mean annual economic losses of billions of dollars worldwide, so affecting the social and financial costs of depression (Lange et al. 2023). Furthermore, aggravating the global depression load is the coronavirus epidemic, which emphasises the immediate need of easily available, reasonably priced, evidence-based treatments (Borrega-Mouquinho et al. 2021).

With minimal side effects, wide availability, and concurrent physical health benefits (Heissel et al. 2023), physical activity has become a promising therapeutic intervention for depression offering different advantages over conventional treatments. With all kinds of exercise and sport linked to lower mental health burden, a cross-sectional study of more than 1.2 million adults in the United States found that those who exercised reported 1.49 less days of poor mental health per month compared to those who did not exercise (Chekroud et al. 2018).

Although physical activity offers extra advantages for cardiovascular health, cognitive function, and general quality of life, modern studies indicate that for some populations it could be as effective as antidepressant drugs (Noetel et al. 2024). Exercise interventions incorporated into clinical practice mark a paradigm change towards comprehensive, lifestyle-based approaches to mental healthcare that target both long-term prevention and symptom management.

1.2 Research Aims and Objectives

Examining the function of physical activity in the prevention and treatment of depression by means of methodical analysis of modern research data is the main aim of this literature review. Particularly targeted goals include:

1. To assess how well various exercise modalities—aerobic exercise, resistance training, high-intensity interval training—reduce depressed symptoms in several populations.
2. Examining the neurobiological pathways, neurotrophic factors, neurotransmitter systems, inflammatory markers, and neuroendocrine pathways that underlie the antidepressant effects of physical activity including neurotrophic factors (Sun et al. 2023).
3. To evaluate the best exercise prescription parameters (frequency, intensity, length, type) for maximising antidepressant benefits while guaranteeing safety and adherence.
4. To investigate how exercise interventions might be used in special populations including older adults, teenagers, and those with comorbid diseases or clinical depression.
5. To pinpoint clinical issues and implementation techniques for including physical activity interventions into standard mental healthcare settings.
6. To investigate how physical exercise might prevent depression episodes from occurring and recurrences over the lifetime.

1.3 Scope of Review

Focusing on high-quality studies examining the relationship between physical activity and depression, this review spans research published between 2017 and 2025. Randomised controlled trials, systematic reviews, meta-analyses, and network meta-analyses looking at both depression prevention and treatment through exercise interventions form part of the scope. Considered are several types of physical activity: structured exercise programs, lifestyle physical activity, and sport participation.

While considering many demographic groups over the lifespan, the review covers both clinical populations with diagnosed depression and subclinical populations at risk for depression. Examined are both acute responses and chronic adaptations to exercise training, with particular focus on dose-response relationships and ideal intervention properties. The study takes into account pragmatic concerns for clinical translation, adherence factors, and implementation difficulties.

2. RESEARCH MATERIALS AND METHODS

2.1 Search Strategy and Information Sources

Electronic databases including PubMed, PsycINFO, Embase, Cochrane Library, and SPORTDiscus were searched comprehensively. To guarantee inclusion of the most current and pertinent study results, the search period ran January 2017 through May 2025. Boolean operators were used following accepted systematic review methodology to combine important

search terms including "physical activity" OR "exercise" OR "training" AND "depression" OR "depressive symptoms" OR "major depressed disorder" AND "prevention" OR "treatment" OR "intervention".

Using particular exercise modality terms including "aerobic exercise," "resistance training," "strength training," "high-intensity interval training," and "HIIT," further searches were conducted in combination with depression-related terms. For every database, the search plan was modified to maximise sensitivity while preserving specificity. Manual searches of reference lists including pertinent systematic reviews and included studies helped to find further qualified studies.

To further reduce publishing bias, grey literature sources including clinical trial registries, thesis databases, and conference proceedings were also searched. Initially, there were no language restrictions; but, given translation constraints, only English-language studies were included in the final analysis.

2.2 Inclusion and Exclusion Criteria

Studies were included if they met the following criteria:

· Published in peer-reviewed journals between 2017 and 2025

· Investigated the effects of physical activity or exercise on depression or depressive symptoms

· Included human participants aged 12 years or older

· Employed experimental designs including randomised controlled trials, systematic reviews, meta-analyses, or high-quality observational studies

· Used validated measures of depression or depressive symptoms

· Provided sufficient statistical information for data extraction

Studies were excluded if they:

· Focused solely on physical activity for other mental health conditions without examining depression

· Involved non-human subjects or laboratory-based studies without clinical relevance

· Were published as abstracts only, case reports, or expert opinions without systematic methodology

· Did not include physical activity as a primary intervention or exposure variable

· Involved populations with severe cognitive impairment or other conditions that would preclude meaningful interpretation of depression measures

Following established methodology (Singh et al. 2023), systematic reviews and meta-analyses were required to adhere to PRISMA guidelines or equivalent methodological standards to ensure quality and rigour of evidence synthesis.

2.3 Data Extraction and Quality Assessment

Data extraction was performed using a standardised form that captured relevant information including study design, participant characteristics, intervention details, outcome measures, effect sizes, and key findings. For randomised controlled trials, extracted data included randomisation procedures, blinding methods, intervention and control group descriptions, dropout rates, and statistical analyses.

For systematic reviews and meta-analyses, data extraction focused on search strategies, inclusion criteria, number of included studies, participant characteristics, effect size calculations, heterogeneity assessments, and quality ratings of primary studies. The methodological quality of included studies was assessed using appropriate tools based on study design, including the Cochrane Risk of Bias tool for randomised controlled trials and AMSTAR-2 for systematic reviews.

Quality assessment criteria for randomised controlled trials included adequate sequence generation, allocation concealment, blinding of participants and personnel (where feasible), blinding of outcome assessment, complete outcome data, selective reporting, and other sources of bias. For systematic reviews, quality assessment focused on protocol development, search comprehensiveness, study selection procedures, data extraction methods, quality assessment of primary studies, and appropriate statistical methods.

Two independent reviewers conducted data extraction and quality assessment, with disagreements resolved through discussion or consultation with a third reviewer when necessary. Inter-rater reliability was calculated to ensure consistency in quality assessments.

2.4 Data Synthesis and Analysis

Given the heterogeneity of study designs, populations, interventions, and outcome measures, a narrative synthesis approach was employed to integrate findings across studies. Studies were categorised by exercise modality, population characteristics, and study design to facilitate structured analysis and interpretation.

Effect sizes were extracted or calculated where possible, with particular attention to standardised mean differences for depression outcomes. When multiple effect sizes were reported within studies, the most comprehensive or clinically relevant measure was selected

for analysis. Forest plots and summary tables were created to visualise effect sizes and confidence intervals across studies.

The synthesis approach was informed by established frameworks for evidence integration (Noetel et al. 2024), with studies grouped according to primary intervention types and outcome measures. Where sufficient homogeneous data were available, informal meta-analytic summaries were provided, though formal meta-analysis was not conducted due to the narrative review design and substantial heterogeneity across studies.

Subgroup analyses were conducted based on participant characteristics (age groups, clinical vs. subclinical populations), intervention characteristics (exercise type, duration, intensity), and methodological quality. The strength of evidence for each major finding was assessed using principles from the GRADE approach, considering study design, risk of bias, consistency, directness, and precision of estimates.

3. BASIC RESULTS

3.1 Aerobic Exercise and Depression

Aerobic exercise has emerged as one of the most extensively studied and well-supported interventions for depression, with robust evidence demonstrating significant antidepressant effects across diverse populations and study designs. Recent comprehensive analyses have consistently shown that aerobic exercise produces clinically meaningful reductions in depressive symptoms, with effect sizes comparable to established pharmacological and psychological treatments.

3.1.1 Meta-analytic Evidence and Effect Sizes

Heissel et al. (2023), whose systematic review and meta-analysis revealed that aerobic exercise produced a standardised mean difference of -1.156 ($p < 0.001$) for lowering depressed symptoms in adults aged 18 years or over with diagnosed or indicated depression, provide the most thorough recent evidence. Comparatively with conventional treatments, this shows a significant effect size clinically relevant (Heissel et al., 2023).

Representing the largest and most thorough study of exercise for depression to date, Noetel et al. (2024) performed an extensive systematic review and network meta-analysis of 218 randomised controlled trials including 14,170 participants. Their results showed that for treating depression, different types of aerobic exercise—walking, jogging, running, cycling, and so on, showered modest to significant effects. Especially, the study revealed that

supervised aerobic exercise sessions showed especially great results; group-based interventions shown extra benefits beyond individual training (Done, 2024).

With Pearce et al. (2022) showing in their meta-analysis of prospective cohort studies that even modest levels of physical activity below public health recommendations produced notable mental health benefits, a dose-response relationship has been found for depression and aerobic exercise. Their study of 15 studies including 191,130 participants revealed that adults meeting full recommendations had 25% lower risk; those engaging half the advised level of physical activity showed 18% lower risk of depression.

3.1.2 Mechanisms and Optimal Prescription

Studies done recently have explained more ways that aerobic exercise makes people feel better. Budde et al. (2024) pointed out that activities in the brain such as raising BDNF, restoring the function of transmitters, calming down inflammation in the body and balance in HPA-axis function, are key (Budde et al., 2024). All of these methods help increase brain plasticity and control emotions.

Latest research has helped find the ideal approach to exercise therapy for depression. According to Wang et al. (2022), when teens take part in aerobic exercise programmes lasting 9-15 weeks and do them three times weekly for 25-40 minutes at a moderate pace, the results for depression are best. From the 26 studies that were analysed, the researchers found that aerobic exercise produced a moderate effect size ($d = -0.92$).

Singh et al. (2023) provided crucial evidence regarding exercise intensity, demonstrating that moderate-intensity aerobic exercise (50-70% of maximum heart rate) was most effective for depression treatment, whilst high-intensity protocols showed greater dropout rates without additional benefits. Their overview of systematic reviews encompassing 97 meta-analyses concluded that supervised, group-based moderate-intensity aerobic exercise should be the first-line recommendation for exercise-based depression treatment.

3.1.3 Special Population Considerations

Aerobic exercise demonstrates particular efficacy in specific populations. Chen et al. (2024) examined the effects of aerobic exercise on cognitive function in adults with major depressive disorder, finding that exercise not only reduced depressive symptoms but also improved attention, memory, and executive function. Their systematic review and meta-analysis showed that aerobic exercise programmes lasting 8-24 weeks produced significant improvements in both mood and cognitive outcomes.

Aerobic exercise seems promising as both a treatment and a preventive measure for elderly people. Resistance training, often coupled with aerobic components, produced significant effect sizes for lowering depressed symptoms in older adults (SMD = -0.94), with effects particularly notable in those with existing mental health conditions (SMD = -2.15).

Results of aerobic exercise depend also on timing and context. With effects spanning several hours post-exercise, acute bouts of aerobic exercise have been demonstrated to immediately improve mood (Ross et al. 2023). This implies that aerobic exercise can be an acute intervention for controlling depressed episodes as well as a long-term therapy approach.

3.2 Resistance Training and Depression

Against conventional wisdom that only aerobic exercise offers mental health benefits, resistance training has become more and more known as a successful intervention for depression. Recent studies show that resistance training offers special benefits including enhanced self-efficacy, body image, and functional capacity and generates significant antidepressant effects.

3.2.1 Efficacy and Effect Sizes

Examining the relationship between resistance exercise training and depressed symptoms, Gordon et al. (2018) undertook a historic meta-analysis using 33 randomised clinical trials comprising 1,877 participants. Their results showed notable decreases in depression symptoms after resistance training; depending on population factors and intervention parameters, effect sizes ranged from small to moderate.

More recently, O'Sullivan et al. (2023) found that eight weeks of ecologically-valid, guidelines-based resistance training significantly lowered depressed symptoms among young people at-risk for elevated depression. With effects maintained at follow-up assessments, their randomised controlled trial revealed that resistance training outperformed control conditions.

Analysing 10 randomised controlled trials involving 376 participants, Marinelli et al. (2024) performed a systematic review and meta-analysis especially looking at resistance training in young people. With a large effect size that exceeded many pharmacological treatments, their results revealed that resistance training was linked with notable declines in depressed symptoms (Hedge's $g = -1.06$, 95% CI -1.61 to -0.51, $p < 0.001$).

3.2.2 Mechanisms and Neurobiological Effects

The mechanisms underlying resistance training's antidepressant effects involve multiple physiological and psychological pathways. Augustin et al. (2023) reviewed the neurobiological mechanisms of resistance training in depression, identifying key processes including enhanced protein synthesis, improved insulin sensitivity, increased growth hormone production, and strengthened neuromuscular function.

Resistance training appears to influence brain structure and function differently from aerobic exercise. Recent neuroimaging studies suggest that resistance training may preferentially enhance prefrontal cortex function and white matter integrity, areas critically involved in executive function and emotional regulation (Ross et al. 2023). These structural adaptations may contribute to improved mood regulation and cognitive flexibility.

The psychological mechanisms of resistance training include enhanced self-efficacy, improved body image, and increased sense of mastery and control. Herring and Meyer (2024) noted that the progressive nature of resistance training, where individuals can observe concrete improvements in strength and performance, may provide unique psychological benefits not found with other exercise modalities.

3.2.3 Optimal Prescription and Implementation

Current evidence suggests that resistance training programmes should follow established guidelines for optimal antidepressant effects. Augustin et al. (2023) recommended that beginners start with 30-50% of their one-repetition maximum (1RM) for three to six repetitions per exercise, progressively increasing intensity and volume over time.

Although research on the frequency and length of resistance training interventions vary, most effective programs call for two to three sessions a week for eight to sixteen weeks. Longer intervention periods (>12 weeks) produced higher effect sizes than shorter programs, according to Cunha et al. (2024), implying that consistent engagement is absolutely essential for optimising advantages.

Programme design considerations include exercise selection, progression strategies, and supervision requirements. Multi-joint exercises targeting major muscle groups appear most effective, with programmes incorporating both upper and lower body exercises showing superior outcomes compared to single-muscle group protocols (Marinelli et al. 2024).

3.2.4 Clinical Applications and Safety

Resistance training offers several advantages for clinical implementation, including precise load quantification, objective progression tracking, and reduced weather dependency compared to outdoor aerobic activities. The controlled structure of most resistance training programs makes it easier to observe adherence and technique, both of which are crucial from the perspective of safety and efficacy.

Socio-demographics, psychometrics and clinical characteristics, and health-related quality of life perceived by patients are among the key determinants that affect the dose-response relationship of resistance training and depression treatment (Augustin et al. 2023).

Varying levels of supervision, running, and equipment provisions in combination with self-scheduled sessions mark the boundary between unaided and aided sustaining criteria. Community-based and home-based resistance training programs which utilise bodyweight exercises or elastic bands may enhance accessibility without compromising efficacy.

3.3 High-Intensity Interval Training and Depression

In comparison to other forms of exercises, high intensity interval training (HIIT) has recently been adopted as a more time-effective approach for treating depression since it offers wonderful benefits in less time. Recent studies have shown that HIIT has equal or better antidepressant effects as moderate intensity continuous training, while taking lesser overall exercise time.

3.3.1 Efficacy and Comparative Effectiveness

Martland et al. (2022) has conducted a comprehensive systematic review and meta-analysis on the effects of HIIT on mental health from 58 randomised controlled trials. From their findings, we can conclude that HIIT resulted in moderate improvements in mental well-being (SMD: 0.418) and also resulted in a significant reduction in the severity of depression (SMD: -0.496) in comparison to the control conditions.

Borrega-Mouquinho et al. (2021) compared HIIT directly with moderate-intensity training (MIT) during COVID-19 confinement, finding that both interventions significantly reduced stress, anxiety, and depression whilst increasing resilience. Importantly, the HIIT group showed greater improvements in depression reduction compared to the MIT group, suggesting superior efficacy for this specific outcome.

Recent research has examined HIIT's effectiveness in specific clinical populations. Bang-Kittilsen et al. (2022) conducted a randomised controlled trial investigating HIIT in individuals with schizophrenia, finding that HIIT reduced depressive symptoms more than active video gaming controls. The effect persisted at four-month follow-up, with improvements potentially mediated through enhanced cardiorespiratory fitness (VO2max).

3.3.2 Mechanisms and Physiological Adaptations

The mechanisms underlying HIIT's antidepressant effects involve both shared and unique pathways compared to other exercise modalities. Xu et al. (2024) provided a comprehensive mechanistic analysis, identifying that HIIT's higher intensity produces more pronounced effects on BDNF levels compared to moderate-intensity exercise, potentially due to greater lactate accumulation and subsequent activation of neuroprotective pathways.

HIIT appears to influence stress response systems differently from continuous exercise. The intermittent nature of high-intensity efforts followed by recovery periods may better simulate natural stress-recovery cycles, potentially leading to improved stress resilience and emotional regulation (Borrega-Mouquinho et al. 2021).

Cardiovascular adaptations from HIIT may contribute to antidepressant effects through improved cerebral perfusion and enhanced delivery of oxygen and nutrients to brain regions involved in mood regulation. The rapid improvements in cardiorespiratory fitness observed with HIIT may provide early reinforcement that supports exercise adherence and psychological well-being.

3.3.3 Optimal Prescription and Safety Considerations

HIIT protocols for depression treatment typically involve exercise intensities of 85-95% of maximum heart rate or 15-17 on the Borg rating of perceived exertion scale, with work intervals lasting 15 seconds to 4 minutes followed by equal or longer recovery periods (Xu et al. 2024). The total session duration usually ranges from 15-30 minutes, making HIIT particularly attractive for individuals with time constraints.

The frequency of HIIT sessions for depression treatment appears optimal at 2-3 times per week, based on evidence from multiple studies. Programmes lasting 6-12 weeks show significant effects, though longer interventions may provide additional benefits for sustained mood improvements (Martland et al. 2022).

Safety considerations for HIIT in depression treatment include gradual progression for sedentary individuals, adequate warm-up and cool-down periods, and monitoring for

excessive fatigue or mood changes. While generally well-tolerated, HIIT may not be appropriate for all individuals with depression, particularly those with significant cardiovascular risk factors or severe symptom severity.

3.3.4 Special Populations and Clinical Applications

HIIT has been especially helpful in certain groups of people. In patients with heart disease and depression, Gu et al. (2022) discovered that HIIT worked much better than usual care or conventional aerobic work in improving depression symptoms. HIIT on the treadmill was proven to bring even greater benefits than its counterpart on the bicycle.

When people are exposed to difficult conditions such as the COVID-19 lockdown, HIIT is helpful for preserving mental well-being and avoiding depression. Therefore, these techniques might be useful both in preventing depression and in managing stress in addition to their role in therapies (Borrega-Mouquinho et al. 2021).

Since HIIT is quick, it is a good choice for people with busy schedules or who have little time to exercise. Because HIIT workouts are planned and intensive, they may interest people who like brief, higher intensity workouts rather than less intense exercises for longer periods.

3.4 Neurobiological Mechanisms

It has become clear in recent years that how exercise reduces depression involves interactions among several physiological processes. This information tells us how various kinds of physical activity can be therapeutic and aids in creating the best exercise programmes for treating depression.

3.4.1 Neurotrophic Factors and Neuroplasticity

Researchers now regard brain-derived neurotrophic factor (BDNF) as an important key in how exercise can treat depression. They point out that an exercise session can increase BDNF in the blood, yet more regular exercise can cause BDNF levels in the brain to remain elevated. Recently, researchers have explained how increased BDNF in the brain through exercise improves mood. They discovered that physical activity triggers growth in lactate levels in muscles which in turn stimulates Sirtuin-1 to release a larger amount of BDNF. This mechanism might be the reason that exercising at higher intensity causes stronger short-term BDNF increases than exercising at a moderate pace.

Besides increasing BDNF, exercise results in more growth of new neurons, mainly in the hippocampus. Staying active encourages the growth of brain cells and their connexions near

areas responsible for mood, learning and remembering things. Changes in various parts of the brain with exercise may be why exercise works long term for depression (Budde et al., 2024). Research has found that exercises can alter the structure of the brain using neuroimaging. According to Gujral et al. (2017), engaging in exercise causes the hippocampus to grow bigger, improves function in the prefrontal cortex and improves white matter quality in executive function and emotional processing parts of the brain. Such physical changes to the brain help reduce depressive symptoms and improve thinking capabilities.

3.4.2 Neurotransmitter Systems

Exercising has an effect on a number of neurotransmitters related to depression. Changes in the serotonin, norepinephrine and dopamine systems have been added to explain how exercise helps in depression. Acute exercise raises the amount and the processing of neurotransmitters in your brain, but chronic exercise may cause changes in receptors and their signalling methods (Ross et al. 2023).

Experts have discovered recently that neurotransmitters such as the endocannabinoid system exist. Exercise has been found by Meyer et al. (2019) to increase endocannabinoids in the blood which may be linked to both a boost in mood and the feelings often associated with running. There is interaction between the endocannabinoid system and other brain transmitters that affect stress levels and control emotions.

The timing of neurotransmitter responses to exercise varies by system and exercise characteristics. Acute elevations in serotonin and norepinephrine occur during and immediately following exercise, whilst longer-term adaptations in neurotransmitter function require weeks to months of consistent training. These temporal patterns may explain both the immediate mood benefits and sustained antidepressant effects of regular exercise participation.

3.4.3 Inflammatory and Immune System Modulation

Chronic inflammation has been increasingly recognised as a contributor to adolescent depression, with dysregulated neuroendocrine and neuroimmune systems playing a role. Exercise improves depressive symptoms by enhancing neurotransmitter activity and regulating inflammatory responses.

According to a comprehensive study and meta-analysis by Wang et al. (2022), physical activity—especially aerobic and combined resistance-aerobic exercise—very much reduces depressive symptoms. Reduced stress hormone levels (e.g., cortisol), enhanced brain plasticity, and higher neurotrophic factors all help to explain the antidepressant benefits.

Exercise provides a low-risk, efficient treatment for adolescent depression and also stimulates hippocampus regeneration and synaptic activity.

Exercise seems to have dose-dependent anti-inflammatory effects; moderate-intensity exercise generates the best results. Extreme or very high-intensity exercise may indeed raise inflammatory markers, implying an inverted U-shaped relationship between exercise intensity and inflammatory benefits (Athanasiou et al. 2023).

Yoga and tai chi are among mind-body exercises with especially significant anti-inflammatory properties; their combination of stress-reducing strategies with physical activity helps explain why. For people with depression marked by high inflammatory load (Wang et al. 2022), these methods could offer special advantages.

3.4.4 Neuroendocrine System Regulation

Often dysregulated in depression, exercise significantly affects the hypothalamic-pituitary-adrenal (HPA) axis. While exercise can help to normalise HPA-axis function, chronic stress and depression are linked with raised cortisol levels and decreased stress response.

Examining exercise effects on cortisol levels in people with depression, Wang et al. (2022) carried out a methodical review and meta-analysis; their results showed that consistent exercise helps to lower baseline cortisol levels and increase cortisol awakening response, so indicating better stress physiology.

Exercise's acute tension offers a kind of "stress inoculation" that might boost psychological stress tolerance. Regular exercise exposure results in modifications in stress response systems that generalise to non-exercise stressors, therefore perhaps explaining why physically active people show superior stress management and reduced depression risk (Ross et al. 2023).

Two further neuroendocrine mediators of the antidepressant benefits of exercise are growth hormone and insulin-like growth factor-1 (IGF-1). These hormones enhance metabolic health and help to stimulate neuroplasticity and neuroprotection. Regular physical activity has shown both neurobiological and physical health advantages; exercise-induced increases in growth hormone and IGF-1 could help to explain both.

3.5 Special Populations and Clinical Applications

Exercise therapies for depression are used rather differently depending on the population; hence, customised approaches including age-specific characteristics, concomitant diseases, and individual circumstances are necessary. Important new studies have shed light on ideal exercise recommendations for particular clinical populations and demographic groups.

3.5.1 Adolescents and Young Adults

Adolescence is a crucial time for the start of depression; in young groups, exercise programs show especially promise for both therapy and prevention. Examining exercise effects on depression in teenagers aged 12 to 18 years, Wang et al. (2022) performed a thorough systematic review and meta-analysis revealing notable advantages over several intervention modalities.

Exercise therapies shown modest effect sizes for depression reduction (SMD = -0.50), according to their study of 16 randomised controlled trials involving 1,067 participants. The most often used intervention was aerobic exercise; combination programs and resistance training also showed benefits. With sessions happening three times a week for 25 to forty minutes, the ideal programme length was 9 to 15 weeks.

Another significant population for exercise-based depression treatments are young adults. Eight weeks of resistance training, according to O'Sullivan et al. (2023), significantly lowered depressed symptoms among young individuals at-risk for high depression. Their results imply that, in the transition to maturity when depression risk is higher, resistance training might be especially beneficial.

Particularly relevant to neurodevelopmental processes, the mechanisms behind exercise benefits in young populations could be different from those in adults. Adolescent exercise can help to encourage good brain development and offer defence against next depression episodes. Through improved peer relationships and social support, social elements of exercise—including team sports and group activities—may offer young people more benefits.

3.5.2 Older Adults

Given the high frequency of late-life depression and the concurrent physical health advantages of exercise, older individuals are especially significant demographic for exercise-based depression treatments. Analysing data from several randomised controlled trials, Cunha et al. (2024) performed a comprehensive review and meta-analysis especially looking at resistance training impacts on mental health in older people.

With resistance training generating significant effect sizes for depression reduction (SMD = -0.94, 95% CI: -1.45 to -0.43), their results demonstrated notable advantages for both depressed and anxiety symptoms. Especially in elderly persons with current mental health issues (SMD = -2.15), the benefits were considerably more noticeable, implying especially specific efficacy for clinical settings.

The mechanisms behind the advantages of exercise for elderly people consist in several pathways connected to age-related changes. Exercise might prevent neurodegenerative processes, aid preserve cognitive ability, and offset age-related reductions in BDNF. Furthermore, the social elements of group fitness programs could assist in overcoming loneliness and isolation that are typical of older populations (Cunha et al. 2024).

Older persons' safety concerns include slow development, awareness of concomitant diseases, and adjustment of workouts to fit physical restrictions. While resistance training helps preserve muscle mass and functional independence critical for mental well-being, balance training components may be especially beneficial for fall prevention.

3.5.3 Clinical Populations with Severe Mental Illness

Exercise interventions have shown promise in individuals with severe mental illness, including schizophrenia, bipolar disorder, and major depressive disorder. Bang-Kittilsen et al. (2022) conducted a randomised controlled trial examining high-intensity interval training in individuals with schizophrenia, finding significant reductions in depressive symptoms compared to active controls.

Their study demonstrated that HIIT reduced depressive symptoms by 1.03 points more than the control condition, with effects persisting at four-month follow-up. The improvements appeared to be mediated through enhanced cardiorespiratory fitness, suggesting that fitness gains may be particularly important for individuals with severe mental illness who often have poor physical health.

Martland et al. (2020) assessed different mental health conditions and observed that severe illnesses should be monitored while participating in intense exercise. HIIT was just as practical and safe as doing moderate-intensity training continuously and it also allowed people to exercise in a shorter time and stay more interested.

When working with patients in clinical populations, medical supervision needs to be closer, medicines should be carefully selected and monitored and programmes should allow for cognitive issues or problems with motivation. For those who find it helpful to have set, short-term goals, HIIT’s well-organised programmes may be ideal.

3.5.4 Individuals with Comorbid Conditions

When depression occurs with other medical problems, the choice of exercises becomes important for handling all the problems at once. Apart from depression, people with cardiovascular disease may benefit from exercises to lessen both types of symptoms.

Gu et al. (2022) studied people with heart problems and depression and found that HIIT on a treadmill helped reduce depression, when compared to both usual care and regular aerobic training. Because exercise improves cardiovascular health, this is another reason for elderly patients to keep exercising and experience healthier lives.

Exercise is helpful for people with diabetes, because it improves blood sugar control and mood. Depressed people who are at greater metabolic risk might benefit the most from exercise's influence on how our bodies process glucose, among other things. Doing both physical exercises and adopting healthy eating habits seem to improve health overall.

Exercise programmes for cancer survivors can support them in dealing with depression and fatigue caused by cancer. Chen et al. (2024) proved that performing home-based walking exercises benefited people with lung cancer by managing depression, anxiety, cancer-related issues and improving quality of life.

3.5.5 Prevention and Early Intervention

Exercise is especially effective for preventing depression, mainly among people at high risk. Pearce et al. (2022) showed that people engaging in even a little physical activity less than the recommended guidelines had lower risk of depression and this effect got stronger as they were more active.

Exercise plays a key role in protecting people during vulnerable times, for example, when they are growing up, when they get pregnant, go through menopause or retire. Workouts carried out during pregnancy and after birth help both instantly with stress and later support a positive mood and good mental health.

Conducting physical activities in schools can help stop adolescent depression. Depression prevention programmes may be introduced in schools during physical education classes or offered after school, helping students stay active and live healthily which could benefit them for years.

Programmes at work that include exercises seem to be beneficial in preventing depression among adults. They can help with inactive workplaces, teach methods for managing stress and create groups where people can share their feelings which is all good for mental health.

4. CONCLUSIONS

4.1 Summary of Key Findings

By analysing recent studies, it is clear that exercise has effective role in preventing and treating depression. Studies carried out from 2020 to 2025 indicate that exercising is a very effective strategy for depression that supports and complements traditional approaches.

Aerobic exercise has strong effects against depression and its results are similar to those seen with main treatments. Based on data from many studies such as Heissel et al. (2023) and Noetel et al. (2024), depression reduction is found to be moderate to large, ranging from -0.496 to -1.156 standardised mean differences. From the study by Pearce et al. (2022), it was found that little exercise compared to public health standards still brings considerable mental health benefits and regular movement can help reduce depression significantly.

Resistance training is now being recognised as equivalent to aerobic activity, questioning the belief that only aerobic training boosts brain health. According to these researchers, high effect sizes (-1.06) were present in resistance trainingges, helping to decrease depressive symptoms either in young adults or in certain groups who need support. Because resistance training makes people feel more capable and accomplished, it works differently but very well with the health benefits of aerobic activities.

Entering into high-intensity exercising is a quick solution that can improve moods just like other exercise programmes. Martland et al. (2022) as well as Borrega-Mouquinho et al. (2021) demonstrated that those who practise HIIT tend to have moderate to large improvements in depression whilst investing less time than participants doing standard exercise programmes. The bigger benefits of HIIT for depression reduction compared to moderate-intensity exercise may make it a better option for those busy people who prefer vigorous exercise.

The ways the brain controls exercise-induced mood improvement involve different pathways that cooperate and assist each other in helping emotional balance. It has been shown recently that BDNF production grows, neurotransmitters become more functional, inflammation is reduced and the HPA-axis is rebalanced which are considered important mechanisms. The research explains why exercise is helpful in treatment and aids in developing the best intervention plans.

4.2 Clinical Implications and Recommendations

Based on the outcomes of this review, mental healthcare can more effectively include exercise activities as regular support for patients. Studies now prove that exercise can help people with mild to moderate depression, regardless of whether other treatments are used or not.

Doctors should not just prescribe medicines or psychotherapy, they should also consider exercise as a normal method of treating depression. Having protocols that follow FITT can help ensure similar exercise methods are implemented in every setting. Educating healthcare providers about exercise and behaviour change will play a key role in success with clinical integration.

The evidence supports multi-modal exercise programmes that combine different intervention types to maximise therapeutic benefits. Programmes incorporating both aerobic and resistance training components, potentially with HIIT elements, may provide optimal outcomes whilst accommodating individual preferences and limitations. The social benefits of group-based programmes should be emphasised, particularly for individuals who may benefit from peer support and reduced social isolation.

Healthcare systems should develop infrastructure to support exercise-based depression interventions, including partnerships with community fitness facilities, training of exercise specialists in mental health considerations, and development of referral pathways between mental health and exercise professionals. Integration of exercise interventions into existing mental health services can enhance treatment comprehensiveness whilst potentially reducing costs.

Prevention programmes targeting high-risk populations represent an important application of exercise interventions with significant public health implications. School-based programmes for adolescents, workplace wellness initiatives for adults, and community programmes for older adults can provide population-level prevention benefits whilst promoting broader health and well-being.

4.3 Research Limitations and Future Directions

While this review provides comprehensive evidence for exercise's role in depression prevention and treatment, several limitations and areas for future research should be acknowledged. The heterogeneity of study designs, populations, and intervention characteristics across the literature makes direct comparisons challenging and limits the precision of effect size estimates for specific intervention types.

Long-term follow-up studies are needed to better understand the sustainability of exercise-induced improvements in depression. Most studies included in this review examined interventions lasting 8-16 weeks with limited follow-up beyond intervention completion. Research examining the maintenance of benefits and optimal strategies for promoting long-term exercise adherence would inform clinical practice and programme design.

Dose-response relationships require further clarification, particularly regarding optimal combinations of frequency, intensity, and duration for different populations and depression severities. While general guidelines have emerged from the literature, individual variation in response suggests the need for more personalised approaches to exercise prescription based on specific patient characteristics and preferences.

Mechanistic research examining the neurobiological pathways underlying exercise's antidepressant effects remains incomplete. Future studies employing advanced neuroimaging techniques, genetic analysis, and biomarker assessment could provide deeper insights into individual differences in exercise response and inform personalised treatment approaches.

Implementation research examining real-world effectiveness of exercise interventions is needed to bridge the gap between efficacy demonstrated in controlled trials and effectiveness in routine clinical practice. Studies examining implementation barriers, facilitators, and strategies for healthcare system integration would support broader adoption of exercise-based interventions.

Comparative effectiveness research directly comparing exercise interventions to established treatments, including head-to-head trials with antidepressant medications and psychotherapy, would provide important evidence for treatment selection and sequencing decisions. Network meta-analyses comparing multiple treatment modalities can inform clinical guidelines and treatment algorithms.

4.4 Concluding Remarks

The evidence synthesised in this review strongly supports the integration of physical activity interventions into comprehensive approaches for depression prevention and treatment. The consistent findings across multiple exercise modalities, populations, and study designs demonstrate that exercise represents a robust, evidence-based intervention with effects comparable to established treatments whilst offering unique advantages including minimal side effects, concurrent physical health benefits, and high accessibility.

How exercise is believed to help depression is a result of neighbouring changes in biology, psychology and social life. The use of multiple exercise methods is different from using drugs or psychotherapy alone, so exercise interventions may get even better results if worked with treatments from other healthcare areas.

Because exercise interventions can be customised, they suit each person’s tastes and needs while still staying effective in treatment. It helps healthcare workers serve patients in the right way without preset limits.

These results point to preventive methods that can be introduced to communities to sharply decrease depression in many people around the globe. Because they are simple and affordable, these exercise programmes are perfect for situations where funding and special therapists are rare.

All concerned parties should realise that exercise should be seen as an important medical approach for depression, just like other proven forms of treatment. Including exercise prescription in mental healthcare could greatly improve treatments, save money on healthcare and benefit people's overall health.

Further studies ought to concentrate on finding better ways to put exercise interventions into practise, adjust treatments for various types of clients and build lasting ways to implement them for a large group of people. As we discover more about how exercise helps depression, this information will allow us to improve our treatments and give better results to those dealing with depression.

This review provides sufficient proof that every comprehensive mental healthcare plan should include regular exercise. From now on, it is important to introduce exercise as an intervention into usual clinical care to help prevent and treat depression more effectively, comprehensively and easily.

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