

The Effect of Group Aerobic Exercise on Emotional and Social Cognition of Patients with Schizophrenia: A One-Blind Clinical Study

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Abstract--- Background: Today, owing to the high side effects of antipsychotic drugs in the symptomatic treatment of schizophrenia (SZ) patients and their lack of effect on the social, cognitive and occupational function of patients, other non-pharmacological methods such as exercise therapy as a combination therapy have been considered. Therefore, in this study, we try to investigate the effect of group aerobic exercise on emotional and social cognition of patients with schizophrenia.

Methods: In this one-blind clinical study, 30 males with schizophrenia aged 20 to 60 years who satisfied the inclusion criteria (including informed consent from the patient or his or her legal guardian and no underlying cardiovascular illness) were studied at Kashan's Parham Psychiatric Center. Then, for six months (during the spring and summer of 2022), they did aerobic exercises twice a week for half an hour each, under the direction of a sports coach. Finally, Ekman and Stroop cognitive tests were administered to each patient in the form of interviews and questionnaires before and after the intervention, and the findings were analyzed.

Results: In our study, the mean age of the subjects was 45.87 ± 10.59 years and the mean age of the onset of disease was 23.00 ± 3.85 years. Aerobic exercise significantly reduced the scores of the construction tests of sequences 1, 2 and 3 and also the Stroop test 1, 2 and 3 at the end of the study compared to the initial values ($P < 0.05$).

In addition, it caused a significant increase in the Strope test score of the direct and inverse span of words and direct numbers after the intervention compared to before the intervention ($P < 0.05$).

Conclusion: According to our findings, aerobic exercise has a favorable and significant influence on the emotional and social cognition of schizophrenia patients. However, greater sample size studies and the use of diverse approaches to analyze the effect of exercise in these patients are required to more accurately understand the issue and make better recommendations.

Keywords--- Schizophrenia, Emotional Cognition, Social Cognition, Aerobic Exercise.

I. Introduction

Schizophrenia (SZ) is a chronic psychiatric disorder with a genetic and neurobiological background that affects the early development of the brain and manifests itself in a combination of psychotic symptoms - such as hallucinations and mental disorders and motivational and cognitive disorders (1, 2). More than 26 million people worldwide suffer from this chronic disease, with schizophrenia having a prevalence of about one percent worldwide (3, 4). People with schizophrenia show disorders in selective attention, working memory, and executive function, so that cognitive function is impaired in patients with moderate to severe schizophrenia (5). However, these disorders do not respond well to antipsychotic drug therapies, which often have severe side effects and reduce patients' well-being (6).

On the other hand, schizophrenia patients require a large number of antipsychotic medicines, and the long-term use of these treatments, in addition to having severe side effects, imposes a significant financial burden on patients. Non-drug treatments for the treatment of these people are of enormous economic relevance in this respect, since they limit the harm caused by medications (7). Regular exercise is one source of non-pharmacological cure for the condition (8). Because exercise by secreting factors such as serotonin modulates the nervous system and strengthens the secretory systems of neurotransmitters such as dopamine, which play a key role in the pathogenesis of schizophrenia patients. For most patients with schizophrenia, exercise is used along with other therapies as a combination therapy (9). Because it is believed that exercise in people with psychiatric disorders, such as schizophrenia, can make a significant difference in their course of treatment (7). The effect of aerobic exercise on cognition seems to be selective and depends on the nature of patients' cognitive functional problems as well as their underlying brain problems. Exercise therapy, if done once or twice a week, improves mental health and cardiovascular fitness and reduces the need for care in patients with schizophrenia (10, 11). In a way, it can be said that the effect of exercise on multiple dimensions of the disease is not well understood. For example, in a study conducted by Oertel-Knöchel et al. In 2014 on 29 patients with schizophrenia, after 4 weeks of aerobic exercise, no acceptable and significant change in patients' verbal learning was observed (12).

Therefore, in view of the above and the lack of sufficient studies to investigate the effect of aerobic exercise on emotional cognition and social cognition of patients with schizophrenia, this study was designed to investigate the effect of aerobic exercise on emotional and social cognition of schizophrenic patients.

II. Method and Material

Subjects and Inclusion and Exclusion Criteria

Our study population consisted of 30 patients including male patients aged 20 to 60 years who were included in the study by census. The patients were referred to Parham Psychiatric Care Center in Kashan for more than 6 months and received standard antipsychotic drug treatment. It should be noted that in this study, only schizophrenic patients were included in the study who had informed consent (Obtained from the patient himself or his legal guardian) did not have underlying disease such as heart and lung problems and did not receive any new treatment in the last six months. Patients who missed more than three treatment sessions, patients who required new pharmacological or non-pharmacological intervention during the project, patients whose medication protocol was changed for any reason, patients with hearing problems, vision problems, mental retardation, motor problems, and patients who used drugs were also excluded from the study. Subjects received first - and second - generation antipsychotics and antipsychotics, as well as benzodiazepines and TCAs throughout the study, and no dose or type of medication was changed. If a dose change was required, the participant was excluded from the study due to the possibility of bias.

Outcome Evaluation

First, before performing the interventions, Ekman and Stroop cognitive tests for the subjects were completed in the form of interviews and questionnaires by a psychologist who was not part of the research team and was unaware of the objectives of the intervention study (at this stage, patients were also screened for cardiovascular and pulmonary problems using the patient's examination file and ECG and the patient's history, so that patients who did not meet the requirements to enter the study were not admitted from the beginning). The procedure was then repeated for each patient after 6 months by the same previous psychologist to identify and record possible cognitive changes in patients.

Intervention

In this study, in addition to taking standard drugs, the patients underwent aerobic exercise for six months, twice a week and each time for half an hour in the April 2022 under the supervision of a sports instructor. In this study, aerobic exercise meant fast and regular movements of the neck, arms, legs and back in a specific exercise package that were repeated in each session and included movements such as butterfly, raising the opposite arm and leg, hitting around and rope play. In other words, it included a regular and specific package of aerobic exercise and intense hypo-stretching, which included simple movements that could be imitated by patients in the neck, arms, back and legs, and was performed with loud music to create excitement in patients. These exercises are associated with energy consumption and increased oxygen consumption for patients and do not require special equipment to perform. In aerobic activity, heart rate was an indicator of activity intensity. In this way, for people who had no history of participating in sports activities and did not have cardiovascular problems, the intensity of activity was determined based on 50 to 60% of the maximum heart rate. This type of aerobic exercise program is called submaximal, where the maximum heart rate is calculated using the 220-age formula. In this regard, during exercise, people's heart rate was monitored using a polar clock. In an aerobic exercise protocol, three parameters of intensity, duration and repetition of training sessions plus duration of training were considered. If the patient did not want to continue participating in the study and his continuous absence was excluded from the study.

Features of Used Tools

In this study, Ekman cognitive test was used to assess patients' social and emotional cognition, the validity of which has been confirmed in the study of Derogatis et al. (13). Its reliability was also evaluated in the study of Derogatis et al. (13) in 1994, for which the figure was obtained between 0.78 and 0.90. This test provides an extensive list of key emotions, including a expanse of positive and negative emotions, including 54 questions; The answers to the questions are optional and angry, happy, sad, scared. A score less than 27 indicates the average person's social cognition and less than 15 indicates the patient's cognitive impairment.

In this study, in addition to the mentioned tools, we also used the Facial Emotions Recognition Test (TREF) for social cognition (14). In summary, the test consists of 13 images and assesses people's ability to recognize six universal emotions (happiness, anger, sadness, fear, disgust and humiliation). Each of these emotions is represented by 4 different models (two men and two women) in nine intensity levels from 20 to 100%. Each photo will be presented in 10 seconds and there is no time limit for responding. In our study, patients' social cognition was measured using TREF, without determining the cutoff point and only based on the number of correct or incorrect answers in the test before and after the intervention.

Finally, in this study, we used the Stroop test to measure patients sustained and selective attention and short-term and functional memory. This test is timed and consists of three main sections in which the speed of mental transmission is also measured. The three sections include the word expanse, the number expanse, and the color word expanse. In the expanse of numbers and words, the patient should be able to repeat the words one after the other after observing or hearing, and the repetition of the words is also measured in inverse in the patient. The number and word expanses are used, both directly and indirectly, to measure short-term and functional memory and sustained attention. The number and colored word expanses are also used to measure sustained and selective attention. Finally, according to the test time and speed of patient transfer and the number of errors, he is awarded a score. The color word test has two steps. In the first step, to measure the reading time of the words, the patient is shown non-colored words and the reading time is measured with a stopwatch. Then, in the second stage, the words do not match their color and the patient should be able to read words from them regardless of the color, in this test, the score is measured based on the number of errors and the speed of reading words. The reliability of this test has been obtained by retesting for different parts between 0.59 and 0.92 (15).

Statistical Analysis

In this study, after collecting data, descriptive statistics such as mean, frequency and percentage were used to describe the study population. Then, in order to evaluate the effect of the intervention, the paired t-test of Paired Samples Test for normal data and the non-parametric Wilcoxon test for abnormal data were used. Significance level was considered less than 0.05 in all cases.

III. Results

Basic Information

In this study, the effect of group aerobic exercise on emotional and social cognition of patients with schizophrenia in Kashan in 2022 was investigated. The total number of patients at the beginning of the study was 30, of which 7 fell during the study, and 23 patients remained in the study and did aerobic exercise for six twice a week for half an hour each month. The mean age of our subjects was 45.87 ± 10.59 years and the mean age of onset of the disease was 23.00 ± 3.85 years. Moreover, most of the people included in our study had a middle school education.

Comparison

After checking the normality of the data, except for the direct number measurement and Stroop1 test, for other measurements, the data almost followed the normal distribution. Therefore, in all cases except the mentioned cases, paired t-test and in two cases, non-parametric Wilcoxon test were used to compare the results before and after the intervention. As can be seen in Table 1, no significant difference was observed between emotional cognition before and after the intervention ($P=0.215$). However, the test score increased after the intervention, and this could indicate the effect of aerobic exercise on emotional cognition. The observations of Table 1 showed that aerobic exercise significantly increased the score of the direct expanse of numbers ($P=0.014$), the direct expanse of words ($P=0.008$) and inverse expanse of words ($P=0.043$) after intervention (Table1). It can almost be said that the values changed in all cases are between 0.1 and 0.3. However, our intervention did not significantly increase the score of inverse expanses of numbers at the end of the study compared to the initial values ($P=0.103$). Similarly, after the intervention, lower values of sequence construction tests 1, 2 and 3 were observed, which were also significant compared to before the intervention. After the intervention, a decrease of approximately 13 units of sequence construction test scores was observed (Table 1). In this regard, we observed a significant decrease in Stroop test scores 1, 2 and 3 after the intervention compared to before (Table 1). So that the range of differences between the two groups differed by about seven points for the Stroop 1 score and by about 29 points for the Stroop 3 score.

Table 1: Comparison of Emotional Cognition Scores, different Areas of Stroop Test, Sequence Tests 1, 2 and 3 and Strobo Test 1, 2 and 3 in the Subjects Before and After the Intervention; b: Before, a: After

Variable (seconds / word count)	No.	Mean	SD	P-value
Emotion cognition (b)	23	2.70	1.55	0.215
Emotion cognition (a)	23	3.09	1.59	
Direct expanse of numbers (b)	23	2.87	0.97	0.14
Direct expanse of numbers (a)	23	3.13	0.92	
Inverse expanse of numbers (b)	23	1.43	0.84	0.103
Inverse expanse of numbers (a)	23	1.61	0.78	
Direct expanse of words (b)	23	2.35	1.03	0.008
Direct expanse of words (a)	23	2.70	0.93	
Inverse expanse of words (b)	23	1.04	0.71	0.043
Inverse expanse of words (a)	23	1.22	0.60	
Sequence construction test 1 (b)	23	98.04	25.86	0.02
Sequence construction test 1 (a)	23	85.52	20.00	
Sequence construction test 2(b)	18	107.94	16.53	0.005
Sequence construction test 2 (a)	18	93.44	19.91	
Sequence construction test 3 (b)	23	94.70	37.02	0.001
Sequence construction test 3 (a)	23	83.17	30.99	
Stroop test 1(b)	23	78.74	29.72	0.024
Stroop test 1(a)	23	71.30	26.13	
Stroop test 2 (b)	23	76.57	27.82	0.001
Stroop test 2 (a)	23	67.22	23.30	
Stroop test 3 (b)	23	193.42	49.93	0.001
Stroop test 3 (a)	23	164.53	49.73	

IV. Discussion

In this one-blinded intervention study, we were able to take a step towards explaining the effect of aerobic exercise on the emotional and social cognition of schizophrenic patients. Findings of our study showed that patients' abilities were significantly different in terms of Strop test score, direct expanse of numbers and words, inverse expanse of words, sequence construction test 1, 2 and 3 and also Strop test 1, 2 and 3 after the intervention, which can indicate the effect of aerobic exercise on cognitive and emotional performance of these patients.

In comparison with previous evidence, in 2014, a study entitled the effect of aerobic exercise on cognitive function and individual psychological pathology of patients with major depressive disorder (MDD) and SZ was conducted by Oertel-Knochel et al. In this study, the effects of aerobic exercise on cognitive function and symptom severity in psychiatric patients were investigated (12). Two groups of patients (n = 22 MDD patients, n = 29 SZ patients) who matched in terms of age, gender, duration of illness and years of study, received cognitive training with aerobic exercise or with relaxation exercise.

The interventions consisted of 12 sessions (3 times a week) over a period of 4 weeks, each lasting 75 minutes (30 minutes of cognitive training - 45 minutes of cardio / mental relaxation training). The findings of this study showed an increase in cognitive function in the areas of visual learning, working memory and processing speed, reduced state anxiety and increased mental quality of life after the intervention. However, the effects were stronger in SZ patients than in MDD patients for cognitive function, while there were stronger effects in MDD patients than in SZ patients in individual psychopathological values (12).

The severity of negative symptoms in SZ patients decreased after the intervention and the effects of combination training were superior to other forms of treatment. The results of this study were inconsistent with the data obtained from our work, which can probably be attributed to the discrepancy between the different courses of exercise, the study of exercise on SZ and MDD patients simultaneously, and the lack of factors such as Stroop test and sequence test. But it was in line with the results of Pajonk et al. (16), which showed the beneficial effects of aerobic exercise on depressed and schizophrenic patients.

Furthermore, Areshtanab et al. conducted a study in 2020 with the aim of investigating the effect of aerobic exercise on the quality of life of men with schizophrenia admitted to Razi Psychiatric Center in Tabriz from 2015 to 2016. In this randomized controlled trial, 68 patients who met the inclusion criteria were randomly divided into two groups of intervention (n = 34) and control (n = 34). The intervention group benefited from 24 sessions for 8 weeks and a total of 12 hours of aerobic exercise, and the control group used fresh air at the same time. The Schizophrenia Quality of Life Scale (SQLS) was completed before and after the intervention in both groups. There was no

significant difference in quality of life between the two groups before the intervention, but they were significantly different after the intervention. In addition, the results of the study showed a significant difference in terms of motivational quality of life in both groups after the intervention (17). Overall, regular aerobic exercise has been shown to reduce the symptoms of male patients with schizophrenia, which in turn improves all aspects of quality of life. The results of these researchers were inconsistent with our data in that the factors under study were different. The results of these researchers were consistent with a study by Kalateh Jari et al. (18) which showed that aerobic exercise positively affects the quality of life of schizophrenic patients.

On the other hand, the effect of aerobic exercise on improving the symptoms of people with schizophrenia was evaluated in another a one-blinded randomized controlled trial by Wang et al. (19). In this study, 33 and 29 participants, respectively, who were treated with antipsychotic drugs for schizophrenia, were randomly assigned to the aerobic exercise group and the control group. The severity of schizophrenia symptoms was measured using the Positive and Negative Syndrome Scale (PANSS) before, immediately after and 3 months after the intervention in both groups. The results of this study showed that the severity of positive symptoms and general psychological pathology in the intervention group decreased significantly during 12 weeks, but there was no significant difference compared to the 3-month follow-up period. However, the severity of negative symptoms in the intervention group decreased during the intervention and 3 months after. Finally, it was found that aerobic exercise can improve the severity of symptoms on negative and general psychiatric pathology scales in people with schizophrenia treated with antipsychotic drugs. The results of this study were not in line with our findings on the use of PANSS and the duration of the intervention.

In another study by Mahdinasari Nasution et al., The effect of aerobic exercise on the positive and negative symptoms of schizophrenia was investigated (20). In this study, the subjects were divided into two groups of intervention and control, which was given to the intervention group 3 times a week for 8 weeks of aerobic exercise. The results showed that no significant differences in age, sex, level of education, disease period, age of onset and BMI were observed between the two groups. In addition, there was no difference in the total PANSS score between the intervention group and the control group. But the mean change of PANSS negative score in the intervention group and in the control, group were significantly different ($P < 0.0001$) (20). Which is consistent with other similar studies that have examined the positive and negative symptoms of the disease (21, 22). However, the evaluation method used in this study is different from our study and cannot be properly compared. But it can be said that measuring the effect of exercise in these patients by considering the positive and negative symptoms and with different tools can provide a better clinical perspective in these patients.

One of the limitations of this study is its small sample size. It is better to consider more people with this disease in future studies in order to generalize the findings of the study with more confidence. Another limitation of our study was the lack of study of the role of fitness as a potential confounder in the relationship between exercise and disease.

V. Conclusion

In this study, we were able to take an effective step to explain the effect of aerobic exercise on emotional and social cognition of schizophrenic patients and the effect of exercise was investigated with various tools. However, in order to more accurately explain the issue and make better decisions, studies with larger sample sizes and the use of multiple methods to assess the role of exercise in these patients are needed.

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