



The Effect of Aerobic Exercise on the Quality of Life of Male Patients Who Suffer from Chronic Schizophrenia: Double-Blind, Randomized Control Trial

Hossein Namdar Areshtanab¹, Hossein Ebrahimi¹, Mohammad Abdi², Robab Mohammadian³, Asghar Mohammadpoor Asl⁴ and Shahram Piri^{3,*}

¹Faculty of Nursing and Midwifery, Tabriz University of Medical Sciences, Tabriz, Iran

²Department of Emergency and Critical Care, Faculty of Nursing and Midwifery, Zanjan University of Medical Sciences, Zanjan, Iran

³Department of Nursing, Islamic Azad University, Maragheh Branch, Maragheh, Iran

⁴Department of Epidemiology and Biostatistics, School of Health, Tabriz University of Medical Sciences, Tabriz, Iran

*Corresponding author: Msc, Department of Nursing, Islamic Azad University, Maragheh Branch, Maragheh, Iran. Tel/Fax: +98-9149114292, Email: pirishahram67@yahoo.com

Received 2018 March 06; Revised 2020 April 12; Accepted 2020 July 11.

Abstract

Background: Chronic schizophrenia is a long-term and severe mental disorder. Aerobic exercises can reduce the symptoms of mental disorders, particularly schizophrenia, through improving the patient's quality of life (QoL).

Objectives: The current study aimed to investigate the effect of aerobic exercise on the QoL of male schizophrenics hospitalized at the Razi Psychiatric Center in Tabriz from 2015 to 2016.

Methods: In this randomized controlled trial, 68 patients who met the inclusion criteria were randomly allocated into groups of intervention (n = 34) and control (n = 34). The intervention group has benefited from the aerobic exercise 24 sessions for 8 weeks, 12 hours in total. The control group simultaneously enjoyed the fresh air. The Schizophrenic Quality of Life Scale (SQLS) was completed before and after intervention in both groups. The data were analyzed in SPSS20 using the t-test and chi-squared test.

Results: The mean age of participants was 37.82 ± 7.14 years. No significant differences were found between the demographic characteristics of the two groups. This study showed that no significant difference was found in the quality of life in both groups before intervention ($P \leq 0.37$), but there was a significant difference after the intervention ($P = 0.001$). Aerobic exercises reduce patient's mental disorders and promote their QoL ($P < 0.05$).

Conclusions: Regular aerobic exercise can reduce the symptoms of male patients with schizophrenics, which in turn improves all dimensions of QoL.

Keywords: Aerobic Exercise, Anxiety, Delusional Disorder, Quality of Life, Schizophrenia

1. Background

Nowadays, mental disorders are one of the greatest problems of human societies. Depression, bipolar disorder, schizophrenia, psychosis, and dementia disorders are major contributors to the global burden of mental disorders that their incidence is on the rise (1). Among these disorders, schizophrenia often referred to one of the most serious challenges of communities, due to its costs and consequences. Chronic schizophrenia is a severe long-term mental disorder characterized by psychotic behaviors, not commonly seen in healthy people. The symptoms of schizophrenia fall into two categories: positive- negative and cognitive. Positive symptoms include hallucinations, delusions, thought disorders, movement disorders. Negative symptoms are associated with reduced speech,

flat affect (reduced expression of emotions), reduced feelings, difficulty beginning, and sustaining activities. On the other hand, cognitive symptoms of schizophrenia are generally more severe and the patient's family should notice that schizophrenics have poor executive functioning (2, 3). In addition to signs of the disease, paying attention to the quality of life (QoL), social rehabilitation, and general functioning of schizophrenics is applied as variables to show the effectiveness of pharmacological and non-pharmacological interventions (4).

According to the World Health Organization, regardless of culture, system of values, goals, expectations, standards, and concerns, QoL is one of the important elements of human perceptions about their situation (5). Due to factors such as side effects of antipsychotic drugs, poor diet,

smoking, and poor lifestyle as well as cognitive problems, schizophrenics are doomed to be deprived of good physical health, high life expectancy, and high QoL (6-8).

Although drug therapy may be more effective, it has potentially serious side effects. Anticholinergic side-effects include metabolic problems such as weight gain, medication intolerance, sleep disorders, dry mouth, and neuroleptic malignant syndrome (9). Currently, anticholinergic drugs are used to treat several mental and behavioral disorders, including psychosis and schizophrenia. However, these drugs cause important side effects, including a significant reduction of behavior and mental functioning and the QoL of patients (10).

Compared to females, male schizophrenics have a lower age of onset, more negative symptoms, and low social functioning and QoL (11). Iran's national strategy of schizophrenics treatment includes providing Psychotherapy, Psychopharmacology, and psychosocial interventions, which reveals the emphasis on the necessity of reducing psychotic symptoms as well as relapse and ameliorating the patients' long-term outcomes such as recovery, remission, and illness progression (12, 13).

Treatment strategies intend to enable patients to acquire social and job skills and, consequently, to have an independent life (14). What is more, the goals of continuing treatment with doing exercise are to maintain suppression of symptoms, prevent relapse, improve QoL, and support engagement in psychosocial therapy (15). Although many studies have investigated the positive effects of exercise on individuals who suffer from schizophrenia, sport variants that have positive effects on schizophrenics haven't been well evaluated yet (16-18). There are many challenges about how to use aerobic exercise. The variability of exercise programming, like sport frequency, intensity, duration, and type, which lead to positive mental health outcomes for a patient with schizophrenia, is not known (19, 20). Stone reported that no study had provided a base for how to choose the right exercise intensity. This is highly problematic, as it makes replication of successful studies impossible (21).

Although several bio-medical treatments have incorporated the psychiatric nursing practice and custodial care has been the center of attention, continuity of care seems to be a significant factor in psychiatric nurse care. What is more, the responsibilities of a mental health nurse include encouraging the mentally ill and motivating them to do physical activities and exercises. Measures such as psychotic therapy can improve the results of therapeutic interventions by identifying and controlling the risk factors, which in turn improve the QoL of patients, as an indicator of the outcomes of nurse interventions and treatments. This conclusion briefly sets out to enhance caretakers (schizophrenics) social skills, motivation, and desire to

change as well as decreasing their lethargic and apathetic state (22, 23).

An important consideration is that schizophrenics with chronic mental disorders are highly susceptible to stress and dependence, and the disease affects their life skills, employment, and social relationships. On the other hand, encouraging patients to utilize the society facilities, promoting their social functioning, and enhancing QoL may reduce the costs of relapse and hospital readmission (24). Hence, the value of regular aerobic exercise for enhancing the QoL in male schizophrenics has remained a prominent topic, in this paper.

2. Objectives

The current study aimed to investigate the effect of aerobic exercise on the quality of male schizophrenics hospitalized at the Razi Psychiatric Center in Tabriz from 2015 to 2016.

3. Methods

3.1. Study Design and Settings

The present double-blind Randomized Controlled clinical trial intended to evaluate how regular aerobic exercise influences the QoL in male schizophrenics hospitalized in psychiatric wards. Following ethical approval from the Ethics Committee of Tabriz University of Medical Sciences receiving the code IRCT2016020823525N3 from Clinical Trial Registry, this study carried out within 16 months in 2015-2016.

3.2. Participants

68 patients were selected based on inclusion criteria using the convenience sampling method. The inclusion criteria were as follow: diagnosis of chronic schizophrenia, physical health to engage in the regular aerobic exercise with the approval of a physician, having no ulcerations or scarring in the foot, and willingness and potential to participate in the study.

To determine the sample size, we followed the study by Wang (d = 65) (25). Regarding the equation of:

$$n = \frac{2 \left(Z_{\frac{\alpha}{2}} + Z_{1-\beta} \right)^2}{d^2} \quad (1)$$

$$\beta = 0.02, \alpha = 0.05$$

Then, using the normal distribution table $Z_{0.025} = 1.96$ and $Z_{0.2} = 0.84$, the sample size was estimated as 64. To consider the attrition bias and increase the accuracy of the findings, the sample size was increased to 80 subjects.

However, 12 patients refused to continue the study. Hence, 68 subjects who were randomly divided into two double-blind groups finished the study: intervention (34 patients) and control (34 patients).

Initially, subjects of the control and intervention groups were assessed for age, sex, duration of illness, education, treatment duration, and treating physician, to avoid potential confounding variables. Then, the objectives and benefits of participating in the study were explained to patients' family and, if agreeing, written informed consent was obtained. Data were collected both before and after the intervention. In this study, exercises were instructed by a person unrelated to the current study and, the questionnaires were also collected by another person who was unrelated to the study. Statistical analysts were also blinded to the research conditions.

3.3. Study Procedure

The proposed exercise processes were based on the Karvonen exercise program, including three times a week for 8 weeks, and each time one session for 5min warm up with different types of running, stretching. Then, running at 65% heart rate reserve for 12 minutes was conducted in the first week that it was raised to 26 mins and 80% heart rate reserve in 8th week (2mins were added for exercise time every week, and 5% for the exercise severity every two weeks) (25, 26).

The intervention group received 24 sessions of aerobic exercise for three sessions per week for up to 8 weeks, and each session for 20 to 40 minutes. The weekly outdoor intervention program (aerobic exercise) was undertaken, while the control group simultaneously benefited from the fresh air without any programmed sports activity. Both groups knew they were being taken out for fun and games, but no group knew that some kind of planned sport would have been taught.

3.4. Questionnaire

Psychosocial interventions may reduce the need for antipsychotics. Thus, after providing interventions, the quality of life scale (QOLS) was used in both groups. QOLS is designed to measure the QoL of patients with schizophrenia. It consists of 30 items, which are categorized into three domains: social-psychological (15 items), energy and motivation (7 items), and symptoms and side effects (8 items). The score of each domain ranges from 0 to 4. The items should be answered based on a 5-point Likert-scale of "never=0", "rarely=1", "sometimes=2", "often=3", and "always=4". The minimum and maximum scores of each domain are zero and 120, respectively, which refer to the QoL level. Concerning the QoL characteristics, a higher weight is given to the

psychosocial domain (with 15 items) than motivation, energy, symptoms, and side effects (27). This scale is standardized to be used in Iran with high reliability and validity (28). To establish random sampling, the consent form was filled by patients' companions. The blocking technique was used to randomize arranging participants units into groups. As the 95% confidence interval and 90% test power, this study measured 68 patients (34 for each group). To measure the QoL, data were collected using a demographic information form (including age, marital status, degree of education, BMI), and the schizophrenic quality of life scale (SQLS).

3.5. Statistical Analysis

Descriptive statistics were used to describe the sample characteristics. A P value < 0.05 was considered statistically significant. Data were analyzed using SPSS version 20 by the t-test and chi-squared test.

3.6. Ethical Consideration

The current study is approved by the Ethics Committee of Tabriz University of Medical Sciences. Besides, it is registered in the Clinical Trial Registry (REC.1394.1019). This study was conducted in 2016.

4. Results

This study was conducted on 68 schizophrenics (34 participants in the intervention and control groups, respectively). The mean age of intervention and control groups was 37.29 ± 7.68 and 38.35 ± 6.64 years, respectively. Most of the participants were married and had a primary education degree. Concerning the demographic characteristics, no significant difference was found between the intervention and control groups ($P = 0.42$, $P = 0.35$) (Table 1). The result of the T-test indicated no significant difference in QoL of both groups before intervention ($P \leq 0.37$), but there was a significant difference after the intervention. ($P = 0.001$). On the other hand, the study outcomes revealed a remarkable difference in terms of the motivation domain of the QoL in both groups after the intervention ($P < 0.001$) (Table 2).

5. Discussion

Based on the findings of the current study, the QoL of patients with schizophrenia varied considerably across the control and intervention groups. In line with this finding, Brenes et al. reported that aerobic exercise has no significant effect on the mental health domain of older adults

Table 1. Demographic Characteristics of the Control and Intervention Group

| Variable | Control Group (n = 34) | Intervention Group (n = 34) | P Value |
|--|------------------------|-----------------------------|---------|
| Marital status, No. (%) | | | 0.42 |
| Single | 21 (61.8) | 25 (73.5) | |
| Married | 8 (23.5) | 7 (20.6) | |
| Divorced | 5 (14.7) | 2 (5.9) | |
| Education level, No. (%) | | | 0.35 |
| Illiterate | 7 (20.6) | 2 (5.9) | |
| Primary school | 10 (29.4) | 13 (38.2) | |
| Under diploma | 7 (20.6) | 6 (17.6) | |
| Diploma | 10 (29.4) | 13 (38.2) | |
| Age (years), Mean \pm SD | 38.35 \pm 6.64 | 37.26 \pm 7.68 | 0.54 |

with minor depression (29). On the other hand, Kalateh-Jari et al. demonstrated that aerobic exercise positively influences the QoL of schizophrenia patients (30). Gorczyński et al. argued that aerobic exercise improves the physical health of schizophrenics. Thus, it is interesting that the results of Gorczyński's study coincide with this study, considering the positive effects of physical health on the QoL of patients with schizophrenia (31). Falkai et al. acknowledged that exercise is positively associated with mental health, anxiety, depression and negative mood, self-esteem, and cognitive function in schizophrenics (32). Exercise can improve mental and physical health, cognitive function, and brain by increasing the volume of the hippocampus (33-35).

Nevertheless, factors such as type and duration of the exercises, the gender of the participants, nature of the disease, sample size, and the time interval of measuring the variables after the intervention may have caused differences. Another Challenging point is the lack of agreement on the quality of sports programs and exercises for patients with chronic lung diseases and other mental disorders. In each of these studies, a particular method has been used for instructing the exercise. In this study, aerobic exercise performed 24 sessions, three sessions per week, and ranged from 12 to 26 minutes, and QoL scores improved from 67.44 ± 18.13 to 41.91 ± 6.34 (measured by QOLS). But in the study of Kalateh-Jari et al., the patients performed 20 exercise sessions per session for 30 minutes, and the QoL score improved from 52.1 ± 14 to 67.15 ± 9 (measured by QOLS). In another study conducted by Brenes et al., exercise sessions lasted 60 minutes and consisted of both aerobic and resistance training. Each session consisted of a

5-minute warm-up, 15-minute aerobic phase, a 20-minute resistance training phase, a 15-minute aerobic phase, and 5 minutes cool-down period. The QoL scores improved from 54.1 ± 14.3 to 31.3 ± 13.5 (measure by the SF-36 mental health component). It seems the methodology used by Brenes to perform sports exercises to improve the QoL of patients with chronic schizophrenia is more appropriate than other studies because it is more regular and uses both aerobic and resistance exercises.

What is more, the findings revealed is a significant difference in terms of the motivation dimension of QoL in both groups after the intervention. All points are taken into consideration; the regular aerobic exercise can enhance the motivation of participants.

Among psychological factors, personal motivation plays a fundamental role in ameliorating lifestyle programs and modifying unhealthy habits. Researchers emphasize increasing motivation in schizophrenia, which means enjoying QOL. Because motivation can change a person from a static state to a dynamic state by changing interpersonal factors. Thus, motivation can be considered as an interpersonal accessible factor that can be modified during a change process (36).

On the other hand, this study showed that exercise regulates neurotransmitters such as dopamine, serotonin, glutamate, norepinephrine, and acetylcholine, which are related to the biological etiology of schizophrenia (37).

The current study had limitations, including only investigating male patients. Therefore, the results cannot be generalized to female patients. Further studies with a special focus on women are needed. Moreover, it should be noted that the psychosocial status of respondents during questionnaire completion and exercise can affect the quality of their responsiveness and performance.

In conclusion, although mental disorders, such as schizophrenia, negatively affect the QoL of patients, but they can improve their QoL through regular aerobic exercise. Also, exercise can enhance the QoL domains, such as the psychological, motivation and energy, and symptoms and side effects of patients with schizophrenia. To recap, it is recommended to provide various training programs such as consulting, physical, and psychological protection to patients and their caregivers.

Acknowledgments

The authors would like to thank all the patients for their participation in the study. We thank the Vice-Chancellor of Research of Tabriz University of Medical Sciences for financially supporting the present study.

Table 2. Comparing the Mean of QOL After the Intervention Than Before the Intervention in Two Group^a

| Variable | Control Group | | P Value | Test Group | | P Value |
|---------------------------|---------------------|--------------------|---------|---------------------|--------------------|---------|
| | Before Intervention | After Intervention | | Before Intervention | After Intervention | |
| Quality of Life | | | | | | |
| Psychosocial | 38.29 ± 4.98 | 37.81 ± 5.48 | 0.12 | 39.50 ± 4.18 | 23.20 ± 4.79 | 0.001 |
| Motivation and energy | 13.64 ± 3.20 | 12.14 ± 2.59 | 0.14 | 11.41 ± 2.81 | 8.35 ± 3.18 | 0.001 |
| Symptoms and side effects | 18.05 ± 4.62 | 17.55 ± 3.59 | 0.18 | 16.52 ± 3.61 | 14.35 ± 2.34 | 0.001 |
| Total | 70 ± 9.94 | 69.56 ± 7.79 | 0.30 | 67.44 ± 18.13 | 45.91 ± 6.34 | 0.001 |

^aValues are presented as Mean ± SD.

Footnotes

Authors' Contribution: Author Contributions: Study concept and design:Namdar A H , Abdi M and Piri Sh. Analysis and interpretation of data: Namdar A H , Abdi M and Piri Sh. Drafting of the manuscript: Abdi M. Critical revision of the manuscript for important intellectual content: Namdar A H , Ebrahimi H , Abdi M , Mohammadian R, Mohammadpoorasl A and Piri Sh . Statistical analysis: Namdar A H , Abdi M and Piri Sh.

Clinical Trial Registration Code: IRCT2016020823525N3.

Conflict of Interests: The authors declare no conflict of interest.

Ethical Approval: The study was approved by the Ethics Committee of Tabriz University of Medical Sciences and receiving a license from the Clinical Trial Registry (REC.1394.1019).

Funding/Support: This project was financially supported by Tabriz University of Medical Sciences.

Informed Consent: Written informed consent was obtained from all participants.

References

- Vos T, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet*. 2017;**390**(10100):1211–59. doi: [10.1016/s0140-6736\(17\)32154-2](https://doi.org/10.1016/s0140-6736(17)32154-2).
- Ayano G. Schizophrenia: a concise overview of etiology, epidemiology diagnosis and management: review of literatures. *J Schizophrenia Res*. 2016;**3**(2):2–7.
- Hope J, Keks N. Chronic schizophrenia and the role of the general practitioner. *Royal Australian College of General Practitioners (RACGP)*. 2015;**44**(11):802–8.
- Hwang SS, Lee JY, Cho SJ, Lee DW, Kim YS, Jung HY. The model of the relationships among the predictors of quality of life in chronic stage of schizophrenia. *Prog Neuropsychopharmacol Biol Psychiatry*. 2009;**33**(7):1113–8. doi: [10.1016/j.pnpbp.2009.06.006](https://doi.org/10.1016/j.pnpbp.2009.06.006). [PubMed: [19539682](https://pubmed.ncbi.nlm.nih.gov/19539682/)].
- Suttajit S, Pilakanta S. Predictors of quality of life among individuals with schizophrenia. *Neuropsychiatr Dis Treat*. 2015;**11**:1371–9.

- doi: [10.2147/NDT.S81024](https://doi.org/10.2147/NDT.S81024). [PubMed: [26064055](https://pubmed.ncbi.nlm.nih.gov/26064055/)]. [PubMed Central: [PMC4455844](https://pubmed.ncbi.nlm.nih.gov/PMC4455844/)].
- Crawford MJ, Jayakumar S, Lemmey SJ, Zalewska K, Patel MX, Cooper SJ, et al. Assessment and treatment of physical health problems among people with schizophrenia: national cross-sectional study. *Br J Psychiatry*. 2014;**205**(6):473–7. doi: [10.1192/bjp.bp.113.142521](https://doi.org/10.1192/bjp.bp.113.142521). [PubMed: [25323141](https://pubmed.ncbi.nlm.nih.gov/25323141/)].
- Masoudi Alavi N, Madani M, Sadat Z, Haddad Kashani H, Reza Sharif M. Fatigue and Vitamin D Status in Iranian Female Nurses. *Glob J Health Sci*. 2015;**8**(6):196–202. doi: [10.5539/gjhs.v8n6p196](https://doi.org/10.5539/gjhs.v8n6p196). [PubMed: [26755458](https://pubmed.ncbi.nlm.nih.gov/26755458/)]. [PubMed Central: [PMC4954906](https://pubmed.ncbi.nlm.nih.gov/PMC4954906/)].
- Rahimimoghadam Z, Rahemi Z, Mirbagher Ajorpaz N, Sadat Z. Effects of Pilates exercise on general health of hemodialysis patients. *J Bodyw Mov Ther*. 2017;**21**(1):86–92. doi: [10.1016/j.jbmt.2016.05.012](https://doi.org/10.1016/j.jbmt.2016.05.012). [PubMed: [28167196](https://pubmed.ncbi.nlm.nih.gov/28167196/)].
- Kane JM, Correll CU. Pharmacologic treatment of schizophrenia. *Dialogues Clin Neurosci*. 2010;**12**(3):345–57. [PubMed: [20954430](https://pubmed.ncbi.nlm.nih.gov/20954430/)]. [PubMed Central: [PMC3085113](https://pubmed.ncbi.nlm.nih.gov/PMC3085113/)].
- Patel KR, Cherian J, Gohil K, Atkinson D. Schizophrenia: overview and treatment options. *Pharm Therapeutics*. 2014;**39**(9):638–45. [PubMed: [25210417](https://pubmed.ncbi.nlm.nih.gov/25210417/)]. [PubMed Central: [PMC4159061](https://pubmed.ncbi.nlm.nih.gov/PMC4159061/)].
- Kelly DL, Rowland LM, Patchan KM, Sullivan K, Earl A, Raley H, et al. Schizophrenia clinical symptom differences in women vs. men with and without a history of childhood physical abuse. *Child Adolesc Psychiatry Ment Health*. 2016;**10**:5. doi: [10.1186/s13034-016-0092-9](https://doi.org/10.1186/s13034-016-0092-9). [PubMed: [26941836](https://pubmed.ncbi.nlm.nih.gov/26941836/)]. [PubMed Central: [PMC4776423](https://pubmed.ncbi.nlm.nih.gov/PMC4776423/)].
- Fadai F. Rehabilitation of schizophrenia: at the end or in the beginning? *Iranian Rehabilitation Journal*. 2007;**5**(1):53–5.
- Rahimimoghadam Z, Rahemi Z, Sadat Z, Mirbagher Ajorpaz N. Pilates exercises and quality of life of patients with chronic kidney disease. *Complement Ther Clin Pract*. 2019;**34**:35–40. doi: [10.1016/j.ctcp.2018.10.017](https://doi.org/10.1016/j.ctcp.2018.10.017). [PubMed: [30712743](https://pubmed.ncbi.nlm.nih.gov/30712743/)].
- Biddle S. Physical activity and mental health: evidence is growing. *World Psychiatry*. 2016;**15**(2):176–7. doi: [10.1002/wps.20331](https://doi.org/10.1002/wps.20331). [PubMed: [27265709](https://pubmed.ncbi.nlm.nih.gov/27265709/)]. [PubMed Central: [PMC4911759](https://pubmed.ncbi.nlm.nih.gov/PMC4911759/)].
- Callaghan P. Exercise: a neglected intervention in mental health care? *J Psychiatr Ment Health Nurs*. 2004;**11**(4):476–83. doi: [10.1111/j.1365-2850.2004.00751.x](https://doi.org/10.1111/j.1365-2850.2004.00751.x). [PubMed: [15255923](https://pubmed.ncbi.nlm.nih.gov/15255923/)].
- Maayan L, Correll CU. Management of antipsychotic-related weight gain. *Expert Rev Neurother*. 2010;**10**(7):1175–200. doi: [10.1586/ern.10.85](https://doi.org/10.1586/ern.10.85). [PubMed: [20586697](https://pubmed.ncbi.nlm.nih.gov/20586697/)]. [PubMed Central: [PMC3501406](https://pubmed.ncbi.nlm.nih.gov/PMC3501406/)].
- Marzolini S, Jensen B, Melville P. Feasibility and effects of a group-based resistance and aerobic exercise program for individuals with severe schizophrenia: A multidisciplinary approach. *Ment Health Phys Act*. 2009;**2**(1):29–36. doi: [10.1016/j.mhpa.2008.11.001](https://doi.org/10.1016/j.mhpa.2008.11.001).
- Scheewe TW, Backx FJ, Takken T, Jorg F, van Strater AC, Kroes AG, et al. Exercise therapy improves mental and physical health in schizophrenia: a randomised controlled trial. *Acta Psychiatr Scand*. 2013;**127**(6):464–73. doi: [10.1111/jacsps.12029](https://doi.org/10.1111/jacsps.12029). [PubMed: [23106093](https://pubmed.ncbi.nlm.nih.gov/23106093/)].

19. Yogaratnam J, Biswas N, Vadivel R, Jacob R. Metabolic complications of schizophrenia and antipsychotic medications-an updated review. *East Asian Arch Psychiatry*. 2013;**23**(1):21-8. [PubMed: [23535629](#)].
20. Holley J, Crone D, Tyson P, Lovell G. The effects of physical activity on psychological well-being for those with schizophrenia: A systematic review. *Br J Clin Psychol*. 2011;**50**(1):84-105. doi: [10.1348/014466510X496220](#). [PubMed: [21332522](#)].
21. Stanton R, Happell B. A systematic review of the aerobic exercise program variables for people with schizophrenia. *Curr Sports Med Rep*. 2014;**13**(4):260-6. doi: [10.1249/JSR.000000000000069](#). [PubMed: [25014392](#)].
22. Happell B, Platania-Phung C, Scott D. Placing physical activity in mental health care: a leadership role for mental health nurses. *Int J Ment Health Nurs*. 2011;**20**(5):310-8. doi: [10.1111/j.1447-0349.2010.00732.x](#). [PubMed: [21896121](#)].
23. Zaheri A, Sadat Z, Abasian M, Ghanbari Afra L, Abdi M, Joodaki K, et al. Quality of life and related factors among patients discharged from critical care units. *Nurs Crit Care*. 2017;**10**(4). doi: [10.5812/ccn.62148](#).
24. Solanki RK, Singh P, Midha A, Chugh K. Schizophrenia: Impact on quality of life. *Indian J Psychiatry*. 2008;**50**(3):181-6. doi: [10.4103/0019-5545.43632](#). [PubMed: [19742235](#)]. [PubMed Central: [PMC2738356](#)].
25. Wang PW, Lin HC, Su CY, Chen MD, Lin KC, Ko CH, et al. Effect of aerobic exercise on improving symptoms of individuals with schizophrenia: A single blinded randomized control study. *Front Psychiatry*. 2018;**9**:167. doi: [10.3389/fpsy.2018.00167](#). [PubMed: [29867600](#)]. [PubMed Central: [PMC5962673](#)].
26. She J, Nakamura H, Makino K, Ohyama Y, Hashimoto H. Selection of suitable maximum-heart-rate formulas for use with Karvonen formula to calculate exercise intensity. *International Journal of Automation and Computing*. 2014;**12**(1):62-9. doi: [10.1007/s11633-014-0824-3](#).
27. Wilkinson G, Hesdon B, Wild D, Cookson R, Farina C, Sharma V, et al. Self-report quality of life measure for people with schizophrenia: the SQLS. *Br J Psychiatry*. 2000;**177**:42-6. doi: [10.1192/bjp.177.1.42](#). [PubMed: [10945087](#)].
28. Foruzandeh N, Delaram M, Aeen F, Deris F. [The relationship between positive and negative symptoms and quality of life in chronic schizophrenic patients of Sina hospital Juneqan]. *Researches of behavioral sciences*. 2011;**9**(4):295-304. Persian.
29. Brenes GA, Williamson JD, Messier SP, Rejeski WJ, Pahor M, Ip E, et al. Treatment of minor depression in older adults: a pilot study comparing sertraline and exercise. *Aging Ment Health*. 2007;**11**(1):61-8. doi: [10.1080/13607860600736372](#). [PubMed: [17164159](#)]. [PubMed Central: [PMC2885010](#)].
30. Kalateh Jari M, Bagheri H, Hasani MR. [The effect of aerobic exercise on quality of life in schizophrenia patients]. *Shahrekord University of Medical Sciences*. 2007;**9**(3):28-36. Persian.
31. Gorczynski P, Faulkner G. Exercise therapy for schizophrenia. *Schizophr Bull*. 2010;**36**(4):665-6. doi: [10.1093/schbul/sbq049](#). [PubMed: [20484521](#)]. [PubMed Central: [PMC2894605](#)].
32. Falkai P, Malchow B, Wobrock T, Gruber O, Schmitt A, Honer WG, et al. The effect of aerobic exercise on cortical architecture in patients with chronic schizophrenia: a randomized controlled MRI study. *Eur Arch Psychiatry Clin Neurosci*. 2013;**263**(6):469-73. doi: [10.1007/s00406-012-0383-y](#). [PubMed: [23161338](#)].
33. Rimes RR, de Souza Moura AM, Lamego MK, de Sa Filho AS, Manochio J, Paes F, et al. Effects of exercise on physical and mental health, and cognitive and brain functions in schizophrenia: Clinical and experimental evidence. *CNS Neurol Disord Drug Targets*. 2015;**14**(10):1244-54. doi: [10.2174/187152731566615111130659](#). [PubMed: [26556069](#)].
34. Oertel-Knochel V, Mehler P, Thiel C, Steinbrecher K, Malchow B, Tesky V, et al. Effects of aerobic exercise on cognitive performance and individual psychopathology in depressive and schizophrenia patients. *Eur Arch Psychiatry Clin Neurosci*. 2014;**264**(7):589-604. doi: [10.1007/s00406-014-0485-9](#). [PubMed: [24487666](#)].
35. Gomez-Pinilla F, Hillman C. The influence of exercise on cognitive abilities. *Compr Physiol*. 2013;**3**(1). doi: [10.1002/cphy.c110063](#).
36. Livia B, Elisa R, Claudia R, Roberto P, Cristina A, Emilia ST, et al. Stage of change and motivation to a healthier lifestyle before and after an intensive lifestyle intervention. *J Obes*. 2016;**2016**:6421265. doi: [10.1155/2016/6421265](#). [PubMed: [27239339](#)]. [PubMed Central: [PMC4864539](#)].
37. Petzinger GM, Holschneider DP, Fisher BE, McEwen S, Kintz N, Halliday M, et al. The effects of exercise on dopamine neurotransmission in parkinson's disease: Targeting neuroplasticity to modulate basal ganglia circuitry. *Brain Plast*. 2015;**1**(1):29-39. doi: [10.3233/bpl-150021](#). [PubMed: [26512345](#)]. [PubMed Central: [PMC4621077](#)].