

## **Physical Exercise as an Adjunct Therapy in Schizophrenia: A Scoping Review of Its Effectiveness in Symptom Reduction**

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### **Abstract**

Schizophrenia is a mental disorder that causes individuals to become physiologically and socially dysfunctional. Physical exercise is one of the non-pharmacological therapies that can be applied to patients with schizophrenia, offering advantages such as ease of implementation, wide applicability, and lower costs, making it a feasible option for widespread use. This study aims to determine the effectiveness of physical exercise interventions in reducing signs and symptoms in patients with schizophrenia. This study employed a scoping review design following the PRISMA-ScR guidelines, with articles collected from three databases: PubMed, EBSCO, and Scopus. The selection process was guided by inclusion and exclusion criteria based on the PICOS framework. The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools. A total of 10 studies met the inclusion criteria and were included in the final analysis. The results indicate that physical exercise interventions are effective in reducing signs and symptoms of schizophrenia. The types of physical activities identified across the studies include cycling, yoga, treadmill walking, and aerobic exercises. In conclusion, in addition to antipsychotic medications used to manage symptoms, non-pharmacological interventions such as regular and structured physical exercise can help reduce symptoms and improve the quality of life in patients with schizophrenia.

**Keywords:** Adjunct therapy, physical exercise, schizophrenia, scoping review, symptom reduction.

## **Introduction**

Schizophrenia is a mental disorder that causes individuals to become physiologically dysfunctional, both for themselves and in social interactions. It is considered one of the most complex and challenging psychiatric disorders (Putri & Maharani, 2022). Patients with schizophrenia generally experience two main types of symptoms: positive and negative symptoms. Positive symptoms include delusions, hallucinations, disorganized speech, and abnormal motor behavior. Meanwhile, negative symptoms include flat affect, anhedonia (lack of pleasure), social withdrawal, loss of interest in activities, changes in sleep patterns, and deficits in self-care.

According to a study by the World Health Organization (WHO) in 2019, the prevalence of schizophrenia increased by 40%, from 20 million to 24 million people worldwide. In Indonesia, based on data from Riset Kesehatan Dasar (Riskesdas) 2018 indicates that the prevalence of severe mental disorders is 7 per 1,000 households. Specifically, provinces such as Bali and the Special Region of Yogyakarta report the highest incidence rates, reaching 11.1 and 10.4 per 1,000 households, respectively (Muthmainnah et al., 2023).

Mental health has become a significant global concern, affecting both physical and psychological well-being, and remains a major issue in Indonesia. In schizophrenia, untreated symptoms lead to severe functional impairment, social isolation, and a significantly reduced quality of life. If left unaddressed, these effects often escalate into chronic disability and an increased risk of premature mortality due to comorbid physical health issues, such as cardiovascular disease and metabolic syndrome (Monteiro et al., 2024).

In Indonesia, treatment for patients with schizophrenia includes both pharmacological and non-pharmacological approaches to reduce symptoms. While antipsychotic medications are the primary treatment for managing chemical imbalances in the brain (Augusta, Wilson, & Hermawati, 2024). However, this treatment mainly addresses chemical imbalances in the brain. They often fall short in addressing negative symptoms and cognitive deficits (Firth et al., 2017). Furthermore, prolonged use of antipsychotics is frequently associated with metabolic side effects, such as weight gain and cardiovascular risks (Correll et al., 2015). This creates a critical therapeutic gap, necessitating physical exercise as a vital adjunct therapy. Physical exercise not only aids in symptom reduction through neuroplasticity and dopamine regulation but also mitigates the physical health risks associated with sedentary behavior and long-term medication use (Stubbs et al., 2018; Dauwan et al., 2016).

In recent years, non-pharmacological therapies have increasingly been applied to patients with schizophrenia, with physical exercise emerging as a prominent intervention (Guo et al., 2024). Previous systematic reviews and meta-analyses, such as Guo et al. (2024), have demonstrated the effectiveness of aerobic exercise in reducing schizophrenia symptoms, particularly in improving cognitive function and overall clinical outcomes. Physical exercise offers distinct advantages, including ease of implementation, broad applicability across clinical settings, and significantly lower

cost compared to specialized psychological interventions, making it a feasible option for broader adoption (Dauwan et al., 2016; Vancampfort et al., 2017).

However, despite these advantages, there is a lack of comprehensive mapping regarding which specific modalities such as aerobic training, resistance exercise, or mind-body interventions like yoga are most effective for specific symptom clusters. A scoping review is therefore necessary to map the breadth of available evidence, identify various exercise protocols, and clarify their impacts on positive symptoms, negative symptoms, and cognitive deficits. Therefore, by synthesizing these diverse findings this study aims to examine the effectiveness of various physical exercise interventions and provide a foundational map for integrating structured exercise into standard schizophrenia care.

## **Method**

### **Study Design**

This study employed a scoping review framework to systematically map the evidence regarding physical exercise as an adjunct therapy in schizophrenia. Unlike a narrative review, a scoping review follows a structured process to identify the nature and extent of research evidence, allowing for a comprehensive mapping of various exercise modalities and their specific outcomes (Arksey & O'Malley, 2005). The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines to ensure transparency and replicability. The objective of this study is to examine the effectiveness of physical exercise interventions in reducing both positive and negative symptoms in patients with schizophrenia.

### **Eligibility Criteria**

The inclusion criteria in this study focused on primary research investigating the effects of physical exercise that can reduce symptoms in patients with schizophrenia. Another inclusion criterion is that the articles published between 2019 and 2024 (within the last 5 years), free full-text articles, articles published in Indonesian or English, and employing rigorous study designs such as Randomized Controlled Trials (RCTs), experimental, quasi-experimental, or cohort studies. The exclusion criteria comprised secondary research, such as systematic reviews and meta-analyses, to avoid data duplication and ensure that the findings were derived directly from original clinical data. Additionally, articles that did not focus specifically on schizophrenia or lacked measurable symptom-related outcomes were excluded.

### **Search Strategy**

The search strategy began with the identification of keywords using the PICO framework to identify relevant keywords aligned with Medical Subject Headings (MeSH) terms. Two reviewers (SNPI, RDP) performed a structured literature search across three databases: Pubmed, Scopus, and EBSCOhost, to ensure consistency with the study's initial design. The keywords were systematically arranged using Boolean operators (AND/OR) as follows: ("schizophrenia" OR "psychotic disorder") AND ("physical exercise" OR "physical activity" OR "aerobic exercise" OR "yoga") AND ("symptom

reduction" OR "effectiveness"). This approach ensured a comprehensive retrieval of articles specifically focusing on exercise-based interventions for schizophrenia symptoms.

**Table 1. Search Strategy and Results across Databases**

Database	Search Query (Keywords Used)	Initial Results	After Screening (Final)
PubMed	("Schizophrenia"[MeSH Terms] OR "Psychotic Disorders"[MeSH Terms]) AND ("Physical Exercise" [MeSH Terms] OR "Exercise Therapy" OR "Aerobic Exercise" OR "Yoga") AND ("Symptom Reduction" OR "Effectiveness")	2.067	4
Scopus	(TITLE-ABS-KEY ("Schizophrenia" OR "Psychotic disorder") AND TITLE-ABS-KEY ("Physical exercise" OR "Yoga" OR "Aerobic") AND TITLE-ABS-KEY ("Symptom reduction" OR "Effectiveness"))	876	3
EBSCOhost	(Schizophrenia OR Psychotic disorder) AND (Physical exercise OR Exercise therapy) AND (Symptom reduction OR Symptom improvement)	654	3
<b>Total</b>			<b>10</b>

**Article Selection**

The article selection process in this study was conducted by four reviewers (SNPI, NR, RDP, NAF). Articles identified from the initial search were screened for duplication, as well as for the relevance of titles, abstracts, and compliance with the inclusion and exclusion criteria. Any disagreements regarding article eligibility were resolved through discussion within the research team.

**Data Collection and Analysis**

After retrieving articles from each database and search engine using the predetermined keywords, the researchers conducted a systematic selection process guided by the PRISMA Extension for Scoping Reviews (PRISMA-ScR) flowchart diagram (Tricco et al., 2018). This process involved several stages, including the removal of duplicate records, title and abstract screening, and a full-text eligibility assessment based on the established inclusion and exclusion criteria.

**Data Extraction and Synthesis**

The data extraction table included information on the characteristics of the analyzed studies and was used to facilitate data synthesis. The information presented in the table was further verified by another research team. The study characteristics comprised research design, objectives, participants, interventions, and outcomes. Subsequently, the findings were summarized, compared, and reported qualitatively in accordance with the research problems and objectives.

## **Results**

A total of 3,597 articles were identified during the initial search, including 2,067 from PubMed, 876 from EBSCO, and 654 from Scopus. Based on the inclusion and exclusion criteria, 3,509 articles were removed, leaving 88 articles for further assessment. After duplicate screening, 53 articles remained. Subsequently, 35 articles were excluded due to irrelevance of titles, resulting in 18 articles for further evaluation. These articles were then assessed based on the inclusion and exclusion criteria, yielding 10 full-text articles. After a final selection process, eight articles were excluded, and the remaining studies were included in the review. The study selection process is illustrated in **Figure 1**.

## **Article Characteristics**

There are ten articles included in the qualitative synthesis. These studies were systematically reviewed to map the effectiveness of physical exercise interventions on schizophrenia symptoms. Two research articles collected were in India, and each one from Korea, Hongkong, USA, India, Japan, Brazil, and Taiwan. Most of the articles used experimental research methods with six randomized controlled trial, one clinical trial, one non-randomized clinical trial, one pilot randomized controlled trial, and one experimental study with non-randomized pre-test and post-test design.

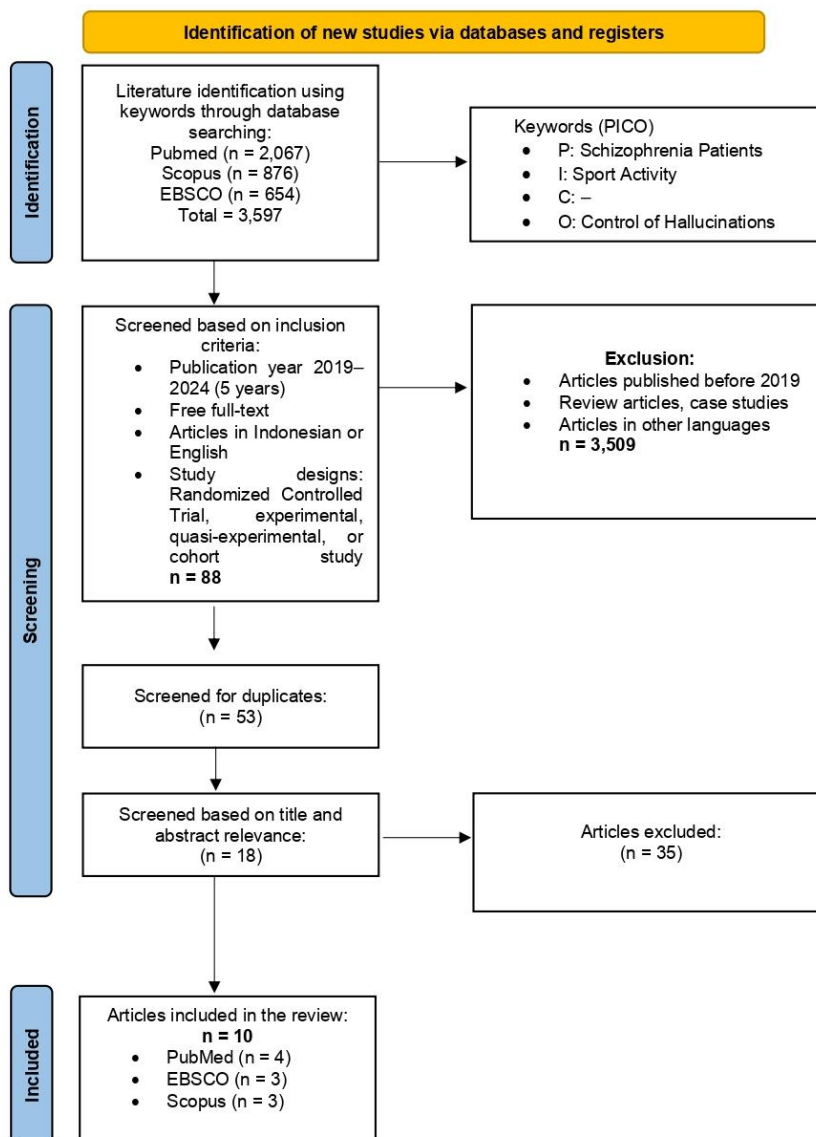


Figure 1. PRISMA-ScR Flow Diagram of the Study Selection Process

### Interventions

A total of ten studies were included in this review, all of which examined physical exercise interventions in patients with schizophrenia. Half of the studies (50%) focused on aerobic-based exercises, while 30% investigated high-intensity or combined exercise modalities, and 20% explored yoga interventions. Most studies (70%) reported improvements in cognitive or neurocognitive function. Additionally, 30% of the studies demonstrated reductions in schizophrenia symptoms, including positive and negative symptoms, while 20% highlighted improvements in negative symptoms and social cognition. Improvements in physical health and quality of life were also reported in 30% of the studies.

**Table 2. Summary of Peer-reviewed Journal Articles Supporting Recent Research on Physical Exercise Intervention in Reducing Symptoms in Schizophrenia Patients**

No	Author, Year (Country)	Research design	Objectives	Participants	Interventions	Results
1.	Ryu et al., 2020 (Korea)	Single-blinded randomized controlled trial	To examine the effects of outdoor cycling on physical activity and cognition	60 outpatients with schizophrenia	Outdoor cycling (90 min/week for 16 weeks)	Significant improvement in psychotic symptoms, mental health, executive function, and daily step count
2.	Gangadhar et al., 2021 (India)	Multi-centric randomized waitlist-controlled trial	To evaluate yoga as an adjunct treatment for negative symptoms	89 patients with schizophrenia	Yoga (12 sessions over 12 weeks; supervised and home-based)	Significantly greater improvement in negative symptoms compared to TAU
3.	Lee et al., 2021 (Hong Kong)	Randomized controlled trial	To assess the effect of high-endurance exercise on memory consolidation	51 patients with schizophrenia	High-intensity interval cycling exceeding functional threshold power (FTP)	Superior improvement in sleep-dependent procedural memory consolidation
4.	Bang-Kittilsen et al., 2020 (Norway)	Randomized controlled trial	To investigate neurocognitive effects of HIIT	82 outpatients with schizophrenia	HIIT (Treadmill running/walking: 4x4 intervals) vs. Active Video Gaming (45 min)	Comparable improvements in neurocognitive function for both HIIT and AVG groups
5.	Massa et al., 2020 (USA)	Clinical trial	To evaluate aerobic exercise on cognitive and physical outcomes	38 patients with schizophrenia	Aerobic exercise (Stationary bicycle: 20–45 min, 3x/week for 12 weeks)	Modest improvements in cognitive and functional outcomes
6.	Nasution et al., 2021 (Indonesia)	Non-randomized pretest-posttest experimental study.	To examine the effect of aerobic exercise on symptoms	34 female patients with chronic schizophrenia	Aerobic exercise (45 min, 3x/week)	Significant improvements in positive and negative PANSS scores
7.	Kurebayashi et al., 2021 (Japan)	Pilot randomized controlled trial.	To examine the effect of mild exercise on neurocognition	22 inpatients with schizophrenia	Mild aerobic exercise (60 min, 2x/week for 8 weeks)	Improvement in neurocognitive function
8.	Szortyka et al., 2023 (Brazil)	Non-randomized clinical trial.	To evaluate effects of aerobic and postural exercise	38 patients with schizophrenia	Aerobic Physical Intervention (API) vs. Postural Physical Intervention (PPI) (1 hour, 2x/week for 12 weeks)	API improved body weight, BMI, and blood pressure; PPI improved sedentary

						behavior and quality of life
9.	Huang et al., 2021 (Taiwan)	Randomized controlled trial.	To examine the effect of aerobic walking on cognition	67 patients with schizophrenia	Supervised aerobic walking (30 min, 5x/week for 12 weeks)	Significant cognitive benefits in the intervention group
10.	Govindaraj et al., 2021 (India)	Randomized controlled trial.	To compare social cognition changes	51 patients with schizophrenia	Yoga module (60 min, 4–5x/week for 6 weeks; total 20 sessions)	Significant improvement in social cognition

**Table 3. Summary of Peer-reviewed Journal Articles informing Schizophrenia symptoms influenced by physical exercise in Schizophrenia Patients**

No	Reference	Types of exercise implemented in patients with schizophrenia	Schizophrenia symptoms influenced by physical exercise
1.	Ryu et al., 2020 (Korea)	Outdoor cycling (structured exercise program)	Decrease in psychotic symptoms; improvement in executive function.
2.	Gangadhar et al., 2021 (India)	Yoga (mind-body intervention)	Significant reduction in negative symptoms
3.	Lee et al., 2021 (Hong Kong)	High-intensity interval training (HIIT) cycling	Decrease in memory consolidation deficits (procedural memory improvement).
4.	Bang-Kittilsen et al., 2020 (Norway)	HIIT and active video gaming (AVG)	Reduction in neurocognitive deficits.
5.	Massa et al., 2020 (USA)	Aerobic exercise (stationary cycling)	Decrease in cognitive impairment and functional deficits.
6.	Nasution et al., 2021 (Indonesia)	Aerobic exercise	Significant decrease in both positive and negative PANSS scores.
7.	Kurebayashi et al., 2021 (Japan)	Mild-intensity aerobic exercise	Reduction in neurocognitive symptoms.
8.	Szortyka et al., 2023 (Brazil)	Aerobic exercise (API) and postural exercise (PPI)	Decrease in sedentary behavior and blood pressure.
9.	Huang et al., 2021 (Taiwan)	Aerobic walking	Decrease in cognitive impairment.
10.	Govindaraj et al., 2021 (India)	Yoga (validated yoga module)	Reduction in social cognition deficits.

A total of ten studies were included in this literature review, primarily employing randomized controlled trial designs, with several non-randomized and pilot studies. The included studies examined various physical activity interventions, such as aerobic exercise, high-intensity interval training (HIIT), yoga, outdoor cycling, and postural exercises in individuals with schizophrenia (Ryu et al., 2020; Gangadhar et al., 2021; Lee et al., 2021; Bang-Kittilsen et al., 2020).

Overall, the findings consistently demonstrated that physical activity interventions had positive effects on clinical symptoms, cognitive function, and overall functioning in patients with schizophrenia. Several studies reported significant improvements in both positive and negative symptoms following aerobic exercise and yoga interventions (Nasution et al., 2021; Gangadhar et al.,

2021). These improvements were commonly measured using standardized instruments such as the Positive and Negative Syndrome Scale (PANSS).

In terms of cognitive outcomes, multiple studies highlighted the beneficial effects of physical activity on neurocognition. Interventions such as HIIT, aerobic walking, and mild-intensity exercise were associated with improvements in memory, executive function, and overall cognitive performance (Lee et al., 2021; Huang et al., 2021; Kurebayashi et al., 2021). Additionally, both HIIT and active video gaming demonstrated comparable effectiveness in enhancing neurocognitive outcomes (Bang-Kittilsen et al., 2020).

Yoga-based interventions also showed significant benefits, particularly in improving negative symptoms and social cognition (Gangadhar et al., 2021; Govindaraj et al., 2021). These findings suggest that mind-body interventions may play an important role in addressing psychosocial and cognitive deficits in schizophrenia.

Furthermore, some studies reported improvements in physical health outcomes, including increased physical activity levels, better cardiovascular fitness, and enhanced quality of life (Ryu et al., 2020; Szortyka et al., 2023). For example, outdoor cycling and aerobic interventions were associated with increased daily step count and improved overall physical functioning.

## **Discussion**

Schizophrenia is a widely recognized mental disorder characterized by disruptions in thinking, perception, emotions, and behavior (Videbeck, 2020). It affects about 1% of the world's population and is considered one of the leading contributors to global disability (Hany et al., 2024). The disorder manifests through a range of symptom domains. Positive symptoms may include hallucinations, delusional thinking, disorganized communication, and atypical or catatonic behaviors. In addition, individuals often experience negative symptoms such as diminished motivation and blunted emotional expression, as well as cognitive deficits that affect executive functioning, memory, and the speed of information processing.

The symptoms experienced by individuals with schizophrenia can be reduced through various interventions, one of which is physical exercise. Exercise interventions are clinically defined as programmed, regulated, and recurring physical activities intended to develop or sustain physical fitness. These interventions involve structured and programmed exercises that are supervised to ensure patients meet the minimum exercise requirements.

Based on the analysis of 10 selected articles, physical activity was identified as an effective intervention for reducing schizophrenia symptoms. All articles were published in English and originated from various countries, using randomized controlled trial and clinical trial research designs.

### **Effectiveness and Variations of Exercise Interventions**

The types of physical exercise identified varied widely. Three studies used cycling, two focused on yoga, three examined treadmill walking and aerobic walking, and two applied aerobic exercise training. Cycling interventions were explored by Lo et al. (2023), Massa et al. (2020), and Ryu et al. (2020), with differences in duration, setting, and type of bicycle used. Ryu et al. (2020) implemented outdoor cycling over 16 weeks, with a total duration of 80 minutes per week. The sessions included 15 minutes for goal setting and safety education, 10 minutes of warm up, 40 minutes of cycling, 10 minutes of cool down stretching, and 15 minutes of reflection and discussion. To maintain motivation, participants set individual goals and discussed challenges before and after each session.

Ryu et al. (2020) also compared the cycling group with an Occupational Therapy group conducted at a Mental Health Promotion Center. The Occupational Therapy group was divided based on participants' abilities, such as social and creative skills. The results showed that the cycling group demonstrated significant improvements in psychiatric symptoms, cognitive function, and overall functioning. Similarly, Lo et al. (2023) found that intensive cycling improved memory function in patients with schizophrenia. This improvement is associated with the interaction between exercise and the hippocampus, as physical activity is positively correlated with hippocampal volume (Genzel et al., 2017; Lin et al., 2015). The intervention lasted 12 weeks using a stationary bicycle and was conducted three times per week. Each session began with a 10 minute warm up, followed by high intensity interval cycling until participants reached a target of 150 kJ, measured using a Garmin Edge 520 device. The study concluded that intensive cycling was more effective than other aerobic exercise in improving memory impairment.

Massa et al. (2020) also used stationary cycling three times per week for 12 weeks, with session durations gradually increasing from 20 to 45 minutes. The results indicated improvements in cognitive and physical functioning among patients with schizophrenia. In addition to cycling, yoga interventions were implemented by Govindaraj et al. (2021) and Rao et al. (2021). Govindaraj et al. conducted 60 minute sessions, 4 to 5 times per week, totaling 20 sessions over 6 weeks. Rao et al. provided 12 sessions over 12 weeks, with initial supervision followed by independent home practice. These findings are supported by Khalsa et al. (2015), which showed that yoga significantly reduced anxiety, depression, and panic symptoms in individuals with treatment resistant mental disorders.

Aerobic walking interventions were conducted by Bang Kittilsen et al. (2020), Szortyka et al. (2023), and Huang et al. (2021), both with and without equipment. Huang et al. implemented walking five times per week for 30 minutes over 12 weeks. Szortyka et al. used treadmill walking twice weekly for one hour over 12 weeks. Bang Kittilsen et al. incorporated interval training with warm up, four intervals of activity, and cool down sessions. Aerobic exercise interventions were conducted by Kurebayashi et al. (2021) and Nasution et al. (2021). Kurebayashi et al. implemented group sessions

twice weekly for 8 weeks, including warm up, aerobic exercise, and cool down phases. Nasution et al. conducted sessions three times per week, each lasting 45 minutes, with physiological monitoring before and during exercise.

Mental health problems such as schizophrenia highlight the importance of maintaining both mental and physical health. Physical health is closely linked to mental health, and engaging in productive activities can help individuals maintain emotional stability and overall well being (Fitriani and Syaifullah, 2024). Reduced physical activity can negatively affect blood circulation, leading to decreased oxygen and nutrient distribution throughout the body and ultimately affecting metabolism. Metabolic disturbances in the brain influence neurotransmitter production, including serotonin and norepinephrine in the limbic system, which regulate emotion, motivation, and behavior.

Previous studies have shown that physical activity improves patients' trust in others and enhances social interaction (Campbell, 2010). Mahindru et al. (2023) also reported that exercise reduces depression, anxiety, and schizophrenia symptoms. These findings are consistent with earlier studies showing that exercise therapy reduces psychotic symptoms (Dauwan et al., 2015), depression (Leone et al., 2015), and anxiety (Heggelund et al., 2014) in schizophrenia. In addition, exercise increases endorphin levels, often referred to as happiness hormones, which help regulate mood and emotions (Mikkelsen et al., 2017). Overall, the findings indicate that physical activities such as aerobic exercise, yoga, cycling, and walking can improve cognitive function and reduce negative symptoms in individuals with schizophrenia. This study has several limitations. First, the search was limited to English and Indonesian articles, which may introduce language bias. Second, only free full-text articles were included. Third, heterogeneity of exercise types and outcome measures limited comparison across studies. Additionally, no meta-analysis was conducted, limiting effect size interpretation.

## **Conclusions**

Physical exercise interventions, specifically aerobic training, high-intensity cycling, and yoga, serve as effective adjunct therapies in reducing the clinical symptoms of Schizophrenia. The findings from this review demonstrate that structured exercise protocols, ranging from 30 to 90 minutes per session, significantly decrease both positive and negative symptoms by enhancing neurocognitive function and mitigating social cognition deficits. These interventions reduce symptoms through improved procedural memory, executive functioning, and metabolic health, ultimately fostering better daily functioning and quality of life. Therefore, integrating systematic physical exercise into standard psychiatric care is essential for a more holistic management of schizophrenia. Future research should focus on standardizing exercise protocols, including intensity, frequency, and duration, to enhance comparability across studies. Large-scale randomized controlled trials are needed to strengthen the evidence base. Additionally, future studies should explore the long-term sustainability of exercise interventions and their impact on relapse prevention. The integration

of digital or technology-assisted exercise programs may also provide innovative approaches to improving adherence and accessibility among patients with schizophrenia.

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