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Original article

Effect of aerobic exercise on certain blood parameters of patients with type 2 diabetes

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Abstract. *Study Objectives:* The objective of our study was to determine whether aerobic exercise has any effects on the thyroid hormone levels and certain blood parameters of patients with Type 2 diabetes. *Methods:* 8 female patients with type 2 diabetes, whose average age was 39.62±6.30, years were voluntarily included in our study. Specialists obtained fasting blood samples from participants, who underwent an exercise program with aerobic content, in a suitable laboratory environment in the predetermined health care institution in the morning in order to determine FT3, FT4, Triglyceride, Total Cholesterol, HDL, LDL, Iron, and B12 values before and after doing exercise. The case analysis method, which is one of the scientific research techniques, was used in the research, and pre- and post-test modelling were performed. Wilcoxon Signed Rank Test was performed in order to compare pre- and post-exercise values, and thus, analysis of obtained data was made by descriptive statistics via SPSS 22.0 package program. *Results:* it was determined that the exercise program ensured a statistically significant decrease to occur on the Weight, BMI, Total Cholesterol, TRIG, HDL, LDL, T3, and T4 values of sedentary patients and women with type 2 diabetes ($p<0,05$). Furthermore, no statistically significant result was found in B12 and Iron values ($p>0,05$). Blood and weight values, which were are-obtained done a week from tests made in the previous week, were similar to post-test measurements. *Conclusion:* We may say that, in this research that is conducted on female patients with type 2 diabetes, 8 weeks of aerobic exercise made a positive effect on organizing thyroid hormone, as well as weight loss and blood lipids. Furthermore, we are of the opinion that type 2 diabetic syndrome, which is caused by a sedentary lifestyle and irregular eating habits, may be adjusted by regular and long-term exercise program and by reinforcing insulin resistance.

Keywords: Diabetes, Aerobic Exercise, Hormone

Introduction

The development of technology causes human beings to live more sedentarily day-by-day. Today, we observe that many people make themselves lazy by keeping in step with this adventure. This laziness may leave its place to permanent diseases (cardiovascular diseases, hypertension and diabetes, etc.) in time. It is known that physical activity plays a critical role in being protected from such diseases.

Physical activity refers to body movements exhibited via skeletal muscles by the usage of energy (1). Exercise refers to regularly performed activities, which are planned and designed, and which aim to develop one or several characteristics of physical fitness (2). Exercise is divided into two categories as anaerobic and aerobic. Exercises, in which a significant part of the energy requirement is met by aerobic methods, are referred to as aerobic exercises. Aerobic exercises are referred to as the continuous activity of large muscle groups within the limits of a specific rhythm for a long time under circumstances where there is plenty of oxygen (3). Exercise decreases the potential of becoming a diabetes patient, and it is reported as a critical factor, with diet and pharmacological treatment, for diabetes patients (4).

Diabetes mellitus is a chronic case that causes blood glucose to increase due to insufficient excretion of insulin hormone or inability to use insulin effectively (5-7). Type 2 diabetes is the most common type of diabetes globally, and it is known as a critical chronic metabolic disease since it causes macrovascular complications (coronary heart disease, peripheral vascular disease, and cerebrovascular disease) and microvascular complications (neuropathy, nephropathy, and retinopathy) (8,9).

An increase is observed in the prevalence of type 2 diabetes globally. This increases sources from people's sedentary lifestyle, which sources from the aging of the population, economic development, and industrialization. Furthermore, it sources from the increase in the consumption of unhealthy foods in connection with obesity (7,10). An increase in physical inactivity and obesity causes type 2 diabetes disease to increase rapidly (11). Based on the aforementioned critical data, we aimed to detect the effect of aerobic exercises on specific blood parameters of sedentary female patients with type 2 diabetes.

Material and Methods

Participants

The case analysis method, which is one of the scientific research techniques, was used in the research, and pre- and post-test modelling were performed. 8 voluntary sedentary female patients with type 2 diabetes, whose average age was 39.62±6.30, years were included in our study. No extra nutrition program was applied to individuals during the research for the sake of validity and reliability of the research, and individuals continued to feed routinely.

Certain Blood Parameters Measurements

The blood transfusion procedure was performed by visiting the pre-determined health care institution 8 weeks after measurements, which were performed 8 weeks prior to the exercise, provided that food and beverage intake is suspended 12 hours before such procedure. Obtained bloods were centrifuged rapidly. Obtained serums were stored in -80°C by being transferred to plastic and capped Eppendorf tubes for biochemical analyses, and total cholesterol, HDL, LDL, triglyceride, iron, B12, FT3, and FT4 results were obtained in conformity with procedures.

Body Mass Index (BMI)

Body weight measurements were made with an electronic scale (SECA) with an accuracy of 0.1 kg. The length measurement was made with a Holtain brand stadiometer with a sensitivity of 0.1 cm with bare feet. While evaluating, BMI was calculated as Weight (kg) / Height² (m) by using the special body mass index (BMI) calculation formula for height and weight (12,13).

Exercise Program

The exercise program, which continued for 8 weeks, was comprised of moderate aerobic exercises of 60 minutes for 4 days weekly. The intensity was kept in a tempo, in which participants felt comfortable (in a way to keep pulse rate between 130-150). The below exercises were performed in every exercise period after 10 minutes of warm-up. Each exercise was completed by cool down exercises of 5 minutes.

Exercises, Implementation Methods, and Durations

Participant patients with Type 2 diabetes underwent an exercise program of 30 hours in total, i.e. 75 minutes per day, by making a calculation based on Karvonen Formula for three days a week for a period of 8 (eight) weeks, i.e. participants ran on a Diesel Fitness 500 brand treadmill at the intensity of 40% for 30 minutes, ride a bike on an elliptical exercise bike of VoitLc 210 brand for 30 minutes, did floor exercises for legs for 10 minutes, and finally, did cool-down exercises for 5 minutes in a private fitness center in Samsun Province.

Statistical Analysis

Data obtained in the research were analyzed by using SPSS 22.0 package program. Wilcoxon Signed Rank Test, which is one of the non-parametric tests, was used in order to reveal the difference between pre- and post-test values of the research group.

Results

When we examine the physical characteristics of participants as indicated on the table, average age and height were determined as 39,62±6,30 years and 169,12±6,44 cm respectively.

When we examine the of participants as indicated on the table out of the values of weight and BMI we observed that there was a statistical significance was detected (p<0,05).

When we examine Table 3, out of the values of total cholesterol, triglyceride, HDL, LDL, FT3, FT4, B12, and Iron, we observed that there were statistically significant differences between the values of total cholesterol, triglyceride, FT3, FT4, HDL, and LDL (p<0,05). No statistical significance was detected on the values of B12 and Iron (p>0,05).

Table 1. Physical Characteristics of Participants

N	**Age (years)** (Mean±SD)	**Height (cm)** (Mean±SD)
8	39,62±6,30	169,12±6,44

Discussion

As a result of the main findings of the research, it was noted that significant differences were observed between pre- and post-test of body weight and BMI values in sedentary women with type 2 diabetes, who did aerobic exercises regularly for eight weeks. Additionally, There was a significant difference were determined between total cholesterol, triglyceride, FT3, FT4, HDL, and LDL values of sedentary women with type 2 diabetes. Despite that, there were no significant differences between Iron and B12 values.

When the literature was examined, Akıl et al. (14) have reported that applied subject study on 14 sedentary males and made blood measurements by Bruce Protocol. The analysis made on the pre-test and post-test results are parallel with the results of our study. However, in the subject study, another measurement was made 48 hours from post-test measurements, and it was determined that measurements obtained were not parallel with the post-test. This aspect of the study is parallel with our study. As we explained above, we are of the opinion that it sources from the fact that subjects applied for an exercise program with aerobic content for the long term and at the same severity level. In another study, Çınar et al. (15,16) determined that 6 weeks weight exercise, which was applied to 40 healthy males aged between 18-22 in combination with a zinc supplement, made positive changes on the hormone levels (thyroid) of participants. The result of this study supports our research as well.

In another study (17), results similar to our study were obtained after examining thyroid hormones

Table 2. Comparison of Pre- and Post-test Results of Body Weight and BMI Parameters of Participants

Measurements (cm)	**Ranks**	**N**	**Mean Rank**	**Rank Total**	**Z**	**p**
Body Weight (kg)	Negative Ranks	8[a]	4,50	36,00	-2,52	**,012***
	Positive Ranks	0[b]	,00	,00		
Pre- and Post-test	Equal	0[d]				
BMI (kg/m2)	Negative Ranks	8[e]	4,50	36,00	-2,53	**,011***
	Positive Ranks	0[f]	,00	,00		
Pre- and Post-test	Equal	0[g]				

*p<0,05**

Table 3. Comparison of Pre and Post-Test Results of Certain Blood Parameters of Participants

Blood Parameters	Ranks	N	Mean Rank	Rank Total	Z	p
Total Cholesterol (mg/dL)	Negative Ranks	8[d]	4,50	36,00	-2,52	,012*
	Positive Ranks	0[e]	,00	,00		
	Equal	0[f]				
Triglyceride (mg/dL)	Negative Ranks	8[g]	4,50	36,00	-2,52	,012*
	Positive Ranks	0[h]	,00	,00		
	Equal	0[i]				
HDL (mg/dL)	Negative Ranks	0[j]	,00	,00	-2,52	,012*
	Positive Ranks	8[k]	4,50	36,00		
	Equal	0[l]				
LDL (mg/dL)	Negative Ranks	6[m]	5,50	33,00	-2,10	,036*
	Positive Ranks	2[n]	1,50	3,00		
	Equal	0[o]				
FT3 (mg/dL)	Negative Ranks	8[p]	4,50	36,00	-2,52	,012*
	Positive Ranks	0[q]	,00	,00		
	Equal	0[r]				
FT4 (mg/dL)	Negative Ranks	8[s]	4,50	36,00	-2,52	,012*
	Positive Ranks	0[t]	,00	,00		
	Equal	0[u]				
Iron (mg/dL)	Negative Ranks	3[v]	5,67	17,00	- ,14	,889
	Positive Ranks	5[w]	3,80	19,00		
	Equal	0[x]				
B12 (mg/dL)	Negative Ranks	3[y]	4,00	12,00	- ,84	,401
	Positive Ranks	5[z]	4,80	24,00		
	Equal	0[aa]				

*p<0,05**

therein. However, in contradistinction to our study, significant results were obtained in pre-test and post-test values in terms of vitamin B12 and iron values. We assume that it sources from analysed research samples' usage of supplementary products, which were not included to the exercise program (Akkurt, 2019). Koz, et al. (2016) noted that the aerobic exercises in moderate and high severity levels made by women with Type 2 Diabetes Mellitus for 3 days for a period of 6 months caused an increase in insulin sensitivity, and that it facilitated losing weight. However, it is reported that changes that occurred on insulin sensitivity by one-off acute exercise are lost in a few days and that it does not make any effect on glucose regulation (18). Therefore, physical activity that is performed to decrease insulin resistance must be performed regularly and for the long-term. Thus, it is noted that the above sentence also supports our study.

In another study that researched the role of exercise in diabetes treatment; Yamanouchi et al. (1995) compared the effect of diet and diet + exercise on insulin sensitivity in the research they made with the participation of subjects diagnosed with type 2 diabetes.

It was detected that there was a significant decrease in the insulin resistance of exercise group subjects, who had to take a minimum of 10000 steps daily, after six-eight weeks (19).

Mourier et al. (1997) divided diabetes patients into two groups as control and exercise groups in their research, and as a result of eight weeks, they observed that there was an increase in maxVO2 levels of the exercise group and that there was a decrease in fasting blood glucose and HbA1c levels of the same (20). In the research conducted on 24 type 2 diabetes patients with diabetic peripheral neuropathy, who were selected randomly in order to research specifically the effects of serum kinesin-1 on physical function, Seyedizadeh et al. (2020) divided participants into two groups (experimental and control), and the experimental group did resistance-aerobic exercise for 3 sessions for eight weeks. Consequently, they determined that serum kinesin-1 level and aerobic resistance decreased after exercising (resistance-aerobic) for eight weeks, and detected that exercise may be beneficial for the progress of diabetic peripheral neuropathy (21). The results of this study bear a resemblance to our study and emphasized that exercise may be beneficial for Type 2 diabetes patients.

Koca and Talu (2015) critical developments are observed on glucose metabolism by exercise on most scientific studies. Improvements in insulin sensitivity by exercise training in, particular, are observed even better in high aerobic exercises. Also, the adaptation of patients was high in comparison to combined type exercises (22). The results of this study support the result of our study as well. In the study, in which the effect of aerobic exercise frequencies and the weekend warrior workout model on diabetes parameters and muscle tissue in rats, on which type 2 diabetes was generated experimentally, Alaca and Kurtel (2015) determined that exercise decreased blood glucose parameters consistent with the literature (23). T2DM risk was found as low in physically active individuals, and insulin resistance and glucose intolerance decreased (24-26). Sabag et al. (2017) emphasized that more number of studies are required to assess the effect of exercise on the pancreas, heart, and intramyocellular lipid in type 2 diabetes, and to reveal the effect of exercise on ectopic lipid independently from weight loss (27).

Conclusion

We may say that the aerobic exercise program, which we applied for eight weeks, caused critical changes to occur on thyroid hormone levels and certain blood lipid values of women with type 2 diabetes. In this research, which is conducted on female patients with type 2 diabetes, it is concluded that 8 weeks of aerobic exercise made a positive effect on organizing thyroid hormone and weight loss, and that type 2 diabetic syndrome, which is caused by a sedentary lifestyle and irregular eating habits, may be adjusted by regular and long-term exercise program and by reinforcing insulin resistance. It is recommended to conduct such type of researches by increasing sampling groups and to raise awareness in adolescent individuals in particular on ways of protection from obesity, which is considered as the disease of this century, and type 2 diabetic syndrome.

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Conflicts of Interest

The authors declare that there is no conflict of interest about this manuscript.

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