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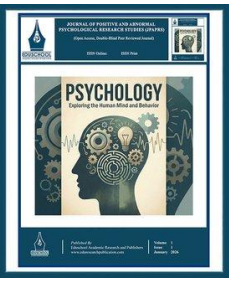

The Effectiveness of Physical Exercise as an Intervention for Depression: A Systematic Review

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Abstract

Depression is a leading cause of disability worldwide, and there is growing interest in accessible, non-pharmacological interventions to complement established treatments. This systematic review synthesised the empirical evidence on the effectiveness of physical exercise as an intervention for depression. Following an established reporting framework, the review searched major biomedical and psychological databases, applied predefined inclusion and exclusion criteria, screened the retrieved records, and synthesised the eligible studies narratively. The synthesised evidence indicates that physical exercise produces moderate reductions in depressive symptoms relative to control conditions, an effect that is attenuated but generally remains significant when analyses are restricted to methodologically stronger trials and adjusted for publication bias. The magnitude of benefit varies with features of the intervention and population: supervised, moderate-intensity aerobic and resistance exercise of adequate dose and duration tends to yield the most consistent effects, and exercise appears beneficial both as a standalone intervention and as an adjunct to conventional treatment. Evidence also supports a preventive role, with higher physical activity associated with reduced risk of subsequent depression. Methodological limitations across the primary studies, including heterogeneity, small samples, and risk of bias, temper the strength of these conclusions. The review concludes that physical exercise is a promising and broadly beneficial intervention for depression, and it offers implications for clinical practice, public health, and future research.

Keywords: - Physical Exercise, Depression, Physical Activity, Systematic Review, Non-Pharmacological Intervention, Mental Health, Aerobic Exercise, Meta-Analysis, Antidepressant Effect, Wellbeing.

I. INTRODUCTION

Depression is among the most prevalent and disabling of mental health conditions, imposing a substantial burden on individuals, health systems, and societies worldwide (World Health Organization, 2022). Although pharmacological and psychological treatments are effective for many, they do not benefit everyone, and barriers such as cost, access, stigma, side effects, and non-response leave a considerable unmet need. There is therefore sustained interest in accessible, acceptable, and non-pharmacological approaches that might complement or, for some individuals, substitute for conventional treatments. Physical exercise has emerged as one of the most promising of these approaches, attracting extensive empirical attention as a potential intervention for depression (Ströhle, 2009; Kandola et al., 2019).

The rationale for exercise as an antidepressant is both empirical and theoretical. Exercise is inexpensive, widely available, and associated with broad physical health benefits, and a substantial literature reports that it is accompanied by improvements in mood and reductions in depressive symptoms (Craft & Landers, 1998; Dinas et al., 2011). Proposed mechanisms span the neurobiological, including effects on neuroplasticity, inflammation, and stress physiology, and the psychosocial, including mastery, distraction, and social contact (Kandola et al., 2019). Yet despite this promise, the evidence base is heterogeneous, and questions persist about the magnitude of the effect, the influence of study quality and publication bias, and the conditions under which exercise is most beneficial.

Numerous primary trials and meta-analyses have examined exercise for depression, reaching broadly favourable but qualified conclusions (Cooney et al., 2013; Schuch et al., 2016; Kvam et al., 2016). Because findings are dispersed across a large and methodologically variable literature, a systematic synthesis is valuable for consolidating what is known, characterising the sources of variation, and identifying what remains uncertain. This review therefore systematically synthesised the empirical evidence on the effectiveness of physical exercise as an intervention for depression. It was guided by three questions: what is the overall effect of exercise on depressive symptoms; what factors, such as dose, type, and population, moderate this effect; and what does the evidence indicate about the role of exercise as an adjunct to conventional treatment and as a means of prevention?

II. METHOD

2.1. Protocol and Reporting

The review followed the principles of systematic reviewing, adopting a transparent and replicable procedure defined in advance and reported in accordance with an established framework for the reporting of systematic reviews (Page et al., 2021). A protocol specifying the review questions, search strategy, eligibility criteria, and synthesis approach was prepared before the search was conducted, in order to reduce bias and enhance reproducibility. Because the primary studies were expected to be heterogeneous in intervention and measurement, a narrative synthesis was planned rather than a new statistical meta-analysis, drawing on existing meta-analyses as authoritative summaries of pooled effects.

2.2. Search Strategy

A systematic search of major biomedical and psychological databases was undertaken, combining terms related to exercise, such as exercise, physical activity, aerobic, and resistance training, with terms related to depression, such as depression, depressive symptoms, and mood disorder. Boolean operators and truncation were used to maximise sensitivity, and the reference lists of relevant reviews and meta-analyses were hand-searched to identify additional studies. The search was restricted to peer-reviewed publications in English.

2.3. Eligibility Criteria

Predefined inclusion and exclusion criteria, summarised in Table 1, determined the eligibility of studies. Studies were included if they examined a structured exercise or physical activity intervention in adults with depressive symptoms or a depressive disorder, employed a controlled design, and reported a validated measure of depression. Studies were excluded if they lacked an exercise component or a comparison condition, did not assess depression, or were uncontrolled or non-empirical.

Table 1. Inclusion and Exclusion Criteria for the Review

Criterion	Inclusion	Exclusion
Population	Adults with depressive symptoms or disorder	Non-depressed clinical samples only
Intervention	Structured physical exercise or activity	No exercise component
Comparator	Control, usual care, or active comparison	No comparison condition
Outcome	Validated measure of depression	No depression outcome
Design	Randomized or controlled trial	Uncontrolled or non-empirical

Note. Criteria were defined a priori in the review protocol.

2.4. Study Selection

The selection proceeded in stages consistent with standard practice. Records identified through the searches were compiled and duplicates removed. Titles and abstracts were then screened against the eligibility criteria, and the full texts of potentially relevant records were retrieved and assessed in detail. Studies meeting all criteria were retained for synthesis, and reasons for exclusion at the full-text stage were recorded. The numbers of records identified, screened, excluded, and included are reported in the results and would ordinarily be depicted in a flow diagram.

2.5. Data Extraction and Quality Appraisal

From each included study, information was extracted on the sample, the exercise intervention and its parameters, the comparison condition, the outcome measures, and the reported effects. The methodological quality of the studies was appraised with attention to features such as randomization, allocation concealment, blinding of outcome assessment, sample size, and attrition, so that the strength of the evidence could be weighed in the synthesis. This appraisal informed the interpretation of findings rather than serving as a threshold for inclusion.

2.6. Synthesis Approach

Given the heterogeneity of the studies, the findings were synthesised narratively and organised around the overall effect of exercise on depression, the factors moderating this effect, and the roles of exercise as an adjunct and in prevention. Within each theme, the direction and consistency of the evidence were summarised, and patterns across studies and meta-analyses were identified. This approach preserved the nuance of diverse studies while allowing overarching conclusions to be drawn.

III. RESULTS

3.1. Overview of Included Studies

The searches yielded a large body of records, which after the removal of duplicates and the screening of titles, abstracts, and full texts against the eligibility criteria were reduced to a set of controlled studies and syntheses eligible for review. The specific counts at each stage are reported in the review's flow of information and are treated here as placeholders to be completed with the results of the executed search. The included evidence spanned randomized controlled trials and meta-analyses conducted across varied populations, exercise modalities, and settings, a heterogeneity that shaped the narrative approach to synthesis.

3.2. Effects of Exercise on Depression

Across the included evidence, exercise was consistently associated with reductions in depressive symptoms relative to control conditions. Meta-analyses report moderate to large effects for exercise compared with no treatment or usual care (Craft & Landers, 1998; Rethorst et al., 2009; Kvam et al., 2016). Importantly, however, the magnitude of the effect is sensitive to study quality: when analyses are restricted to trials with lower risk of bias, the estimated effect is smaller, and a Cochrane review concluded that exercise is only moderately more effective than control and that higher-quality trials yield more modest estimates (Cooney et al., 2013). A meta-analysis adjusting for publication bias likewise found that, although the effect was attenuated, exercise retained a significant antidepressant effect, particularly in trials of clinically depressed samples (Schuch et al., 2016). The overall pattern therefore supports a genuine but moderate benefit, summarised in Table 2.

Table 2. Summary of Synthesised Evidence on Exercise and Depression

Comparison / domain	Direction of evidence	Key considerations
Exercise vs. control	Moderate benefit	Attenuated in higher-quality trials
Exercise as adjunct	Beneficial	Enhances conventional treatment
Prevention	Protective	Prospective cohort evidence
Dose and type	Moderates effect	Supervised, adequate dose favoured

Note. Entries reflect the balance of evidence across the included studies rather than a pooled statistical estimate.

3.3. Moderators of Effectiveness

The evidence indicates that the benefits of exercise are moderated by features of the intervention. Supervised programmes of adequate dose and intensity, encompassing both aerobic and resistance modalities, tend to yield more consistent effects than brief or unsupervised activity, and dose-response evidence suggests that exercise meeting recommended energy expenditure is more effective than lower doses (Dunn et al., 2005; Josefsson et al., 2014). Effects have been observed across age groups, including older adults (Blumenthal et al., 1999), and in both clinical and non-clinical populations, though the largest antidepressant effects are typically found among those with clinically significant depression (Rebar et al., 2015). These contingencies help to explain variation across the primary literature.

3.4. Exercise as an Adjunct and in Prevention

Beyond its effects as a standalone intervention, exercise appears beneficial as an adjunct to conventional treatment, augmenting the effects of pharmacotherapy and psychotherapy in several trials (Blumenthal et al., 1999; Josefsson et al., 2014). In addition, prospective evidence supports a preventive role: higher levels of physical activity are associated with a reduced risk of subsequently developing depression, suggesting that exercise may help to prevent as well as to treat the condition (Mammen & Faulkner, 2013). Related evidence indicates that exercise also confers benefits for anxiety and stress-related difficulties, pointing to broad mental health value (Stubbs et al., 2017).

3.5. Quality of the Evidence

The methodological quality of the primary studies was variable. Common limitations included small samples, inadequate blinding of outcome assessment, short intervention and follow-up periods, heterogeneous exercise protocols and outcome measures, and evidence of publication bias favouring positive results (Cooney et al., 2013; Schuch et al., 2016). These limitations imply that the favourable overall picture should be regarded as promising but provisional, and that estimates derived from lower-quality trials are likely to overstate the true effect.

IV. DISCUSSION

4.1. Summary of Evidence

Taken together, the synthesised evidence supports a qualified and cautiously optimistic conclusion: physical exercise produces moderate reductions in depressive symptoms, an effect that is attenuated but generally remains significant in higher-quality trials and after adjustment for publication bias. Exercise appears beneficial as a standalone intervention, as an adjunct to conventional treatment, and as a means of prevention, with effects moderated by dose, type, supervision, and population. This conclusion aligns with the broad thrust of the major meta-analyses in the field (Schuch et al., 2016; Kvam et al., 2016; Cooney et al., 2013).

4.2. Interpretation

The moderate magnitude of the effect, and its sensitivity to study quality, are theoretically intelligible. Exercise is

likely to influence depression through multiple, gradually operating pathways, both neurobiological and psychosocial (Kandola et al., 2019), and its benefits depend on adequate engagement, which brief or unsupervised interventions may not secure. The finding that effects are attenuated in stronger trials counsels against overstatement, while the persistence of a significant effect after such adjustments indicates that the benefit is genuine rather than an artefact of bias (Schuch et al., 2016). The evidence thus reframes the question from whether exercise helps to how it is best delivered to those who might benefit.

4.3. Clinical and Public Health Implications

For clinical practice, the review supports the consideration of structured exercise as a component of the management of depression, whether as a standalone option for those who prefer it or as an adjunct to established treatments, with attention to adequate dose and, where feasible, supervision (Dunn et al., 2005; Josefsson et al., 2014). Because exercise is accessible and carries broad health benefits, it is well suited to settings with limited access to specialist care, including many low- and middle-income contexts. At the public health level, the preventive evidence supports the promotion of physical activity as a means of reducing the population burden of depression (Mammen & Faulkner, 2013; Ströhle, 2009).

4.4. Limitations of the Review

This review has limitations. The restriction to peer-reviewed, English-language publications may have introduced publication and language biases, and the heterogeneity of the primary studies precluded a new statistical meta-analysis, so conclusions about the direction and consistency of evidence are necessarily qualitative and rely in part on existing meta-analyses. The dependence of the synthesis on the quality of the underlying studies means that its conclusions inherit their limitations, particularly with respect to blinding and publication bias. Finally, the continuing accumulation of trials means that any synthesis captures an evolving field.

4.5. Future Directions

Future research would benefit from larger, methodologically rigorous trials with adequate blinding of outcome assessment, active comparison conditions, and longer follow-up to establish the durability of effects. Research clarifying the optimal dose, type, and delivery of exercise, and identifying who is most likely to benefit, would enhance clinical utility, as would studies of implementation and adherence in real-world settings. Investigation of mechanisms, and of exercise in under-represented populations and contexts, including low-resource settings, would further strengthen the evidence base.

V. CONCLUSION

This systematic review synthesised the evidence on the effectiveness of physical exercise as an intervention for depression. The evidence indicates that exercise produces moderate reductions in depressive symptoms, an effect that is attenuated but generally remains significant in higher-quality trials, and that exercise is beneficial as a standalone intervention, as an adjunct to conventional treatment, and in the prevention of depression, with effects shaped by dose, type, and population. Physical exercise is thus best understood as a promising, broadly beneficial, and accessible intervention for depression, warranting fuller integration into clinical and public health approaches and more rigorous research to refine its delivery and to establish its long-term effects.

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