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Short Review

Exercise Intervention in the Treatment of Schizophrenia: From Preliminary Exploration to Personalized Approaches

Jing Guo[1,2,3] and Weihua Yue[1,2,3,4,5]*

[1]*Peking University Sixth Hospital, Peking University Institute of Mental Health, Beijing, China*

[2]*National Clinical Research Center for Mental Disorders, Peking University Sixth Hospital, Beijing, China*

[3]*NHC Key Laboratory of Mental Health, Peking University, Beijing, China*

[4]*PKU-IDG/McGovern Institute for Brain Research, Peking University, Beijing, China*

[5]*Chinese Institute for Brain Research, Beijing, China*

Schizophrenia is a severe mental disorder characterized by complex, diverse clinical manifestations. These include positive symptoms such as hallucinations and delusions, as well as negative symptoms like emotional flatness, lack of motivation, and social withdrawal [1]. Cognitive dysfunction, which affects memory, attention, and executive functions, is also a common problem among schizophrenia patients, further impairing their daily lives and social functioning [2].

Pharmacological treatment, especially antipsychotic medications, remains the cornerstone of schizophrenia management. However, while such medications effectively control positive symptoms, they have limited efficacy in improving negative symptoms and cognitive function [3]. Moreover, long-term use of antipsychotics can lead to side effects such as metabolic disturbances, weight gain, and increased cardiovascular risk. As a result, pharmacotherapy alone cannot fully meet the treatment needs of patients with schizophrenia [4].

To address the limitations of pharmacotherapy, adjunctive treatments such as psychotherapy, social support, and rehabilitation programs are increasingly being integrated into comprehensive treatment plans for schizophrenia. Among these, exercise interventions have gained growing attention in recent years as a promising adjunctive therapy. Research indicates that exercise not only improves the overall health of schizophrenia patients but may also positively impact negative symptoms and quality of life [5] (Figure 1).

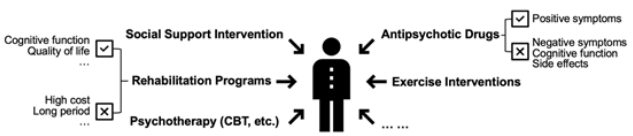

Figure 1: Research indicates that exercise not only improves the overall health of schizophrenia patients but may also positively impact negative symptoms and quality of life.

In the early 1980s through the early 2000s, the medical community began focusing on the physical health and quality of life issues faced by individuals with schizophrenia. Studies found that these patients were at higher risk for cardiovascular disease and metabolic disorders [6,7]. Against this backdrop, exercise interventions emerged as a potential therapeutic strategy. Although early exploratory research suggested potential health benefits of exercise for patients, the lack of rigorous experimental validation at the time meant that the approach did not gain widespread acceptance [8].

Exercise interventions can be categorized into aerobic exercise, anaerobic exercise, and high-intensity interval training (HIIT). Among these types, anaerobic exercise involves greater physical intensity and requires a higher level of physical fitness, rendering it less suitable for individuals with schizophrenia, who frequently experience physical deconditioning and diminished motivation[5]. Aerobic exercise, on the other hand, typically involves moderate-intensity activities such as walking, jogging, or cycling, which are more accessible and feasible for this population. As a result, aerobic exercise has become the most studied form of physical activity intervention for individuals with schizophrenia.

Since the 2000s, clinical trials, particularly randomized controlled trials (RCTs), have systematically examined the effects of aerobic exercise on negative symptoms, cognitive function, and quality of life in schizophrenia patients [9,10]. Vancampfort et al. [11] systematically reviewed the effects of aerobic exercise and found that aerobic exercise not only significantly improved cognitive function and emotional symptoms but also enhanced quality of life. These findings suggest that aerobic exercise can reduce the severity of psychiatric symptoms, particularly demonstrating significant benefits in addressing negative symptoms and cognitive impairments.

Since these clinical trials have consistently demonstrated the therapeutic benefits of aerobic exercise, particularly in improving cognitive function and reducing psychiatric symptoms, researchers have shifted their attention towards understanding the neurophysiological mechanisms that underlie these effects [12,13]. Research has increasingly focused on exploring the underlying mechanisms and expanding the applications of exercise interventions. Studies have delved into the neurophysiological processes through which exercise exerts

***Corresponding author:** Weihua Yue, Institute of Mental Health, Peking University Sixth Hospital, Beijing, PR China, Tel: +86 1082805307; E-mail: dryue@bjmu.edu.cn

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its beneficial effects, with evidence suggesting that aerobic exercise enhances cognitive function by promoting neuroplasticity, primarily by increasing the secretion of Brain-Derived Neurotrophic Factor (BDNF) [14]. This elevation of BDNF is linked to improvements in cognitive abilities [15]. Furthermore, research has demonstrated that combining exercise with pharmacotherapy yields better outcomes than using either approach alone, offering physiological and neurological support for the integration of aerobic exercise into treatment strategies [16].

In recent years, research has shifted toward personalized and refined exercise interventions. Given the substantial individual variability among schizophrenia patients, responses to exercise interventions vary [17]. Consequently, researchers have emphasized the need for personalized exercise programs tailored to the patient's disease stage and physical health status. A 2021 study highlighted that personalized exercise programs can significantly enhance treatment adherence and efficacy [18,19]. Long-term follow-up studies have demonstrated that sustained aerobic exercise interventions yield lasting improvements in both cognitive function and quality of life [20,21]. Some studies have even integrated digital technologies, using wearable devices to monitor patients' health and exercise outcomes, thereby advancing the development of remote, personalized interventions [22].

A network meta-analysis conducted in 2024, which systematically reviewed randomized controlled trials related to exercise interventions for patients with schizophrenia, found that aerobic exercise, as an adjunctive intervention to pharmacotherapy, was particularly effective in mitigating both positive and negative symptoms in patients, especially in decreasing the total symptom burden and negative symptoms [23]. The data showed that aerobic exercise interventions significantly reduced the total PANSS score (MD = -4.84, 95% CI: -5.72, -3.96), negative symptoms (MD = -2.11, 95% CI: -3.26, -0.95), and SANS scores (MD = -9.11, 95% CI: -11.94, -6.27). Subgroup analysis revealed that aerobic exercise interventions of 100-220 minutes per week over 2-3 months demonstrated optimal effectiveness, and patients' adherence to exercise interventions was comparable to traditional treatment methods.

In summary, aerobic exercise interventions in the treatment of schizophrenia have made significant progress. From early exploratory studies to in-depth mechanistic research and the practical application of personalized interventions, this therapeutic approach has gained increasing recognition. Future research directions may include further integration of digital health technologies and exploration of the combined effects of aerobic exercise with other therapeutic modalities, particularly in improving negative symptoms and cognitive function.

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