The effect of a period of 8-weeks of aerobic exercise training program on some components of sleep subjective quality, weight, and BMI in non-active elderly women with type 2 diabetes

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ABSTRACT

Goals: Diabetes is a chronic disease and the third most common cause of death from illnesses. This disease is a great health problem. Therefore, the purpose of this study was to examine the effect of a period of 8-weeks of aerobic exercise training program on some components of sleep subjective quality, weight, and BMI in non-active elderly women with type 2 diabetes.

Method: The method of this study was semi empirical that has been conducted through field method. 30 elderly women with type 2 diabetes and the valid instrument were used in this study. The collected data were classified by descriptive statistical methods and were analyzed by dependent T-test, independent T-test, and Pearson correlation coefficient (α≤0.05).

Result: The results of this study showed that the score mean of sleep subjective quality decreased from 11.41 to 8.2. The mean of subjects’ weight in the pre-test decreased from 81.14 to 80.11. The mean of BMI variable also decreased from 26.88 to 11.26.

Key Words: Type 2 diabetes, Exercise, Non-active women, Sleep subjective quality, Weight, BMI
**Conclusion:** According to the positive effect of training protocol in this study, aerobic exercise can be an appropriate and practical mechanism to improve the health indicators in elderly women and it is an effective step in the improvement of the health in the aging population.

**INTRODUCTION**

Diabetes is one of the most common and important diseases in people of different ages (1). Diabetes mellitus that is sometimes referred to as a silent epidemic (2) is a chronic metabolic disease and a major and physical health problem that is increasing in developing countries (3). This disorder is due to the body disability in the production or use of insulin and it is a syndrome that is created with the imbalance between the need for insulin and its supply (4). According to the World Health Organization (WHO), diabetes mellitus is one of the most important chronic diseases and the third most common cause of death from illnesses. This disease is a great health problem that it has spread widely from the late twentieth century and there is no sign of its stop at present time (5, 6). The most common types of diabetes are insulin-dependent (type 1) and non-insulin-dependent (type 2) (7) that type 2 diabetes is increasing at an alarming rate around the world (8). Type 2 diabetes is a chronic disease that many factors affect the prevalence of this disease. Environmental and genetic factors such as the low activity and the diet type (9), family history (10), insulin resistance (11), and dysfunction of beta cells (12) are involved in the development of this disease. The daily inactivity, inappropriate life style, and the prevalence of obesity are important and effective factors in the development of type 2 diabetes and its complications (13). Several studies have shown that the prevalence of type 2 diabetes is increasing rapidly in various societies due to the increasing of excessive obesity and the reduction of physical activity (14). On the other hand, there are multiple complications of type 2 diabetes for patients. Its short-term complications include hypoglycemia, hyperglycemia, and chronic hyperglycemia and a long-term complication of it is the silent epidemic (15). People with diabetes experience many problems for their daily activities. Studies indicate that people with type 2 diabetes have emotional problems in addition to physical problems, including anxiety, aggression, depression, and insomnia and (16). The control of blood glucose and the adjustment of negative effective factors on blood glucose are important in type 2 diabetic patients (17). The existence of a sure and practical solution seems to be necessary due to the prevalence of type II diabetes and numerous problems for patients such as high blood lipids, the risk of clogging of the capillaries, including retinopathy and nephropathy, and nephropathy, large vessel occlusive disease, including heart attacks and strokes, high blood pres-
sure, obesity, hypertension, various neurological disorders (auto and peripheral), silent ischemia, etc., (18, 19, 20, 21). The type 2 diabetic individuals’ lifestyle (22) is one of the most important factors that can improve the quality of care in these patients. On the other hand, sport activity is one of the most important components in human’s lifestyle that can help people with diabetes (23). Today, people with type 2 diabetes have the sleep problem of their sleep, so that a poor sleep quality has harmful effects on health (19). The aging period causes sleep patterns change, as well as increasing of insomnia due to nightmares, the reduction of REM sleep, depreciation, frequent waking during sleep, the reduction sleep duration, and the increasing of sleep disorders such as apnea and insomnia (24). Epidemiologic studies have been conducted on the relationship between sleep quality with the prevalence of type 2 diabetes and exercise, so that studies in the field of the effect of sleep quality on type 2 diabetes have shown that people who had continuous sleep disorders had higher BMI and higher percentage of fat (19, 20, 22). The important point to note is that sleep limitations increase the intake of food, especially high carbohydrate foods (20). These factors can affect individuals’ sleep quality and quantity. The poor sleep quality affects insulin and the poor sleep quality is one of effective predictor factors in the development of type 2 diabetes. Therefore, these factors should be considered as factors for the prevalence of type 2 diabetes. There is a strong correlation between exercise and type 2 diabetes (25, 26, 7). The moderate-intensity aerobic exercise can have a useful effect on the quality of life in people with peripheral neuropathy and type 2 diabetes (27). The use of exercise is usually a non-drug strategy that can have useful effects on sleep (28). According to the mentioned contents and the role of diabetes in non-active elderly women’s sleep, the purpose of this study was to examine the effect of a principled and purposeful training protocol on some components of sleep subjective quality, weight, and BMI in non-active elderly women with type 2 diabetes.

MATERIALS AND METHODS

The method of research was semi empirical and applied that has been conducted through field method with a design of pre-test, post-test with control group.

PARTICIPANTS

The subjects of this study were non-athlete elderly women (50-60 years old) who had no history of cardiovascular disease. 30 subjects were non-randomly
selected from this population. The conditions for subjects’ selection were included elderly women aged 50 years and older, the desire for the participation in the exercise program for 8 weeks, the ability to walk without using auxiliary equipment, no history of cardiovascular disease, depression, psychological problems, and smoking, no exercise more than an hour per week.

**INSTRUMENTS AND TASKS**

The instrument of this study was Pittsburgh’s Sleep Quality Index (PSQI) and an appropriate training protocol.

**PROCEDURE**

The subjects were randomly divided into the control group (N=15) and the experimental group (N=15). PSQI has an acceptable validity and reliability for the implementation of the study. This questionnaire defines 7 scores for scales (1. an individual’s general description of the sleep, 2. sleep latency, 3. sleep duration, 4. sleep efficiency, 5. sleep disturbance, 6. use of sleeping medication, and 7. daytime dysfunction as a problem of insomnia that is experienced by the person on the day) and it offers a total score. The sum of scores of the 7 scales forms the total score that it is from 0 to 21. A total score of six or more means poor sleep quality. Subjects were asked to stand on the Camry EB9003 scale without shoes and with minimum dress and their weight was recorded in kilograms.

**TRAINING PROTOCOL**

All subjects participated in the pre-test and the post-test. One day before the conduct of study, all subjects were asked to complete the Pittsburgh’s Sleep Quality Index with a complete honesty. The experimental and control groups were matched at the beginning of the study in terms of marital status, age, education, lack of exercise history, and duration of diabetes. After the holding of a briefing session for the experimental group, they were asked to participate in the designed exercise program one day in between at a gym. The subjects were asked to warm their muscles for ten minutes in researchers’ presence by performing stretching exercises at each session before the start of the exercise program. The aerobic exercise program included eight weeks of aerobic training and 3 sessions a week.
The subjects’ program execution started in the first week with an intensity of 40 to 45% of the maximum heart rate and lasted for 25 minutes and it was performed with an intensity of 70-80% of the maximum heart rate for 45 minutes in the fourth week. This intensity continued until the end of the training week (5 minutes to the time of training and 5% to the intensity of training were added every week). Each training session was included 15 minutes of warm-up with kinds of running, stretching movements, and 45 minutes of walking. The cooling was performed by stretching movements for 10 minutes at the end of each session. The maximum heart rate was calculated from the formula (age - 220) and each person’s training heart rate was calculated using the maximum heart rate and rest heart rate of the Caroni’s method. Subjects were asked to walk 1600 meters after the warm up. The subjects’ heart rate was monitored during the test by the Polar heart rate meter and the time was recorded with a stopwatch.

DATA ANALYSIS

The collected data were classified by descriptive statistical methods and were analyzed by dependent T-test, independent T-test, and Pearson correlation coefficient (α≤0.05).

RESULTS

40 subjects’ demographic characteristics are showed in table (1). The results in table (2) show the mean and standard deviations of the variables of this study at the beginning and after the intervention. According to the results in table (2), the training protocol in this study has created significant changes in the components of sleep subjective quality, weight, and BMI. There was significant changes in the experimental group after the intervention in this group that the score mean of sleep subjective quality decreased from 11.41 to 8.2 that indicates the improvement of sleep subjective quality in non-active women with type 2 diabetes 2. Also, there were changes in the other two variables in this study that subjects’ weight mean in the pre-test (81.41) with a decreasing trend and the effectiveness of the desired intervention was 80.11. The mean of BMI from 26.89 was also reached to 26.11 that it indicated that the BMI has decreased too. According to the used statistical tests in this study, there was a significant relationship between sleep subjective quality index with weight and BMI. However, there was not a significant relationship between changes in sleep subjective quality variable, marital status, education, duration of diabetes, and subjects’ age.
### Table 1

**Subjects’ demographic characteristics**

<table>
<thead>
<tr>
<th>Group</th>
<th>Experimental</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Lack of sports history (month)</td>
<td>44.86±16.91</td>
<td>67.3±22.70</td>
</tr>
<tr>
<td>* Age (years)</td>
<td>57.71±5.31</td>
<td>58.32±6.1</td>
</tr>
<tr>
<td>* Duration of diabetes (month)</td>
<td>30.11±18.81</td>
<td>31.11±17.63</td>
</tr>
</tbody>
</table>

**Education**

<table>
<thead>
<tr>
<th></th>
<th>Bachelor’s degree</th>
<th>Associate’s degree</th>
<th>Diploma</th>
<th>Middle School Diploma</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 (31.3%)</td>
<td>2 (0.20%)</td>
<td>2 (0.20%)</td>
<td>3 (25.6%)</td>
</tr>
</tbody>
</table>

**Marital status**

<table>
<thead>
<tr>
<th></th>
<th>Single</th>
<th>Married</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 (27.6%)</td>
<td>12 (71.1%)</td>
</tr>
</tbody>
</table>

N (%) ** Mean ± SD *

### Table 2

**The results of the variables before and after the intervention and their comparison**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>‡Pre-test</th>
<th>‡Post-test</th>
<th>P*</th>
<th>Difference of pre-test and post-test</th>
<th>P**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep subjective quality</td>
<td>Control</td>
<td>11.1±1.62</td>
<td>11.51±1.8</td>
<td>†0.006</td>
<td>-0.41±0.71</td>
<td>†0.000</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>11.41±1.6</td>
<td>8.2±1.45</td>
<td>†0.000</td>
<td>3.21±0.51</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>Control</td>
<td>80.32±5.1</td>
<td>81.11±4.11</td>
<td>†0.000</td>
<td>-0.79±0.68</td>
<td>†0.000</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>81.14±4.11</td>
<td>80.11±5.11</td>
<td>†0.000</td>
<td>1.03±1.39</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>Control</td>
<td>27.21±1.20</td>
<td>27.64±1.2</td>
<td>†0.004</td>
<td>-0.43±0.18</td>
<td>†0.000</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>26.89±1.40</td>
<td>26.11±1.13</td>
<td>†0.000</td>
<td>0.78±0.39</td>
<td></td>
</tr>
</tbody>
</table>

*P<0.05 according to the results of paired sample t-test,
** P<0.05 according to the results of independent sample t-test,
† Numbers are calculated as standard deviations ± mean
DISCUSSION AND CONCLUSION

The purpose of this study was to examine the effect of a period of 8-weeks of aerobic exercise training program on some components of sleep subjective quality, weight, and BMI in non-active elderly women with type 2 diabetes. The results of this study showed that there was a significant effect on sleep subjective quality and some health-related indicators after the intervention in the experimental group. Sleep is an integral part of a human’s good health. Sleep disturbances and changes in sleep habits are associated with an inflammatory condition that may be the cause or outcome of other conditions, including obesity, diabetes, and cardiovascular disease. The results of this study was consistent with the results of Erlacher, et al.,’s (2014) study that they examined the effect of exercise on sleep among adults with chronic sleep complaints. The results of their study showed that the number of steps and the duration of physical activity is significantly related to the improvement in subjective sleep measures and therefore revealed an independent effect within this combined sleep program. Sleep diary data (recuperation of sleep, number of awakenings after sleep onset, and wake time after sleep onset time) improved significant over the intervention program (29). The results of this study was consistent with the results of Geber, et al.,’s (2014) study that they assessed the effect of vigorous intensity exercise on stress, mental health, and good objective and subjective sleep in undergraduate students. Since the positive role of physical activity on mental disorders has been proven, so the results showed that subjects who accomplish the American College of Sports Medicine’s (ACSM) vigorous-intensity exercise recommendations differ from peers below these standards with regard to their level of perceived stress, depressive symptoms, perceived pain, and subjective and objective sleep. The vigorous physical activity was associated with less stress, pain, subjective sleep complaints, and depressive symptoms. Moreover, vigorous exercisers had more favorable objective sleep pattern. This proves the effectiveness of physical activity on individuals’ sleep quality (30). Also, the results of this study was consistent with the results of Fábio, et al.,’s (2011) study in terms of data analysis. They assessed the effects of moderate exercise training on sleep quality and on the metabolic profile of elderly people with a sedentary lifestyle. Fourteen male sedentary, healthy, elderly volunteers performed moderate training for 60 minutes a day, 3 days a week for 24 weeks at a work rate equivalent to the ventilatory aerobic threshold. The results demonstrate that the moderate exercise training protocol improved some aspects of sleep quality, insulin resistance, and metabolic problems in older people (31). Today, scientific evidence indicate that sleep quality and quantity play an important role in the regulation of ghrelin and leptin levels. In conclusion, sleep deprivation in acute and chronic forms reduces significantly leptin levels and increases ghrelin levels. These changes are
associated with an increase in hunger and appetite (32). Physical activities lead to biological and biochemical changes and improve mental health and sleep quality. Recently, a research team has shown that physical activity reduces pre-sleep anxiety and improve sleep quality in elderly people (33). Such changes have also been confirmed in epidemiological studies. A conducted study in 1024 subjects identified that individuals who had a poor sleep quality and sleeping less than 5 h had a low leptin level and a high ghrelin level than individuals who had a good sleep quality and sleeping 8 h. These changes were associated with an increase in appetite for food and researchers introduced it as a justification for a high BMI in people with sleep disorders (34). The improvement of subjects’ sleep quality through aerobic physical activities is probably due to a reduction of REM period and an increasing of NREM period. Because the changes in body temperature due to these exercises stimulate peroptic nucleus and the anterior hypothalamus that this process improves the sleep quality (35). Also, the increase of the activity of the sympathetic system during exercise and the reduction of its activity than the parasympathetic system during recovery may result in the deeper sleep and an increase of in sleep duration (36). Bakhshalipour, et al., (2016) examined the effect of regular moderate-intensity physical activity on sleep quality in non-active elderly women. The results showed that functions of moderate-intensity aerobic exercise program was an effective treatment for sleep disorders and obesity in non-active people (28). Also, the results of another study that was consistent with the present study showed that elderly individuals’ sleep quality improved significantly after four months of exercise (37). The results of a study that was consistent with the results of this study showed that eight weeks of walking had a significant effect on sleep quality and some metabolic indexes related in old men (38). There is evidence that shows there is a clinical connection between sleep and physical activity. Today, sports trainings are considered as a non-pharmacological approach with a positive effect and have been tested in various studies in different sports, but the biological effect of exercise on sleep quality is unclear that we cannot easily analyzed it. According to the positive effect of the used training protocol in this study on sleep subjective quality, weight, and BMI in non-active elderly women with type 2 diabetes, sport trainings can be effective in the improvement of sleep quality in elderly people and an effective step in the improvement of health of an aging society.

CONFLICT OF INTEREST

The authors declare no conflict of interest.
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