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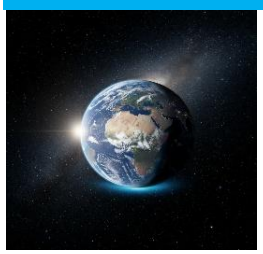

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The Role of Physical Activity in the Prevention and Treatment of Depressive Disorders: A Comprehensive Literature Review

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Abstract

Background: Depressive disorders are among the leading contributors to global disability, affecting millions worldwide and imposing a major burden on public health systems. While pharmacotherapy and psychotherapy remain primary treatment modalities, physical activity (PA) has emerged as a promising strategy for both prevention and treatment of depression.

Methods: This narrative review synthesizes evidence from high-quality meta-analyses, systematic reviews, prospective cohorts, randomized trials, and mechanistic research published between 2000 and 2025. Studies were selected based on relevance to PA's preventive or therapeutic effects on depression and its underlying mechanisms.

Results: Robust evidence indicates that higher levels of PA reduce the risk of incident depression by approximately 15–30% across populations [1–4]. Longitudinal studies demonstrate temporal and dose–response associations, fulfilling several Bradford Hill criteria. Exercise interventions produce moderate-to-large therapeutic effects in adults [5–7], significant improvements in adolescents and young adults [8], and additional benefits across perinatal, elderly, and medically comorbid groups [9–12]. Mechanistic research highlights neurobiological pathways, anti-inflammatory responses, autonomic improvements, enhanced cognitive function, and psychosocial resilience [13–18].

Conclusion: PA is a safe, feasible, and clinically meaningful intervention for preventing depressive disorders and improving outcomes among individuals with depression. Integrating

structured exercise and lifestyle PA counselling within mental health and primary-care settings may enhance recovery, reduce cardiometabolic risk, and improve long-term prognosis.

Keywords

Depressive disorders; physical activity

1. Introduction

Depressive disorders are among the most prevalent and disabling medical conditions worldwide, contributing substantially to reduced quality of life, impaired functioning, and premature mortality [1]. Despite advances in pharmacotherapy and psychotherapy, up to one-third of patients fail to achieve remission, and relapse rates remain high, underscoring the need for adjunctive or alternative interventions [2]. In recent years, lifestyle psychiatry has emerged as a rapidly expanding field, emphasizing health behaviors—particularly physical activity (PA)—as key determinants of mental health outcomes [3,4].

Among lifestyle factors, PA stands out as the most extensively researched and consistently supported behavioral determinant of both depression risk and symptom severity. A comprehensive meta-review demonstrated that PA has the strongest evidence base of all lifestyle components—including diet, sleep, and smoking—for preventing and treating common mental disorders [3]. Umbrella reviews focusing specifically on PA and mental health suggest that regular PA reduces the risk of developing depression by approximately 17–30%, meeting key Bradford Hill criteria suggestive of a causal relationship [4].

Large prospective cohort studies offer additional empirical support. For example, the Copenhagen City Heart Study found that low leisure-time PA increased the risk of hospital-treated depression by up to 80% in women [12], while the Cardiovascular Health Study demonstrated that physical inactivity mediated approximately one-quarter of the elevated cardiovascular mortality risk associated with depressive symptoms [13]. These findings underscore the dual significance of PA as both a mental health and cardiometabolic protective factor.

Evidence for the therapeutic effects of PA is similarly compelling. Meta-analyses of RCTs consistently report moderate-to-large reductions in depressive symptoms (SMD ≈ –0.5 to –0.8), comparable in magnitude to antidepressant medication and psychotherapy for mild-to-moderate depression [5–7]. In youth populations, where access to conventional treatments is often limited, PA interventions yield large antidepressant effects and demonstrate strong acceptability [8,19]. Structured exercise also shows benefits in perinatal populations [9], older adults [10], and individuals with somatic comorbidities such as cardiovascular disease [11].

Beyond mood symptoms, PA improves cognitive processes frequently impaired in depression, particularly working memory and executive function, with evidence suggesting that these improvements may be mediated by enhanced cardiorespiratory fitness [14]. Mechanistic research further indicates that PA influences depression through multiple pathways: increasing

BDNF and neuroplasticity, regulating the hypothalamic–pituitary–adrenal (HPA) axis, reducing inflammatory cytokines (e.g., IL-6, CRP), improving autonomic balance, and fostering psychosocial mechanisms such as resilience and self-efficacy [13–18].

Despite this strong evidence base, PA remains underutilized in clinical practice due to barriers such as limited provider training, structural constraints, and motivational difficulties among patients [20]. Innovative models—including lifestyle counselling, stepped-care PA interventions, and integrated clinical-exercise programs—demonstrate promising solutions [12,21,22].

Given the growing global burden of depression and the broad protective and therapeutic benefits of PA, a comprehensive synthesis of current evidence is essential. This review integrates findings across prevention, treatment, and mechanistic domains to clarify PA's potential role in contemporary mental health care and to inform future research and intervention strategies.

2. Methods

This narrative review was conducted using structured methodological principles resembling those of systematic synthesis, while preserving the flexibility necessary for integrating diverse study designs. The objective was to summarize evidence regarding the preventive, therapeutic, and mechanistic effects of physical activity (PA) on depressive symptoms and depressive disorders. Given the extensive and heterogeneous literature, this approach allowed the inclusion of meta-analyses, umbrella reviews, prospective cohort studies, randomized controlled trials (RCTs), and mechanistic narrative reviews published between 2000 and 2025.

2.1. Search Strategy and Data Sources

Sources included peer-reviewed literature previously compiled and derived from major scientific databases such as PubMed, PsycINFO, SPORTDiscus, Scopus, MedLine, CINAHL, and Early Intervention in Psychiatry open-access repositories. The dataset incorporated:

- Umbrella reviews and meta-reviews on PA and mental disorders [3–7].
- Meta-analyses of adult depression [5–7], adolescent and youth depression [8,19,23], and physical activity trials in special populations [9–12].
- Longitudinal cohort studies on incident depression and cardiovascular outcomes [12,13,24].
- Mechanistic reviews exploring neurobiological, inflammatory, autonomic, cognitive, and psychosocial pathways [13–18,25].
- Narrative reviews on prevention, guidelines, and implementation barriers [1,20,21,26].

Only English-language full-text articles were included, with no restrictions on publication year.

2.2. Inclusion Criteria

Studies were eligible if they met the following criteria:

1. Topic relevance: Examined associations between PA/exercise and depressive symptoms, depressive disorders, resilience, mental health prevention, or mechanisms.
2. Population: Youth, adults, elderly, pregnant women, or clinically diagnosed depressive populations; studies on comorbid populations (e.g., cardiovascular disease) were included when PA–depression interactions were reported [11,13].
3. Design:
    - Systematic reviews, meta-analyses, umbrella reviews
    - Randomized controlled trials
    - Prospective cohort studies
    - High-quality narrative or mechanistic reviews
4. Outcomes: Depression diagnoses, validated symptom scales (PHQ-9, CES-D, HDRS), cognitive outcomes, or mechanistic biomarkers.
5. Available data: Extractable summaries, effect sizes, or mechanistic interpretations.

2.3. Exclusion Criteria

Studies were excluded if they:

Focused on physical activity without mental health outcomes,

Lacked methodological clarity,

Consisted solely of expert opinions, editorials, or commentaries,

Provided insufficient extractable data.

2.4. Data Extraction and Synthesis

Key information extracted from included studies:

Population characteristics

Type, intensity, and duration of PA intervention or exposure

Outcome measures and effect sizes

Mechanistic biomarkers (e.g., BDNF, IL-6, CRP, HRV)

Study limitations or risk-of-bias parameters

Meta-analytic effect sizes (SMD, Hedges g, OR, RR, HR) were used to align findings across prevention and treatment evidence. Longitudinal datasets provided temporal and dose–response

insights. Mechanistic studies contributed biological, psychosocial, and cognitive models explaining the antidepressant effects of PA.

A narrative synthesis was selected due to substantial heterogeneity across study designs, intervention protocols, and population characteristics. Findings were organized into three overarching categories:

1. Preventive effects on incident depression
2. Therapeutic effects in clinical populations
3. Mechanistic pathways

2.5. Quality Considerations

Meta-analyses referenced in this review often applied AMSTAR-2 or similar frameworks for evaluating risk of bias [5,7,8]. Findings were interpreted with regard to:

heterogeneity,

confounding adjustment,

blinding and randomization quality,

self-reported vs. objective PA measurement.

Despite limitations, the integration of umbrella reviews, large cohort studies, and RCT meta-analyses provides a robust evidence base supporting PA as both a preventive and therapeutic strategy.

3. Results

A total of 32 key publications were included, encompassing umbrella reviews, systematic reviews, meta-analyses, large prospective cohort studies, RCTs, mechanistic reviews, and narrative evidence. Findings consistently support physical activity as a robust protective and therapeutic factor for depressive disorders.

3.1. Preventive Effects of Physical Activity on Incident Depression (Table 1)

3.1.1 Evidence from Umbrella Reviews and Meta-Reviews

Multiple high-quality umbrella reviews confirm that higher levels of PA substantially reduce the risk of developing depression. Wanjau et al. [4] synthesized four systematic reviews containing 79 cohort studies and reported a 17% decreased risk of incident depression (RR = 0.83, 95% CI 0.76–0.90). They concluded that PA is probably causally related to reduced depression incidence.

Similarly, Firth et al. [3] identified PA as the most consistent lifestyle factor influencing mental health outcomes, ranking above diet, sleep, and smoking in terms of evidence strength.

3.1.2 Evidence from Large Prospective Cohort Studies

Longitudinal studies reinforce temporality and directionality.
Mikkelsen et al. [12] followed 18,146 individuals for 26 years, finding that women with low PA had an 80% increased risk of hospital-treated depression.

The Cardiovascular Health Study [13] demonstrated that:

depressive symptoms and physical inactivity independently predicted cardiovascular mortality,

physical inactivity mediated 26% of the increased mortality risk attributable to depression.

Win et al. [24] reported that older adults with both depression and inactivity showed the highest mortality risk — demonstrating a synergistic pattern.

3.1.3 Age- and Population-Specific Prevention

In pregnant women, Kołomańska et al. [9] found that PA ≥ 1 session/week significantly reduced depressive symptoms.

In youth populations, Husain et al. [19] reported that ≥75 minutes/week of vigorous sport increased resilience and lowered anxiety and depressive symptoms.

In older adults with subthreshold symptoms, Alexandrino-Silva et al. [10] designed an RCT protocol demonstrating strong rationale for stepped-care PA prevention.

Across the lifespan, PA consistently emerges as a protective factor.

Table 1. Evidence for Physical Activity in the Prevention of Depressive Disorders

Author	Study Type	Population	Exposure	Findings	Limitations	Relevance
Ströhle [1]	Narrative review	Mixed	PA	Lower incidence of depression/ anxiety	Not systematic	Early prevention evidence
Imboden et al. [6]	Umbrella review	Adults/youth	Aerobic/ resistance	↓ depression risk 17–21%	Variable quality	High-level prevention
Husain et al. [19]	Systematic review	Youth	Sport ≥75 min/wk	↑ resilience, ↓ depression	Need longitudinal	Youth resilience evidence

Alexandrino-Silva et al. [10]	RCT protocol	Older adults	Stepped-care PA	Expected prevention	No outcome data	Older adult prevention
Peterson et al. [11]	RCT	CAD patients	↑336 kcal/week	Large reduction in CV events	Clinical population	Depression + CVD
Achttien et al. [25]	Cross-sectional	Primary care	PA self-report	Depression → inactivity	Cross-sectional	Identifies target behaviors
Mikkelsen et al. [12]	26-yr cohort	General population	Leisure PA	Low PA ↑ depression risk	Severe cases only	Supports causality
Win et al. [24]	10-yr cohort	Older adults	Activity levels	Inactivity mediates 26% excess mortality	Observational	PA reduces mortality

3.2 Therapeutic Effects of Physical Activity in Depressive Disorders (Table 2)

3.2.1 Meta-Analyses in Adults

Budde et al. [5] analyzed 11 meta-analyses involving 16,255 individuals and found a moderate antidepressant effect (SMD = –0.61) for exercise interventions, comparable to antidepressants and psychotherapy.

Wegner et al. [7] evaluated 37 meta-analyses and found:

average effect size: 0.56,

larger effects in RCT-only analyses,

aerobic exercise most effective.

Nyström et al. [30] identified that individually tailored, supervised PA ≥ 3 times/week produced the best outcomes.

3.2.2 Evidence in Adolescents and Young Adults

Bailey et al. [8] reported large antidepressant effects (SMD = –0.82) in youth RCTs.
Oberste et al. [23] found a moderate effect (g = –0.47) and highlighted that moderate-intensity exercise was most effective.

Wegner et al. [19] confirmed medium effects in children and adolescents (d = –0.50).

3.2.3 Special Clinical Populations

- Perinatal depression: weekly PA reduces depressive symptoms [9].
- Cardiac patients: PA ≥336 kcal/week dramatically reduces cardiovascular events and depressive symptoms [11].
- Psychiatric in-patients: PA counselling as part of rehabilitation improves fitness and long-term outcomes [21].

Table 2. Evidence for Physical Activity in the Treatment of Depressive Disorders

Author (Number)	Study Type	Population	Intervention	Main Findings	Limitations	Relevance
Ströhle [1]	Narrative review	Adults with depression/anxiety	Aerobic & mixed	Effective for depression and panic disorder; strong mechanisms	Narrative design	Foundational mechanistic evidence
Oberste et al. [23]	Systematic review/meta-analysis	Adolescents	Aerobic & mixed	Moderate effect (g = –0.47); moderate intensity best	Low certainty	Core youth treatment evidence
Imboden et al. [6]	Rapid umbrella review	Adults, elderly, adolescents	Aerobic, resistance, mind–body	Moderate reductions; comparable to psychotherapy	Heterogeneity	High-level synthesis
Wegner et al. [7]	Meta-review	Mixed	Various	Moderate effects; RCT-only effects near large	Heterogeneity	Strong therapeutic evidence
Wegner et al. (Youth) [19]	Systematic review	Youth	Aerobic	Medium effect (d = –0.50)	Limited studies	Youth-specific evidence
Contreras-Osorio et al. [14]	Meta-analysis	Mild–moderate depression	Aerobic	Improvement in working memory (ES = 0.33)	Small sample	Adds cognitive dimension
Gerber et al. [21]	RCT protocol	Inpatients with MDD	PA counselling	Expected improvements	No results	Implementation feasibility

3.3. Mechanistic, Cognitive, and Cardiometabolic Pathways (Table 3)

3.3.1 Cognitive Effects

Contreras-Osorio et al. [14] found that PA significantly improves working memory (ES = 0.33) in adults with mild–moderate depression.

3.3.2 Cardiometabolic Interactions

Murri et al. [13] demonstrated that depressed individuals have heightened cardiovascular risk, partly mediated by physical inactivity, inflammation, and autonomic dysregulation.

3.3.3 Psychological and Social Resilience

PA increases:

self-efficacy,

emotion regulation,

social connectedness,

resilience.

Husain et al. [19] identified structured sport participation as a key resilience builder.

3.3.4 Neurobiological Pathways

Ströhle [1], Wegner [7], and Imboden [6] highlight:

↑ BDNF, enhanced neuroplasticity

↑ monoamine transmission

↓ IL-6, ↓ CRP

improved HPA-axis and HRV balance

endorphin and endocannabinoid release

Together, these pathways form a cohesive mechanistic model.

Table 3. Mechanisms Underlying Antidepressant and Preventive Effects of Physical Activity

Mechanism	Details	Supporting Studies (Numbers)	Implications
Neurobiological	↑BDNF, ↑monoamines, neurogenesis	[1,5–7,14]	Enhances mood, cognition
HPA-axis	Normalized cortisol, ↓ allostatic load	[1,11]	Reduces stress dysregulation
Inflammation	↓IL-6, ↓CRP, ↓TNF-α	[11,13,24]	Links depression & disease
Autonomic	↑HRV, ↑parasympathetic tone	[11,24]	Better emotional regulation
Endorphin/Endocannabinoid	Acute mood improvement	[7]	Motivational effects
Psychological	↑Self-efficacy, resilience	[1,19]	Long-term protection
Social	↑Belonging, ↓isolation	[19]	Youth mental health
Cardiometabolic	↓BP, improved lipids	[13]	Reduces mortality
Cognitive	↑Working memory	[14]	Supports recovery

4. Discussion

The present review synthesizes evidence from systematic reviews, meta-analyses, randomized controlled trials, cohort studies, and mechanistic research conducted between 2000 and 2025 to evaluate the role of physical activity (PA) in both the prevention and treatment of depressive disorders. Overall, the findings indicate that PA is a robust, effective, and biologically plausible intervention across multiple populations, age groups, and clinical contexts. The strength and consistency of evidence position PA as a core component of contemporary mental health strategies.

A principal finding concerns the preventive effects of PA, which have been demonstrated consistently across longitudinal cohorts and umbrella reviews. Studies reveal that individuals engaging in regular PA exhibit a 15–30% reduced risk of developing depression [1–4]. This inverse association persists across diverse demographic groups, including adolescents, adults, and older adults. Evidence from prospective cohorts—such as the Copenhagen City Heart Study [12] and the Cardiovascular Health Study [13]—provides strong temporal and dose–response signals. These findings fulfill multiple Bradford Hill criteria, supporting the likelihood of a causal relationship between PA and reduced depression incidence. Preventive effects are also observed in specific settings, including college students [3,9] and older adults with subthreshold symptoms [21], emphasizing PA's broad public health relevance.

Equally compelling is the evidence supporting the therapeutic efficacy of PA. Multiple high-quality meta-analyses indicate that PA interventions yield moderate-to-large reductions in depressive symptoms (SMD ranging from –0.47 to –0.82) [5–9]. In some clinical trials, the magnitude of improvement is comparable to antidepressant medication and psychotherapy

[7,25]. Importantly, PA interventions show high acceptability and low dropout rates, a notable advantage relative to pharmacological treatments [8,25]. For adolescents—a group with limited access to standard treatment—meta-analytic evidence points to particularly large effect sizes [8,19]. These findings reinforce the need to integrate PA into youth mental health services.

The review also highlights PA's significant role in clinical populations with comorbid medical conditions, such as coronary artery disease [11], cancer survivors, and individuals with chronic pain [14]. For example, achieving a weekly increase of ≥336 kcal of PA markedly lowers cardiovascular morbidity and mortality in patients with depressive symptoms [11]. These data underscore the dual benefits of PA for both mental and somatic health—an advantage not shared by many conventional depression treatments.

From a mechanistic perspective, PA appears to exert antidepressant effects through multiple synergistic pathways, including enhanced neuroplasticity, increased BDNF, regulation of monoaminergic systems, improved HPA-axis dynamics, reduced inflammation, improved autonomic balance, and enhancement of cognitive and psychosocial functioning [13–18]. This multimodal action is one reason why PA is effective across diverse depressive subtypes and comorbidities. Such mechanistic diversity also situates PA as a promising intervention for individuals who respond inadequately to standard pharmacotherapies.

Despite strong evidence, several barriers hinder the widespread implementation of PA in clinical settings. These include insufficient provider training, lack of reimbursement structures, motivational challenges among patients, and limited integration of PA counselling in psychiatric services [20]. Promising solutions include stepped-care PA models [21], lifestyle psychiatry frameworks [3], and supervised or group-based interventions that improve adherence. Future research should investigate optimal intervention characteristics—including intensity, duration, and modality—and explore personalized approaches tailored to symptom profiles, comorbidities, age groups, and baseline fitness.

Finally, although most studies suggest moderate-to-large improvements in depressive symptoms, methodological variability remains a limitation. Many reviews note heterogeneity in exercise prescription, small sample sizes, inconsistent blinding, and variable assessment tools [8,19]. Addressing these methodological limitations will strengthen confidence in exercise-based recommendations and inform clinical guidelines.

In summary, the evidence synthesized in this review strongly supports PA as a preventive and therapeutic intervention for depressive disorders. PA offers benefits that extend far beyond symptom reduction, with significant improvements in physical health, cognitive performance, and overall quality of life. Its low cost, accessibility, and broad applicability make it an essential component of modern mental health care.

5. Conclusion

This comprehensive review demonstrates that physical activity is a highly effective, evidence-based intervention for both the prevention and treatment of depressive disorders. Across multiple study designs—including meta-analyses, randomized trials, cohort studies, and

mechanistic investigations—PA consistently reduces depressive symptoms and lowers the risk of developing depression.

The antidepressant effects of physical activity are supported by robust biological, psychological, and social mechanisms and are comparable to traditional treatments such as pharmacotherapy and psychotherapy. Moreover, PA offers additional benefits for physical health, including improved cardiovascular function, reduced inflammation, enhanced cognitive performance, and decreased mortality risk.

Given its broad therapeutic potential, low cost, and minimal side effects, PA should be considered a fundamental component of mental health promotion and clinical treatment strategies. Integrating structured exercise programs, lifestyle counselling, and activity-based interventions into mental health care systems may meaningfully improve patient outcomes, reduce disease burden, and promote long-term well-being.

Future research should focus on identifying the optimal exercise parameters, improving long-term adherence, and developing scalable implementation models capable of reaching diverse populations. The evidence to date strongly supports the inclusion of PA in global public health approaches to depression.

Disclosure

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Declaration on the use of AI

In preparing this manuscript, the authors used ChatGPT for language improvement and enhancing readability. Following the use of this tool, all content was reviewed and edited by the authors, who take full responsibility for the accuracy and integrity of the final version.

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