Effect of Aerobic Exercise on Depression in Patients with Multiple Sclerosis

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Abstract

Background: Multiple sclerosis is considered the major cause of neurological disability in young adults worldwide (1). Depression is the commonest psychiatric manifestation in MS patients but still remains unclear (2). **The purpose** of this study was to investigate the effect of aerobic exercise on depression in patients with Multiple Sclerosis.

Methodology: twentypatients of both sexes, their ages were ranged from (20-40) years were assigned into two equal groups (group a, b): group (A) patients were treated by eight hours of aerobic exercise using stationery bicycle while group (B) patients did not receive the previous modality (control group). Subjects were assessed using Beck depression inventory. **Results:** "Paired t test" revealed that there was a significant reduction of BDI score ($p<0.05$) at post treatment in compared to pre treatment for group A aerobic exercise while there was no significant difference ($p>0.05$) at group B control group..

Conclusion: It was suggested that aerobic exercise can decrease depressive symptoms in patient with multiple sclerosis.

(Key Words: Multiple Sclerosis, Depression , Aerobic exercise).

Introduction

Multiple sclerosis (MS) is a chronic autoimmune, inflammatory demyelinating disease of the central nervous system (CNS) attacks the myelinated axons; causing myelin destruction and axonal degeneration of the CNS to varying degree. Demylination may cause an abnormal proliferation of sodium channels within the membrane that slows, or blocks axonal conduction and results in the loss of many functions of the body.**(3)**

Patients with MS have different symptoms including visible and invisible symptoms that are associated with greater health distress . Visible symptoms include problems with balance, and speech difficulties, etc., while invisible symptoms include fatigue, pain, depression, and anxiety.(4)

Depressive disorders are common in patients with multiple sclerosis, influencing their quality of life and adherence to treatments, as well as becoming more frequent with the progression of the disease and in the secondary progressive form of multiple sclerosis.(5).

Depressive symptoms can include feelings of hopelessness or despair, diminished interest or pleasure in activities, changes in appetite and significant weight loss or gain, insomnia or hypersomnia (daytime sleepiness), feelings of lethargy or worthlessness, fatigue or loss of energy, decreased concentration, and recurrent thoughts of death and suicide(6).

Depression can occur as a direct result of MS lesions, as a side effect of some drugs (e.g., corticosteroids, possibly interferon) or as a psychological reaction to the stresses and unpredictable disease. As patients with MS face a lot of issues related to the instability of their health status, the unpredictable course of disease activity or future status, and many of the symptoms of MS (tremor, scanning speech, incontinence) are socially embarrassing, causing additional emotional distress(7).

Treatments for depression in patients with MS include pharmacological treatments (e.g. antidepressant drugs) like Selective serotonin reuptake inhibitors (SSRIs) and non pharmacological treatments like psychotherapy, stress reduction techniques, physical exercise, Transcranial Magnetic stimulation but both pharmacological and non pharmacological treatments for depression are underutilized(8)

Physical exercises, like endurance and resistance training, may be a potential treatment to prevent or reduce depressive symptoms in individuals with MS, but existing studies do not allow solid conclusions[9].

So the purpose of this study was to investigate the effect of aerobic exercise on depression in patients with Multiple Sclerosis as aerobic exercise is simple, cheap and training has antidepressant and anxiolytic effects and protects against harmful consequences of stress[10].

Material and methods

Study Design Randomized Control Trial Pre-test- post-test study design

Participants Twenty patients with MS from both sexes were recruited from the outpatient clinic at Faculty of Physical Therapy, Kaser Al-Ainy Multiple Sclerosis unit (KAMSU), Cairo University and MS Unit in Ain Shams University. All patients diagnosed and referred by a neurologist as clinically definite multiple sclerosis in form of relapsing and remitting according to the revised McDonald's criteria.

Patients were chosen according to the following criteria :

Inclusive criteria:

1- Clinically definite MS (relapsing and remitting) patients who are stable for at least three months.
2- Ambulant patients without an assistive device and score less than 4.5 on the Kurtzke Expanded Disability Status Scale (EDSS)**.**
3- All patients at the remission period.
4- The age ranged from 20 – 40 years.
5- Patients with grade less than 15 in Hospital Anxiety and Depression Scale (HADS)

Exclusion Criteria:

1- Patients with any other neurological deficits or orthopedics abnormalities.
2- Patients with cardiovascular diseases.

3- Patients with secondary musculoskeletal complication such as contractures or deformities.
4- Patients with hepatic, renal, hemopoeitic and thyroid diseases.
5- Pregnant women.
6- Post Menopausal women .
7- A acute relapse (attack) during the study.
8- Patients who takes antidepressant medications (like; Selective serotonin reuptake inhibitors (SSRIs) , Serotonin modulators, Tricyclics and other norepinephrine-reuptake inhibitors

Patients were assigned to two equal groups randomly :

Group A:patients recieved eight hours of aerobic exercise using stationery bicycle (half an hour twice per week for 8 weeks).

GroupB:patients didn't receive the previous modality (control group) at the period of the study.

Measurement procedures

Beck Depression Inventory (BDI)

A 21 item self-reporting questionnaire for evaluating the severity of depression in normal and psychiatric populations. Items were consolidated from those observations and ranked 0–3 for severity. The questionnaire is commonly self-administered (takes 5–10min)**.** With scores from 0 to 9: indicates minimal depression , from 10 to 18: indicates mild depression , from 19 to 29: indicates moderate depression and from 30 to 63: indicates severe depression[(11)].

Arabic valid version of the questionnaire was used[(12)]

treatment procedure

Study group A: Ten patients will be treated by 8 hours of aerobic exercise using stationery Bicycle (half an hour twice a week, for 8 weeks)

Stationary bicycle(Monark Rehab trainer model 88E) was used to provides safe, cheap, low-impact and effective cardiovascular training.

Evaluation of the workload (intensity) during Aerobic exercise:

1. Pulse oximeter (Yuwell YX100 finger tip): It is reliable, accurate, relatively inexpensive and invasive device provides continuous, safe, and instantaneous measurement of blood oxygenation. also measures heart rate that is important in measuring submaximal test with MS population 60 to 85% from maximal heart rate , where the maximal heart rate equal 220 - age[13].
2. Visual Analog Scale-Fatigue (VAS-Fatigue):To be caution and aware of the fatigue level at the beginning and during the treatment process, This scale was used as single item self-report of fatigue, was obtained by asking the patient to indicate the degree of fatigue on a 0-10 scale where 0 = fatigue no problem to 10 = fatigue major problem**)**, the cutoff point was 4.5[13].

Training program on the stationary Bicycle[14].

1. Before starting the 8 week aerobic exercise the steps, the effects and the application of the program were explained to each patient. They were instructed to wear comfortable clothes and shoes. Using fans and drinking water to manage core body temperature.
2. On the bicycle , extra feet straps were added to provide feet fixation on pedal when needed. The patients were given motivated wards and were asked to talk to see their level of load.
3. Before the beginning heart rate was monitored by the pulse oximeter at rest, VAS-fatigue was introduced by asking them "How much fatigue are you having now ?" less than 4.5 was accepted to begin[15].
4. Training time will be as following; five min. warming up, twenty min. training session then five min. cooling down [16].
5. Training intensity was detected by pulse oximeter, gradually increased until reaching 60% to 85% of MHR (220-age) (mild intensity exercise, moderate intensity exercise) for each patients according to their capabilitiesand for gradual accepted loading over the sessions (60 to 85% MHR) according to the participant Again monitoring the effect of fatigue by VAS-fatigue during the exercise and after it[7].
6. Last sessions advices about how they can manage aerobic exercise by their own and how much it would affect them to continue.

Control group B: Ten patients didn't receive the previous modaliy at the period of this study (waiting list), but they had done the previous evaluation. Ethically, after completion of this study, those patients will be managed according to the result of it, if they so choose

Ethical Approval

All study participants provided written informed consent prior toparticipation.

Data analysis

Statistical Analysis

Statistical analysis was conducted using SPSS for windows, version 23 (SPSS, Inc., Chicago, IL). The current study involved two independent variables. The first one was the tested group that had two levels (group A receiving aerobic exercise (stationery bicycle) and group B didnt recieve the previous modality (contol group)). The second one was the treatment periods, which had two levels (pre and post). In addition, this study involved one tested dependent variable (Beck Depression Inventory (BDI) score). Normality test of data using Shapiro-Wilk test was used, that reflect the data was normally distributed for BDI score, so parametric statistical tests in the form of (paired t test) was used to compare between "pre" and "post" treatment for each group and "unpaired t test" was conducted to compare BDI score between both groups in the “pre” and “post” treatment. The alpha level was set at 0.05.

RESULTS

Baseline and demographic data

There were no statistically significant differences (P>0.05) between subjects in both groups concerning age, weight, height and BMI(Table 1).

Table (1): Demographic characteristics of both groups:

	Group A	Group B	Comparison	
	Mean ± SD	Mean ± SD	t-value	P-value
Age (years)	31.9±5.82	28.7±4.63	1.359	0.191
Body mass (kg)	62.3±8.62	62.1±4.35	0.26	0.798
Height (cm)	160.5±7.69	159.7±5.98	0.065	0.949
BMI (kg/m^2)	24.05±1.87	24.31±1.05	-0.381	0.707

***SD: standard deviation, P: probability.**

Beck Depression Inventory (BDI) *score:*

The mean ± SD values of pain level in the "pre" and "post" tests are presented in table (2) for both groups. "Paired t test" revealed that there was a significant reduction of BDI score ($p<0.05$) at post treatment in compared to pre treatment for group A while there was no significant difference ($p>0.05$) at group B. Considering the effect of the tested group (first independent variable) on BDI score, "unpaired t test" revealed that the mean values of the "pre" test between both groups showed there was no significant differences ($p>0.05$). But,the mean values of the "post" test between both groups showed there was significant differences ($p<0.05$) and this significant reduction in favor of group A in compared to group B.

Table (): Mean ±SD, t and P values of Beck Depression Inventory (BDI) score pre and post treatment at both groups.

Beck Depression Inventory (BDI)	Means ± SD	Means ± SD	% of Change	t-value	P- value
	Pre test	Post test			
Group A	22.3±6.21	15.1±4.74	32.28 ↓	3.959	0.003*
Group B	20.85±6.17	22.71±8.44	8.9 ↑	-0.961	0.354
t-value	0.563	-2.566			
P- value	0.579	0.018*			

***Significant level is set at alpha level <0.05**.

Discussion

One of the most critical complication that occur frequently in patients with multiple sclerosis is depressive symptoms and mood disorder [(9)].

There are studies suggesting that exercise may be a potential treatment to prevent or reduce depressive symptoms in people with multiple sclerosis but these studies don't allow solid conclusion[(9)], So came the purpose of this study to see the effect of cheap simple modality in form of aerobic exercise on depression in people with multiple sclerosis.

The results of the current study showed that there was significant difference between the two groups

Various psychological hypotheses have been proposed to explain the beneficial effects of physical activity on mental health, the main being 1) distraction, 2) self-efficacy, and 3) social interaction. The distraction hypothesis suggests that diversion from unfavorable stimuli leads to an improved mood during and after exercise. The self-efficacy hypothesis proposes that, since physical exercise can be seen as a challenging activity, the ability to get involved in it in a regular manner might lead to improved mood and self-confidence. With respect to the social interaction hypothesis, the social relationships commonly inherent in physical activity, as well as

the mutual support that occurs among individuals involved in exercise, play an important role in the effects of exercise on mental health[18].

In addition, physiological hypotheses have also been raised to explain the effects of physical activity on mental health, the two most studied ones being based on 1) monoamines and 2) endorphins. The first hypothesis is supported by the fact that physical activity increases the synaptic transmission of monoamines, which supposedly function in the same manner as antidepressive drugs. Because it would be an oversimplification to state that the efficacy of antidepressives is due to increased synaptic transmission of monoamines, it follows that this hypothesis, although plausible, also seems likewise too simple to explain the improvement of mood associated with physical activity.The second hypothesis, however, is based on the observation that physical activity causes the release of endogenous opioids (endorphins — "endogenous morphines"), basically beta-endorphin. Supposedly, the inhibitory effects of these substances on the central nervous system are responsible for the sensation of calm and improved mood experienced after exercise, but this has yet to be confirmed. Another speculation is the possible relation between increased irritability, restlessness, nervousness, and feelings of frustration reported by physically active individuals when withdrawn from exercise and in a state of endorphin abstinence. A last unclarified point is the fact that some studieshave reported that opioid receptor blockers such as naloxone or naltrexone reduce the affective response to exercise, thus favoring a role of endorphins, but there are investigations contradicting this hypothesis[17,18].

In this study, most of those psychobiological combinedmodel could have led to this significant results.

heterogeneous findings on the effects of exercise on depressive symptoms exist[9].In the studies that used bicycle ergometers[19,20]. reported improved depressive symptoms after the exercise intervention, whilst Petajan*et al*. [21]reported a temporary improvement after 5 and 10 weeks of intervention but not after 15 weeks. The study of Hebert *et al*. [22]showed a time effect on depression score in the exercise group, but no time × group interaction.

Oken et al.did not report any significant changes in depressive symptoms after exercise, but the intensity was not reported[23].

The results of these studies and this current study give more attention on the intensity of the aerobic exercise to be well known and suitable for the patients.

Conclusion:

It was suggested that aerobic exercise in form of stationary bicycle, half an hour twice per week for eight weeks with intensity reaching 60 to 85% maximum heart rate, can decrease depressive symptoms in patient with multiple sclerosis.

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