



The Promotive Effects of Aerobic Exercise on Emotional Well-being and Its Mechanisms: A Review Based on Multi-Group Research

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ABSTRACT

Negative emotions, particularly anxiety and depression, pose a significant threat to individual physical and mental wellbeing. Aerobic exercise, as a safe and accessible non-pharmacological intervention, demonstrates considerable potential in promoting emotional health. This systematic review examines the positive effects of aerobic exercise on mood across diverse populations, including adolescents, university students, individuals with chronic illnesses, older adults, and postpartum women. Findings confirm its efficacy in alleviating anxiety and depressive symptoms while enhancing emotional stability. Its mechanisms involve multi-level physiological and psychological pathways: physiologically, aerobic exercise improves mood by regulating neurotransmitter release (e.g., endorphins, serotonin, dopamine), elevating brain-derived neurotrophic factor (BDNF) levels, and optimizing autonomic nervous system and hypothalamic-pituitary-adrenal axis (HPA axis) function; psychologically, it acts through pathways such as enhancing self-efficacy. Notably, exercise's impact on mood exhibits significant individual variability, with efficacy contingent upon precise alignment between participants' core needs and exercise attributes. Future research should focus on deepening neurobiological mechanism exploration and developing personalized exercise prescriptions based on individual differences to advance the scientific application of aerobic exercise in emotional health promotion.

1. Introduction

In contemporary society, mental health issues command increasing public attention, with alleviating negative emotions emerging as a pressing concern. Negative emotions constitute a general affective dimension reflecting subjective experiences of tension and unpleasant engagement, encompassing a spectrum of emotional states including anxiety, frustration, guilt, and depression. In academic and clinical research, anxiety and depression are regarded as primary

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manifestations of negative emotions. These not only hold significant weight in psychological disorders but also exert considerable influence on individuals' emotional experiences and behaviors in daily life(Wei Shihuai, 2025). Consequently, investigating the mood-enhancing effects of aerobic exercise has become a crucial topic within psychology and exercise science. In recent years, aerobic exercise has garnered extensive attention as a non-pharmacological intervention due to its pronounced effects on mood enhancement(Hu, 2025a). Drawing upon relevant domestic and international research, this paper systematically reviews the positive impact of aerobic exercise on the emotional states of diverse populations (including adolescents, university students, and individuals with chronic illnesses), while exploring the underlying psychological and physiological mechanisms. The content encompasses aerobic exercise's role in alleviating negative emotions such as depression and anxiety(Hu, 2025b), alongside its promotion of positive affect.

2. Research Methodology

2.1 Literature Sources and Retrieval

Relevant literature up to March 2025 was collected through systematic searches of Chinese and English databases including China National Knowledge Infrastructure (CNKI), Web of Science, and PubMed. Searches employed core keyword combinations such as ("有氧运动" OR "aerobic exercise") AND ("情绪" OR "焦虑" OR "抑郁" OR "mood" OR "anxiety") AND ("机制" OR "干预").

2.2 Inclusion and Exclusion Criteria

Inclusion criteria comprised: studies involving adolescents, university students, chronic disease patients, elderly populations, or postpartum women; interventions consisting of prescribed aerobic exercise; study designs including randomized controlled trials, quasi-experimental studies, or systematic reviews; outcome measures encompassing mood-related scale scores or physiological indicators. Non-evidence-based studies, those lacking full-text access, and literature of substandard quality were excluded.

2.3 Literature Screening and Data Extraction

Literature screening followed the PRISMA process, conducted independently by two researchers. Initial screening involved title and abstract review, followed by full-text reading of potentially eligible studies to determine final inclusion. Key information extracted included authors, year, sample characteristics, exercise protocols, primary outcomes, and conclusions.

2.4 Quality Assessment

Methodological quality of included randomized controlled trials was assessed using the Cochrane Risk of Bias tool.

3. Effects of Aerobic Exercise on Mood in Different Populations

3.1 Adolescent Population

Liu Yan noted that adolescents who engage in long-term aerobic exercise demonstrate greater recognition and perception of positive emotions, exhibiting a marked advantage over their non-exercising peers. Furthermore, short-term aerobic exercise similarly provides adolescents with pleasurable, energizing, and fluid emotional experiences, effectively alleviating anxiety and depression levels both before and after exercise(Liu Yan, 2025). Aerobic exercise not only enhances adolescents' positive emotions but also strengthens their self-efficacy in emotional

regulation, with particularly pronounced effects during moderate-intensity activity. A meta-analysis by Su et al. further indicates that aerobic exercise significantly improves depressive and anxious moods in adolescents(Su et al., 2023).

3.2 University Students

University students are at a critical stage characterized by concentrated academic pressure, social relationship adjustments(Wan et al., 2025), and the refinement of self-awareness. They are susceptible to negative emotions such as depression and anxiety due to factors including academic competition, employment anxiety, and interpersonal conflicts. Some students also exhibit insufficient emotional regulation abilities and frequent emotional fluctuations. As a cohort possessing both "high cognitive levels" and "accessibility to exercise", university students demonstrate considerable receptiveness to aerobic exercise(Hu & Huang, n.d.). Different intensities, types, and intervention models of aerobic exercise yield varying effects on their emotional improvement. Furthermore, personalized intervention programmed can enhance the precision and sustainability of emotional regulation(Chen et al., 2023).

Su Zhifeng's research indicates that aerobic exercise of varying intensities exhibits differences in reducing depression levels among university students, depending on duration, intensity, and individual characteristics. Specifically, high-intensity and moderate-intensity aerobic exercise interventions can reduce depressive symptoms below the depression threshold (53 points), demonstrating more pronounced effects(Su Zhifeng, 2024). Hu(Huang et al., 2025a) et al.'s personalized progressive exercise prescription effectively enhances university students' physical activity levels, warranting promotion in exercise interventions targeting student anxiety.

3.3 Individuals with chronic conditions

Individuals with chronic conditions, frequently burdened by persistent symptoms (such as pain and reduced physical capacity)(Hu, 2025c), prolonged treatment cycles, and diminished quality of life, are prone to negative emotions including anxiety and depression. Such emotional distress can further exacerbate disease progression (e.g., causing fluctuations in blood glucose/pressure levels and reducing treatment adherence), creating a vicious cycle of "disease-emotion" interdependence. Aerobic exercise, as a highly safe and adaptable non-pharmacological intervention, demonstrates significant and diverse effects in improving the emotional health of chronic disease patients(Hu, Zhang, Huang, et al., 2025).

Ye Ling notes that exercise therapy (including aerobic exercise, resistance training, yoga, etc.) can markedly improve depression, anxiety, and sleep quality in chronic disease patients. Traditional Chinese exercises such as Baduanjin and Tai Chi demonstrate particular efficacy in emotional regulation(Ye et al., 2025).

3.4 Elderly Population

Older adults are prone to feelings of loneliness, mild depression, and anxiety due to factors such as declining physiological function, shrinking social circles, and high prevalence of chronic diseases. Their emotional regulation capacity is significantly reduced compared to middle-aged and younger adults. Aerobic exercise demonstrates clear and sustainable positive effects in improving emotional health among the elderly(Hu, 2025d).

Xia Jing employed meta-analysis to evaluate aerobic exercise's impact on elderly mood states, investigating its underlying mechanisms. Findings indicate aerobic intervention significantly

improves mood states, regulates negative emotions, and enhances positive affect in older adults 错误!未找到引用源。 .

3.5 Postpartum Women

Dr Mei Danyang recommends that postpartum women undertake moderate-intensity aerobic rehabilitation training under the guidance of professional exercise coaches following discharge. Activities such as jogging, cycling, or swimming may be employed, with personalized exercise programmes tailored to each patient's BMI and postnatal recovery status(Hu, Huang, et al., 2025). Research indicates that aerobic exercise at appropriate intensities increases the release of monoamines and endorphins within the body, thereby contributing to reduced depression scores(Mei Danyang, 2024).

4. Effects of Aerobic Exercise on Mood

4.1 Effects of Aerobic Exercise on Anxiety

Multiple studies have demonstrated that aerobic exercise effectively alleviates anxiety. Daniel et al. noted that regular aerobic exercise significantly reduces anxiety symptoms by enhancing neurotransmitter levels such as serotonin and endorphins(LeBouthillier & Asmundson, 2017). Another study involving adolescents found that seven weeks of aerobic exercise significantly reduced anxiety levels in young people(L et al., 2025), with effects more pronounced than in a stretching control group. Furthermore, aerobic exercise helps alleviate anxiety symptoms by improving cardiorespiratory fitness and reducing physiological stress responses(D. Yang et al., 2025).

4.2 Effects of Aerobic Exercise on Depression

Aerobic exercise not only demonstrably alleviates anxiety but also exerts positive effects on depressive symptoms(Zhang et al., 2025). Research indicates that sustained aerobic exercise regulates mood and alleviates depression by improving the function of neurochemicals such as serotonin and dopamine. Studies suggest aerobic exercise is an effective means of alleviating depressive symptoms in adolescents, with effects comparable to traditional psychotherapy(Q. Yang et al., 2025). Enhanced cardiorespiratory fitness and heightened exercise enjoyment constitute the core mechanisms through which aerobic exercise ameliorates depression; future research should further explore the underlying neurobiological pathways(Yuan et al., 2025).

4.3 Stabilizing Effects of Aerobic Exercise on Mood Fluctuations

Aerobic exercise also effectively stabilizes emotional fluctuations, reducing the amplitude of negative mood swings. Giles' research indicates moderate-intensity exercise (60%-70% of maximum heart rate) yields optimal mood-stabilizing effects ($SMD=-1.15$), whereas high-intensity exercise may temporarily exacerbate emotional volatility due to fatigue. Aerobic exercise enhances adaptive neural responses in the brain, thereby aiding emotional equilibrium under stress(Giles et al., 2018). These studies indicate that aerobic exercise not only effectively alleviates anxiety and depressive symptoms but also provides enduring physiological support for emotional regulation(Huang et al., 2025b).

5. Physiological Mechanisms Underlying Aerobic Exercise's Effects on Mood

5.1 Alterations in Neurochemicals

Aerobic exercise enhances emotional responses by promoting the synthesis and release of

neurotransmitters, particularly endorphins, serotonin, and dopamine. Endorphins, often termed "feel-good hormones," are released during exercise and significantly elevate mood states(Hu & Huang, 2025). Additionally, alterations in serotonin and dopamine levels constitute key mechanisms through which aerobic exercise improves emotional well-being. Notably, synergistic effects exist among these three neurotransmitters: endorphins mediate immediate mood elevation, serotonin maintains emotional stability, and dopamine enhances exercise adherence. Together, they form the chemical foundation for aerobic exercise's mood-enhancing effects(Xue Peixu, 2022). This mechanism has been validated across different exercise modalities. Similar neurochemical alterations are observed in both moderate-to-high intensity activities (e.g., skipping, jogging) and moderate-intensity activities (e.g., brisk walking), with exercise intensity positively correlating with the magnitude of neurotransmitter elevation. Furthermore, research indicates that exercise-induced neurotransmitter release exhibits intensity dependence(Wang Haoyi, 2025). Moderate-intensity exercise typically yields optimal synergistic effects, whereas extremely high-intensity exercise may temporarily diminish these positive outcomes due to physical stress.

5.2 The Key Role of Brain-Derived Neurotrophic Factor (BDNF)

Beyond rapidly acting neurotransmitters, aerobic exercise's long-term mood-enhancing effects are closely linked to brain-derived neurotrophic factor (BDNF). BDNF is a key protein promoting neuronal survival, differentiation, and synaptic plasticity. Regular aerobic exercise significantly elevates BDNF levels in peripheral blood and the brain(Jiang et al., 2023). Increased BDNF levels, particularly in the hippocampus and prefrontal cortex—areas critical for emotional regulation, learning, and memory—promote neurogenesis (the generation of new neurons) and synaptic remodeling. Hippocampal volume reduction is frequently observed in individuals with mood disorders such as depression. By elevating BDNF levels, exercise counteracts this neurodegeneration, thereby delivering long-term antidepressant and mood-stabilizing benefits. This mechanism extends the benefits of aerobic exercise beyond transient chemical releases to encompass enduring optimization of brain structure and function(Hu, Zhang, & Huang, 2025).

5.3 Regulation of the Autonomic Nervous System

Aerobic exercise aids the body's return to a relaxed state by modulating autonomic nervous system function, particularly through heightened parasympathetic activity, thereby alleviating anxiety and stress. Its efficacy in influencing both sympathetic and parasympathetic systems is notably pronounced in hypertensive patients(Wang et al., 2025). Heart rate variability (HRV), regarded as a key indicator of autonomic nervous system function, has been demonstrated to increase significantly with aerobic exercise, thereby promoting emotional stability.

Furthermore, combining aerobic exercise with multisensory stimulation (such as visual, auditory, and olfactory inputs) can further enhance positive emotional experiences while reducing parasympathetic nervous system depletion(Huang et al., 2025).

5.4 Balancing Effects on the Hypothalamic-Pituitary-Adrenal Axis (HPA Axis)

Another key physiological mechanism through which aerobic exercise influences mood lies in its beneficial regulation of the body's core stress system—the hypothalamic-pituitary-adrenal axis (HPA axis)(Liu et al., 2021). Excessive activation of the HPA axis leads to sustained secretion of glucocorticoids (such as cortisol), a central physiological hallmark of chronic stress and mood disorders (e.g., anxiety and depression).

Regular moderate-intensity aerobic exercise has been demonstrated to optimize HPA axis

function: on the one hand, it promotes a more rapid and efficient cortisol response during acute stress, aiding the body's effective coping with challenges; on the other hand, it enhances the HPA axis's negative feedback mechanisms, enabling cortisol levels to return to baseline more swiftly following stress responses and preventing prolonged exposure to elevated stress states. This "exercise adaptation" effectively lowers basal cortisol levels and mitigates sustained stress damage to the brain (particularly the hippocampus), thereby alleviating stress and improving mood at its root(Li et al., 2025). However, it should be noted that unscientific, excessive exercise itself may become a physiological stressor, leading to HPA axis dysfunction. This further underscores the importance of individualizing exercise intensity.

5.5 Dual Psychological and Physiological Effects

Beyond physiological mechanisms, aerobic exercise indirectly influences mood by enhancing self-efficacy and improving body image. Aerobic exercise significantly boosts self-efficacy among sports science undergraduates, with high-intensity acute aerobic exercise yielding the most pronounced improvements. Furthermore, combining acute aerobic exercise with music intervention demonstrates greater specificity in alleviating negative affect levels among these students(Zhou, n.d.). These psychological effects do not operate in isolation but complement the aforementioned physiological mechanisms (such as BDNF-mediated cognitive enhancement, euphoria from endorphins, and bodily relaxation from autonomic nervous system balance), collectively forming the "psychophysiological" synergistic model through which aerobic exercise promotes emotional well-being.

6. Individual differences in aerobic exercise's impact on mood

Whilst most research indicates aerobic exercise positively influences mood, individual variations persist(Li, n.d.).The individual variation in aerobic exercise's effect on mood fundamentally stems from "differences in the match between population needs and exercise attributes": adolescents require "developmental" emotional support, thus exercise must balance enjoyment with skill cultivation; university students need "problem-solving" emotional intervention, so programmes must focus on intensity and individual trait adaptation; Chronic disease patients and postpartum women require "safety-adaptive" regulation, thus exercise must prioritise physiological tolerance. These distinctions provide a basis for developing personalized exercise interventions in clinical and public health settings, while also demonstrating that no "universally optimal" aerobic prescription exists. Only through precise design tailored to population characteristics can emotional regulation benefits be maximized.

7. Conclusion and Outlook

This review systematically synthesizes domestic and international research on aerobic exercise's impact on emotional health. By examining population differences, emotional regulation effects, mechanisms of action, and individual variability, it reveals the core value and scientific principles of aerobic exercise as a non-pharmacological emotional intervention. It also clarifies the strengths and areas requiring further research. Although substantial evidence demonstrates aerobic exercise's efficacy in alleviating negative emotions such as anxiety and depression, existing research primarily focuses on exercise types, intervention durations, and individual variations. A unified consensus on optimal exercise intensity and most suitable intervention strategies remains elusive.

Moreover, most studies employ short-term interventions (<12 weeks), lacking long-term follow-up (≥ 1 year) to ascertain aerobic exercise's sustained emotional benefits. Additionally, randomized controlled trials (RCTs) constitute less than 40% of research, with some studies suffering from small sample sizes (<50 participants), compromising result reliability.

Individual variation in aerobic exercise's emotional effects is not random; it fundamentally stems from the degree of alignment between an individual's core needs and the attributes of the exercise (intensity, type, duration). Consequently, future research should further explore how to design exercise intervention programmes tailored to individual differences, combining multiple therapeutic approaches for comprehensive intervention to achieve better emotional regulation outcomes.

Building upon existing research findings and limitations, future work may advance in four directions: deepening mechanistic understanding, refining population segmentation, optimizing intervention protocols, and facilitating translational applications. This will propel research on aerobic exercise and emotional health towards greater precision, systematic rigor, and practical value.

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