

The effect of yoga exercise on executive function in male patients with schizophrenia

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Abstract

A specific model of yoga for schizophrenia has been developed and validated, showing significant improvement in symptoms, especially negative symptoms and impairment in emotion recognition and real-life functioning. This is because yoga can cause changes in the brain structure of schizophrenia patients. In this quasi-experimental study, 30 male patients with schizophrenia participated, who were selected as available and randomly divided into two groups of 15 control and intervention. The Wisconsin Executive Function Test was used to measure executive functions. The findings of the study showed that yoga exercises have a beneficial effect on improving the executive functions of male schizophrenia patients.

Keywords: disease, Schizophrenic men, Yoga exercises, Sports movements, Executive function, Schizophrenia, yoga

Introduction

Schizophrenia is a mental disorder characterized by impaired thought processes and poor emotional responsiveness. This mental illness is a recognized disorder in all regions and cultures, with geographical differences in prevalence (1). Although the prevalence of schizophrenia is unclear, it is estimated that seven out of every thousand people are at risk of developing this disease. Factors affecting the prevalence of this disease include latitude, gender, immigration, and urbanization. McGraw et al. reported in a review study that the average prevalence of schizophrenia in different regions was 15.2% per 100,000 people and the mortality rate from this disease was 2.7% per 100 people. (2) The prevalence of the disease in Iran is such that if the population of Iran is assumed to be 70 million, about 350,000 people are affected by schizophrenia. Factors affecting the occurrence of this disease are genetic, environmental, and psychosocial factors. Given the high heritability of schizophrenia, the important role of genetics in this disease is obvious (3). Generally, three main symptoms are accepted for the presence of schizophrenia: positive symptoms (delusions and hallucinations); negative symptoms (low mood, loss of motivation, loss of pleasure, loss of language abilities); behavioral symptoms (disordered thinking, incoherence, inappropriate behavior). Some research suggests that these three symptoms are combined, and some other observations suggest that

these three symptoms are not related and are independent of each other; although several studies have shown a connection between these symptoms (4). Inappropriate production of free radicals and antioxidant enzymes and increased inflammatory reactions have been observed in schizophrenic patients (2). On the other hand, some biological, psychological and social factors play a role in the etiology of schizophrenia. In addition to heredity, biological factors include increased dopamine, some neurotransmitters such as serotonin, norepinephrine, and inhibitory amino acids such as gamma-aminobutyric acid, and free radicals (3,4).

Cognitive functions play a very important role in the ability of an individual to manage positive symptoms. Cognitive dysfunction is one of the more common symptoms in the early stages of schizophrenia and is considered a core feature of the disease, which can cause functional impairment and may be considered as both negative and positive symptoms in the clinical treatment of the disease. Several findings indicate that a large population of these patients is associated with deficits in cognitive functions (5). In general, the cognitive functions that are affected by this disease include verbal memory, episodic memory, visuospatial memory, working memory, attention, information processing speed, social cognition, motor function, and executive functions (6).

Schizophrenia, as one of the most important mental disorders, has occupied a large part of psychiatric research. Patients with this disorder include a wide spectrum that differ in terms of factors causing the disease, signs and symptoms, and prognosis, so much so that some doctors call it the disease of a thousand faces. The prevalence of schizophrenia in the entire lifespan is 1 – 1.5%. Despite the fact that the prevalence of this disorder is the same in all human societies, significant differences are seen in terms of signs and symptoms of the disease in different communities and cultures. The prevalence of schizophrenia is equal in men and women, but the onset and course of the disease differ in the two sexes. The maximum prevalence is in men aged 15-25 and in women aged 25-35. About 90% of sufferers are between the ages of 15-50.

According to Keifeh, among cognitive deficits, deficits in executive functions play a more effective role in limiting patients' ability to maintain and relearn the skills necessary for action in the real world. (7) The concept of executive function can be expressed in a simpler form as the central system that is at the highest level and directs the cognitive abilities of the individual - planning and executing operations. In this concept, it is clear that the ability to plan, organize, initiate and sequence behavior, model behavior, integrate self-monitoring behavior, and recognize errors again and inhibit behavior that is inconsistent

with the goal are among the tasks of executive functions.

And schizophrenic patients have more subtle neurological symptoms compared to mood patients (4). Also, subtle neurological symptoms in schizophrenic patients are associated with low birth weight and neonatal problems.

Many studies have confirmed changes in the structure of the central nervous system of schizophrenia patients. In a brain imaging study, Chika and colleagues found that a decrease in the connection between the frontal cortex and the thalamus, especially the medial (lateral) nucleus, as well as a decrease in the gray matter volume of the brain, are among the factors affecting the development of executive function disorders in schizophrenia patients (9).

In 1980, Touré described subtle neurological symptoms as unilateral, with most of the left hemisphere of the brain affected (7). There are reports that subtle neurological symptoms are associated with personality traits of social isolation and negative symptoms of pathological vulnerability to movement disorders, delayed ventricular enlargement, and the chronicity of schizophrenia (11). Schizophrenic patients have more subtle neurological symptoms than normal individuals. Also, the prevalence of subtle neurological symptoms in schizophrenia is about 50-65% (8, 4).

Cognitive impairment is widespread among people with schizophrenia, and treatment options are limited. Treatment plans for schizophrenia patients include hospitalization, medication, and electroconvulsive therapy, as well as psychosocial therapies such as behavioral skills, family, individual group, and social therapy, and rehabilitation therapies such as cognitive therapy and physical activity (10). Exercise-based interventions, as an effective non-pharmacological treatment, play a very important role in the rehabilitation of these patients. The reviewed studies concluded that aerobic exercise affects cognitive functions, especially working memory, verbal memory, and short-term memory in people with schizophrenia, and therefore physical activity is recommended for these people. In addition, due to the limitations in physical movements, motor control, and muscle agility of these patients, some mental exercises and physical exercises with mental emphasis, such as yoga and tai chi, can be more effective (11).

Yoga as a sport is a physical activity that consists mainly of various postural postures, often linked together in a sequence of movements, sometimes accompanied by breathing exercises, and often ending with a relaxing stretch or meditation. Yoga in this form is popular all over the world, especially in the United States and Europe. Yoga stretches the muscles, improves flexibility and balance, and helps you relax and reduce stress. Research has also shown that yoga practice also reduces stress, anxiety, depression, and chronic pain. Yoga helps you sleep better. When you practice yoga, many hormones are activated in your body that play a huge role in maintaining your body's health and also in continuing your life (12).

Various studies show that yoga exercises have an effect on the development of cognitive functions of these individuals, because yoga can cause changes in their brain structure, according to (13). therefore, the aim of the present study was to investigate the effect of a course of yoga exercises on the executive functions of schizophrenia patients.

Methods

The present study was a quasi-experimental study that was conducted with a pre-test and post-test design and a follow-up test with an experimental group (15) and a control group (15) person. 30 men who were diagnosed with schizophrenia by a psychologist and psychiatrist based on DSM-IV-TR criteria were selected with full consent and availability. The conditions of the patients to participate in this study were the absence of additional diseases, including diabetes, blood pressure, history of seizures and cardiovascular diseases. Both groups were based on age, level of education, duration of the disease, time of onset, disease, years of hospitalization.

The number of electric shocks and positive and negative symptoms were matched, and there was no significant difference between the two groups at the beginning of the study ($p < 0.05$). In addition, all participants used routine medications and their medication doses did not change during the intervention. During the training period, the control group only followed the usual treatment programs; but the experimental group, in addition to the usual treatments, performed yoga exercises three time per week for 3 months according to Tables 1.

Table 1. Basic yoga exercises

Time (second)	Lying movements	Seated Moves	Standing Moves
12	Liner	Butterfly	Nataraj
12	Grasshopper	Close-Legged Forward Bend	Forward Bend
12	Single leg extension	Single-Legged Forward Bend	Back Bend
12	Lifting butterfly	Open-Legged Forward Bend	Side Bend
12	Leg scissors	Side Bend	Triangle
12	Happy child	Spinal Twist	Split Leg Forward Bend
12	Leg extension	Camel	Agile Rider
12	Lifting simple twist	Cat	Tree
12	Bow	Mountain	Angel

Before starting the exercises, the pre-test phase assessed executive functions using the Wisconsin Test. The duration of each exercise session was a maximum of 70 minutes. After three months of intervention, the aforementioned tests were taken again in the post-test phase, and a follow-up test was performed after six months. In order to collect information in this study, the Wisconsin Card Software was used to assess executive functions.

Wisconsin Card Sorting Test (WCST): Wisconsin Card Sorting Test (64 Cards) were created by Grant and Berg in 1948. In this test, the subject is presented with a set of 64 cards on which there are one to four symbols in the form of a triangle, a star plus, and a circle in four colors: red, blue, yellow, and green; of course, no two cards are alike. Four cards, including a red triangle, two green stars, three plus yellow, and four blue circles, are used as the main cards. The subject is tasked with placing the other cards under the main card based on the principle that governs the four cards. After each answer, the subject receives feedback whether the answer is correct or incorrect. In fact, he is told whether his placement is correct or incorrect. The intended pattern for the four main cards ones are color, shape, and number, which are repeated twice (C, F, N, C, F, N) (14). After the subject gives a sufficient number of consecutive correct answers, the desired pattern changes, but the subject is not aware of the change in the pattern and must discover it himself. Two main indicators (the number of classes obtained and the number of errors in the retention) indicate the subject's performance. The duration of the test is about 2.5 to 10 minutes, depending on the speed of response. Review and summary of the scoring options in this study are:

1. Number of errors in persistence: When the subject persists in an initial incorrect guess at the beginning of the test and responds accordingly, and when he continues his responses according to the previous successful principle while providing incorrect feedback shows that the pattern has changed, the responses are considered as errors in persistence
2. Total number of correct responses
3. Total number of incorrect responses
4. Duration of attempts to complete the pattern.

The validity of this test for cognitive deficits following brain damage is more than 0.86 and its reliability in an Iranian sample with the test-retest method has been reported to be 0.85 (15)

Results

Based on the results of the analysis of variance test, as you can see in the table, the results of the Bonferroni post hoc test showed that in the control group, the average perseveration scores between the pre-test and post-test stages and the post-test and follow-up stages did not differ significantly, but in the intervention group, the average perseveration scores in the pre-test were significantly higher than those in the post-test and follow-up stages. However, there was no significant difference between the average perseveration scores in the post-test and follow-up stages. These results indicate that the intervention was effective in reducing perseveration immediately after the intervention and its sustainability after the intervention was discontinued. Also, in the comparison between the two control and intervention groups, there was no significant difference in the pre-test, and in the post-test and follow-up stages, the average perseveration in the intervention group was significantly lower. The results of Bonferroni's post hoc test in the variable of correct answers showed that in the control group, the average number of correct answers between the stages of pre-test and post-test and post-test and follow-up and pre-test and follow-up did not have a significant difference, but in the intervention group, the average number of correct answers in the pre-test The test is significantly less than the post-test and follow-up stages. Also, there is no significant difference between the average number of correct answers in the post-test and follow-up stages. Therefore, the implementation of the intervention was effective in increasing the number of correct answers, and this effectiveness was stable after the intervention was discontinued. In the comparison between the two control and intervention groups, there was no significant difference in the pre-test, and in the post-test and follow-up, the average number of correct answers in the intervention group was significantly higher.

Table 2. Results of analysis of variance in pre-test, post-test, and follow-up stages in the intervention and control groups

Follow-up		Post-test		Pre-test		Groups	Variable
M	SD	M	SD	M	SD		
9.13	5.36	7.09	3.96	15.27	5.29	Intervention	Perseveration
17.33	8.21	12.01	6.21	14.86	6.27	Control	
33.02	7.53	33.37	8.42	25.09	5.69	Intervention	Correct answers
23.20	4.62	25.49	5.87	26.80	5.64	Control	
26.37	8.67	25.20	9.23	35.05	5.68	Intervention	Incorrect responses
35.68	6.65	33.05	6.71	32.33	5.43	Control	
274.89	76.96	274.11	79.44	375.15	91.42	Intervention	Time required to complete the attempts
357.19	109.80	365.98	129.41	371.39	130.13	Control	

The results of the Bonferroni test regarding the variable of incorrect responses showed that in the control group, the average number of incorrect responses between the pre-test and post-test, post-test and follow-up, and pre-test and follow-up stages did not differ significantly, but in the intervention group, the average number of incorrect responses in the pre-test was significantly lower than the post-test and follow-up stages. There was also no significant difference between the average number of correct responses in the post-test and follow-up stages. Therefore, the implementation of the intervention was effective in reducing the number of correct responses, and this effectiveness was stable after the intervention was discontinued. In the comparison between the two control and intervention groups, no significant difference was observed in the pre-test, and in the post-test and follow-up, the average number of correct responses in the intervention group was significantly lower.

The results of the Bonferroni test regarding the variable of time required to complete the attempts showed that in the control group, the average time between the pre-test and post-test, post-test and follow-up, and pre-test and follow-up stages did not differ significantly. However, in the intervention group, the average time in the pre-test was significantly greater than the post-test and follow-up stages. Also, there was no significant difference between the average time in the post-test and follow-up stages. These results indicate that the intervention was effective in reducing the time to complete the attempts after the intervention and its sustainability after the intervention was discontinued. In the

comparison between the control and intervention groups, no significant difference was observed in the pre-test, and in the post-test and follow-up, the average time in the intervention group was significantly lower.

Discussion

Executive deficits are the main symptom of schizophrenia patients. Many studies show that these patients often perform poorly in various cognitive domains, including attention, memory, and executive functions. For this reason, this study examined the effect of yoga exercises on the executive functions of these patients. Based on the findings of the study, a significant difference was observed between the scores obtained in the retention, number of correct and incorrect responses, and the duration of trying to reach the model in schizophrenia patients in the two experimental and control groups in the pre-test and post-test stages, and the experimental group obtained better average scores. In addition, based on the findings of the present study, in the follow-up stage, which was conducted six months after the post-test, no significant difference was observed between the post-test and follow-up scores in the intervention group. These results indicate that the effect of yoga exercises is maintained after six months of no exercise. Therefore, the findings of the study show the beneficial effect of yoga exercises on improving the executive functions of schizophrenia patients. Yoga is a comprehensive and comprehensive practice that includes physical, breathing, and relaxation exercises. Recent brain imaging studies have shown that mental relaxation in yoga improves frontal lobe activity. The positive effects of yoga on improving patients' executive functions can be attributed to changes in

activity in the frontal lobe, because the impairment in frontal lobe function and the increase in blood flow, oxygen consumption, and metabolic rate due to yoga exercises may have improved symptoms of this disorder. In addition, researchers found that yoga exercises can reduce stress and anxiety, followed by increased attention and improved cognitive functions. It has been observed that yoga exercises can regulate the sympathetic, pituitary, and hypothalamus systems, which are the centers that control adrenaline secretion in response to anxiety. Yoga breathing exercises and their interaction with complex movements can also be used to control stress. On the other hand, studies have shown that yoga can reduce the level of the hormone cortisol in the blood, resulting in a decrease in stress. In addition, yoga increases the secretion of the neurotransmitter serotonin and reduces anxiety and depression. As a result, it helps increase resistance to stress. This exercise reduces stress hormones by increasing oxygen distribution. Decreased mood leads to a decrease in cognitive functions. Yoga exercises can increase self-efficacy, attention, and self-control in individuals by increasing concentration and creating relaxation. As a result, these effects cause greater adaptation of the individual as well as more desirable cognitive functions and ultimately better mood. Researchers predict that improvements in emotional stability can lead to better executive functions. Regulating emotions leads to better decision-making and, as a result, greater mastery of executive functions. These results indicate that yoga practice increases motivation, enthusiasm, and interest in communicating with patients, which improves patients' mental health and prevents cognitive fatigue. Therefore, yoga practice may increase motivation and interest in schizophrenia patients and improve their cognitive functions.

Conclusions

Yoga as a therapy in psychosis, specifically schizophrenia, has been demonstrated to be feasible and effective as an add-on therapy. Most of the studies have used a combination of asanas and pranayama, avoiding meditation. The effects are multifaceted, including reduction of psychotic symptoms and depression, improving cognition, increasing quality of life, and producing neurobiological changes, such as increased oxytocin levels.

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