



# The effects of aerobic exercise training on mental health and self-esteem of type 2 diabetes mellitus patients

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## Abstract

Physical and mental health are very closely tied and either of them can exert a significant effect on the other. The aim of the present study was to examine the effects of aerobic exercise training on mental health and self-esteem of type 2 diabetes mellitus patients. 60 participants, aged 40 to 55 years, with blood sugar ranging between 150 to 250 mg/dL participated in the study. They were randomly divided into two groups of 30 patients. The interventional group exercised for twelve weeks, three sessions per week, lasting from 45 to 60 minutes, followed by endurance training on treadmill. Training's intensity was considered equal to 60-70% of maximum oxygen consumption. According to the results of the study, 12-week aerobic exercise training had significant effects on self-esteem ( $P=0.001$ ), and mental health ( $P=0.020$ ), sub-scales of physical symptoms ( $P=0.001$ ), and anxiety and insomnia ( $P=0.044$ ). But it had no significant effects on the sub-scales of depression ( $P=0.078$ ) and social functioning ( $P=0.207$ ). Regular aerobic exercise training as an effective strategy plays an important role in improving self-esteem and mental health and also promoting life quality among diabetic patients.

## Introduction

Exercise training is commonly considered as a positive and

useful intervention in relieving suffering and pain. According to Shamus and Cohen (2009), there is a strong direct connection between physical health and mental health so that either of them may cause a remarkable impact on the other. Physical exercise can exert strong positive effect on mental health, and consequently, people who undergo physical rehabilitation follow their treatment programs more effectively and make greater improvements in treatment (Shamus and Cohen, 2009). There is such a remarkable association between mental health and chronic physical problems that it may exert significant effects on the life quality, demand for the health care and other costly services, and bring about serious consequences to society. According to the World Health Organization (WHO), health is defined as a state of complete well-being physically, mentally and socially and not just the absence of disease or infirmity. Related literature has greatly discussed the positive and effective role that exercise training plays in psychological and physical health (Oliva *et al.*, 2013). Several studies have reported that regular and moderate exercise training can bring about a reduction in the incidence of cancer, heart disease, diabetes, osteoporosis, obesity and other health conditions (Berger and Owen, 1988; Shamus and Cohen, 2009; Oliva *et al.*, 2013; Heyward and Gibson, 2014). Exercise training, such as aerobic exercises, not only promote the individual's physical health, but also may influence his/her mental condition. As physical and mental status are generally mutually dependent, reduction in physical abilities may cause a decrease in self-esteem, which is a set of abilities, competence and characteristics that an individual believes he/she owns (Ferdowsi *et al.*, 2010). Guskowska (2003) showed significant reduction of anxiety and depression following single sessions of exercise. Reduction of anxiety and depression and changes in mood status following exercise training are commonly explained by the endorphin and monoamine hypotheses. Such psychological mechanisms as improvement of self-efficacy, distraction and cognitive dissonance are possible to take place (Guskowska, 2003). Among general population, physical exercise is considered as an effective antidepressant; in addition, people who suffer from moderate to more severe depression benefit from exercise comparably, and exercise has equal effect on men and women with different age ranges. Studies have revealed that these effects are comparable with psychotherapy and medication, especially for individuals with mild to moderate depression (Craft *et al.*, 2011). Exercise training is usually considered as a recommended intervention to promote life quality, prevent depression, decrease anxiety, and increase overall emotional well-being; meanwhile, some existing evidence confirms these benefits among healthy normal population (Gillison *et al.*, 2009). Review of several studies has shown psychological effects of regular exercise among general population (Paffenbarger *et al.*, 1986; Powell *et al.*, 1987; Ellis *et al.*, 2013; Kenney *et al.*, 2015).

According to World Health Organization diabetes is a chronic disease that may be caused either when the pancreas does not produce enough insulin or when the body fails to effectively use the

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produced insulin (WHO, 1946). Type 2 diabetes mellitus is a major public health problem in the world with a rising trend. Psychological problems are relatively common among individuals suffering from type 2 diabetes (Van der Heijden *et al.*, 2013). Rate of mental illnesses among people with diabetes is nearly twice bigger than that among individuals without diabetes. Individuals suffering from diabetes usually have some emotional stress that can exert negative effects on the person's mental health. According to Britneff and Winkley (2013), there is an association between mental health problems and increased diabetes complications; moreover, people with diabetes type 2 run a poorer quality of life, so managing their emotional health cannot be less important than keeping their blood sugar under control. The condition requires constant attention that can trigger feelings of stress and anxiety. American Diabetes Association proposed a program of exercise which included between 50% and 80% of the highest possible rate of aerobic. This program recommends three or four times of aerobic exercise a week that may last 30 to 60 minutes. Exercise training can increase the basal level of metabolism and can enhance circulation of blood to all body parts; besides, such exercise training also uses extra calories to release endorphin, the agent which creates a sense of well-being (Peirce, 1999). International Diabetes Federation reported that 285 million people were suffering from type 2 diabetes in 2010; they also predicted that the direct and indirect costs of diabetes for 438 million people will reach 174 million dollars in the world by 2030 (Saremi, 2011). In Iran, about five million people suffer from diabetes half of whom are unaware of their disease. and unfortunately, only less than 30 percent of the patients have good control over their disease (Sharifi *et al.*, 2011). Meanwhile, studies show that Iran is among the high risk countries of diabetes (Abolhasani *et al.*, 2005). There is a direct relationship between risk of type 2 diabetes and such factors as age, obesity and lack of exercise. Furthermore, research has revealed that exercise has an extremely important role in controlling diabetes. Regular exercise training can effectively improve the control of blood sugar and prevent the development of type 2 diabetes. Moreover, regular exercise can help control blood lipids, and blood pressure, reduce cardiovascular events and improve quality of life. Physical exercise can change the substrate of free fatty acids (the dominant fuel during rest) into glucose, muscle glycogen, fat and a lesser extent of amino acids. A study in the UK found that one percent reduction in the level of Hemoglobin A1c reduces the risk of death to 21%, risk of myocardial infarction to 14% and risk of microvascular complications to 32% (Da Costa *et al.*, 2004).

Several studies have reported a direct association between diabetes and lower levels of life quality, and mental health; they have also shown a higher prevalence of depression and anxiety among diabetic patients (Shahrjerdi *et al.*, 2010). Black (1999), for instance, reported that 31% of older diabetic patients suffer from degrees of depression, and most of such patients resort to overeating as a self-medication for the treatment of depression. Since use of medication often has complications, regular exercise seems to be an effective strategy to reduce diabetic complications and improve patients' mental health and self-esteem. To the best knowledge of the authors, most studies on the effects of aerobic exercise on the mental health of diabetics have so far been at most 8-week studies; therefore, the present twelve-week study was conducted aiming to investigate the effects of longer aerobic exercise training on mental health and self-esteem of men with type 2 diabetes.

## Materials and Methods

The present clinical trial, with the ethical code 8905 given by the Research and Information Technology Deputy of Zahedan University of Medical Sciences, was carried out on 60 men with diabetes type 2 who were selected from among the patients presenting at Imam Ali Hospital Clinic, Zahedan, Iran. Due to cultural issues and limitations, the study was carried out on only men. All patients were screened and interviewed and their medical records were evaluated. The participants were ascertained that their responses would be kept confidential and a coding system would be used to analyze the data. And in case, a participant missed three successive sessions, he would be excluded from the study; afterwards, the volunteer participants were selected through purposive sampling method. Overall 60 diabetic participants, aged 40 to 55 years, who, according to their records, had blood sugar ranging between 150 to 300 mg/dL were acquainted with the objectives and methodology of the study. All participants completed the twenty-eight item General Health Questionnaire and the ten-item Rosenberg Self-Esteem questionnaire as pretest; then, they were randomly divided into two groups of 30 patients. The interventional group, on average, exercised three 45 to 60-minute-sessions a week for twelve weeks under the supervision of a physical educator who equally presented the program to all participants. The first session started with 45 minutes and gradually reached 60 minutes to observe the overload principle. Each workout session started with stretching and slow running, followed by endurance training on treadmill for 15 to 30 minutes that ultimately ended with cooling down. The protocol for aerobic exercises is as follow. The intensity of the training, obtained by measuring pulses on the left wrist radial within one minute, was considered equal to 60% of maximum consumed oxygen. Maximum oxygen consumption was controlled using heart reserve rate (HRR). Target heart rate was considered equal to rest heart rate + (maximum heart rate – rest heart rate)  $\times$  0.6. And finally, maximum heart rate was calculated according to the following formula: 220 - patient's age. During this period, the control group were asked not to do any sports or physical exercise and they were supervised and asked every week to ascertain they would not do sports or exercise. At the end of the twelve weeks, the post-test was performed and General Health and Rosenberg questionnaires were completed by the participants to determine the difference between interventional and control groups. General Health Questionnaire is a standardized questionnaire with 28 items, consisting of four sub-scales: 1. Physical symptoms: physical symptoms related to pain and physical symptoms associated with mental disorders, 2. Symptoms of anxiety, insomnia, neurological insomnia, and stress 3. Symptoms of social dysfunction and symptoms related to the problems of communicating with the community and individual job and 4. Depressive symptoms and life expectancy problems related to life expectancy, survival, and depression. Rosenberg Self-Esteem questionnaire includes ten items that measure the positive and negative feelings of the person about her/himself. To analyze the data, SPSS Software Version 16 was used. In the present study, the reliability of the General Health and Rosenberg questionnaires, based on Cronbach alpha coefficient, was  $r = 86\%$  and  $82\%$ , respectively. In descriptive analysis, central tendency and distribution indices were used and to check the normality of the data Kolmogorov-Smirnov test was applied revealing the normal distribution of all variables, except in the sub-scale of social dysfunction symptoms. Therefore, Paired T-test was employed to compare all variables before and after intervention, except the sub-scale of social dysfunction sym-



ptoms. For the sub-scale of symptoms of impairment in social functioning, Wilcoxon test was used. To compare the differences in the two groups, except for the sub-scale of social dysfunction symptoms, T-test and for the sub-scale of symptoms of impairment in social functioning, ANCOVA was used. Moreover, T-test was employed to compare the variables before intervention in the two groups. However, for sub-scale of social dysfunction symptoms, Mann-Whitney test was used. All statistical tests were performed at 95% confidence interval ( $P < 0.05$ ).

## Results

As Table 1 shows, the two groups had no statistically significant difference in terms of personal (demographic) characteristics, number, age, medical history, height, weight, and possible consumed medications before the intervention.

According to the results of the study, presented in Table 2, the self-esteem mean score before intervention was 27 in the interventional group and 28.08 in the control group that indicated no statistically significant difference between the two groups before intervention; however, after intervention, the self-esteem mean score of the interventional group increased to 36.17 while in the control group it slightly changed to 27.26. Comparing self-esteem mean scores before and after intervention in each group, by applying dependent T-test, revealed statistically significant increase only in the interventional group ( $P < 0.001$ ) (Table 2). In Table 2, according to the study results, mental health mean scores of the subjects before intervention in the interventional group was 28.78 and in the control group was 31.65 that indicated no statistically significant difference between the two groups before intervention; however,

mental health mean score after intervention changed to 22.39 in the intervention group and to 33.60 in the control group. Comparison of the mental health mean scores before and after intervention in the two groups, by using dependent T-test, revealed statistically significant increase only in the interventional group ( $P < 0.020$ ) (Table 2).

## Discussion

This study was designed to assess the effects of 12-week aerobic exercises training on mental health and self-esteem of type 2 diabetes mellitus patients. The results suggest a significant effect of physical exercise on the mental health and self-esteem of type 2 diabetic patients. It seems that having a regular aerobic exercise training as an intervention can increase the mean of self-esteem score. This result can be interpreted by the fact that there is a relationship between exercise and increasing self-esteem that corresponds with other researches (Moore *et al.*, 2011). Schneider *et al.* (2008) reported that intervention as physical exercise for four sessions per week for nine months had positive effects on the self-esteem of the depressed patients. Self-esteem, one aspect of mental health, is a term in psychology and is expressed as the degree to which individuals feel positive about themselves (Sonstroem *et al.*, 1991). Good self-esteem improves individuals' mental growth and exerts prominent effects on an individual's thoughts, feelings, values, and goals. People with higher self-esteem, evaluate themselves as positive, and have an appropriate positive attitude towards themselves. Some studies have indicated that there is a positive correlation between physical exercise and self-esteem in adults (Opdenacker *et al.*, 2009). Ellis *et al.* (2013) reported that

**Table 1. Characteristics of patients with type 2 diabetes.**

Index	Interventional group Mean $\pm$ SD	Control group Mean $\pm$ SD	P-value
N.	30	30	-
Age (yrs.)	48.86 $\pm$ 5.76	49.08 $\pm$ 6.09	0.90
Diabetes history (yrs.)	4.38 $\pm$ 3.56	4.45 $\pm$ 2.06	-
Height (cm)	169 $\pm$ 0.06	167 $\pm$ 0.08	0.63
Weight (kg)	80.70 $\pm$ 6.17	78.76 $\pm$ 5.98	0.06
Drug treatment before the intervention	2 (metformin + cloropropamid)	2 (metformin + cloropropamid)	

**Table 2. Grades of mental health factors and self-esteem for the control and interventional group before and after training.**

Index	Group	Pre test Mean $\pm$ SD	Post test Mean $\pm$ SD	Difference of pre and post test	P-value
Self-esteem	Control	28.08 $\pm$ 4.87	27.26 $\pm$ 4.11	0.82 $\pm$ 2.65	0.001
	Interventional	27 $\pm$ 4.52	36.17 $\pm$ 2.94	-9.17 $\pm$ 4.93	
Mental Health	Control	31.65 $\pm$ 7.76	33.60 $\pm$ 7.29	-1.95 $\pm$ 11.37	0.020
	Interventional	28.78 $\pm$ 8.42	22.39 $\pm$ 5.49	6.39 $\pm$ 10.40	
Physical Symptoms	Control	6.69 $\pm$ 3.29	10.39 $\pm$ 3.18	-3.69 $\pm$ 4.55	0.001
	Interventional	7.26 $\pm$ 3.42	5.30 $\pm$ 2.54	1.95 $\pm$ 3.72	
Depression	Control	7.13 $\pm$ 4.10	7.60 $\pm$ 4.29	-0.47 $\pm$ 5.94	0.078
	Interventional	7.52 $\pm$ 4.04	4.56 $\pm$ 3.97	2.95 $\pm$ 5.53	
Anxiety and Insomnia	Control	6.95 $\pm$ 5.48	6.17 $\pm$ 4.37	0.78 $\pm$ 7.40	0.044
	Interventional	6.34 $\pm$ 5.54	1.78 $\pm$ 1.99	4.56 $\pm$ 5.47	
Social Functioning	Control	10.86 $\pm$ 4.77	9.43 $\pm$ 3.36	0.248	0.207
	Interventional	7.65 $\pm$ 3.29	10.73 $\pm$ 5.07	0.044	



physical exercise had positive effects on self-esteem in patient (Ellis, *et al.* 2013). Also, Bicer (2013) in a study entitled: *The Effects of 12 weeks of aerobic exercise on Students' self-esteem* found that the mean score of participants' self-esteem which was 33.21 before the intervention increased to 36.32 after intervention. He concluded that aerobic exercise increased self-esteem score (Josephs *et al.*, 1992).

Patients with T2DM need to feel good and be good, so physical exercise may help them achieve a safe and healthy lifestyle. Without having high self-esteem, patients with T2DM may deviate from the path of their life. Results of the present study showed that aerobic exercise training had a significant effect on the mental health in patients with type 2 diabetes mellitus. Many studies have been conducted with regard to physical exercise and its role in improving the mental health and well-being of people (Alleyne, 2003; Nourbakhsh, 2005; Castelli *et al.*, 2007). Cross-sectional studies show that regular physical exercise is associated with better mental health and emotional well-being (Galper *et al.*, 2006). Studies also show an association between physical exercise and reduced risk of developing a mental disorder. There is a growing interest in the interventions focusing on increasing physical exercise as a supplementary treatment therapy for this population. Studies indicate that exercise therapy is well perceived, and is associated with improved physical health (Ellis *et al.*, 2007; Ferdowsi *et al.*, 2010; Gorczynski and Faulkner, 2010). In this study, aerobic exercise training showed significant effects on the sub-scales of the physical symptoms of anxiety and insomnia in patients with type 2 diabetes mellitus; however, it had no effect on the sub-scales of social functioning disorder and depression, that was inconsistent with the findings of the study by the Sardar *et al.* (2014). Van der Heijden *et al.* (2013) through a study showed that aerobic exercise training had significant effects on the sub-scales of the anxiety. Peluso and Andrade (2005) and Ligtenberg *et al.* (1998) believed that aerobic exercise training reduces anxiety levels in people with type 2 diabetes. Shahrjerdi *et al.* (2010) studied the effects of aerobic exercise on quality of life and mental health of 18 women with type 2 diabetes. The results of that study, similar to the present study suggest that following aerobic exercise improves quality of life and mental health. The results of the present study showed that aerobic exercise had no significant influence on the scale of social function and depression that is consistent with the findings of the study by Sardar *et al.* (2014). The observed difference among different findings may be due to the age and gender differences in samples and the difference in the type of training and intensity and duration of implementation in different researches. According to the Department of Health and Human Services United States of America, regular physical exercise as a non-pharmacological intervention will lead to many physiological and psychological benefits, which can improve blood sugar control, overall health and quality of life (Van der Heijden *et al.*, 2013). Regular exercise plays a key role in the prevention and control of insulin resistance in patients with type 2 diabetes. Aerobic exercise improves insulin action and is effective in managing blood glucose, blood lipids, blood pressure, risk of cardiovascular mortality and generally quality of life. In addition to physical and psychological benefits, physical exercise and sports have other benefits including mental, emotional, and social gains (McKay *et al.*, 2001). Physiological mechanism of mental changes is unknown, but the value of exercise in reducing anxiety, stress and psychological changes and depression is clear. One of the theoretical models that explains social changes related to sports in terms of relief or relaxation, is the central nervous system activation and secretion of endorphins. Exercise increases self-esteem and self-

sufficiency. According to some reports increased self-esteem may be related to endocrine regulation, catecholamines and internal opioid system that happens in the body after exercise (Peluso and Andrade, 2005). Psychological mechanisms of the beneficial effects of exercise on quality of life include increased self-esteem, increased self-satisfaction, increased confidence, improved turmoil and physiological mechanisms including increased central norepinephrine, changes in hypothalamic adrenocortical system, and changes in the synthesis and metabolism of serotonin and endorphin.

## Conclusions

We concluded that aerobic exercises training had positive effects on self-esteem and mental health, sub-scales of physical symptoms, and anxiety and insomnia. But it had no significant effects on sub-scales of depression and social functioning. Therefore, regular aerobic exercise training as an effective strategy in improving self-esteem and mental health and also promoting life quality among diabetic patients is highly recommended.

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