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# Examination of the Effects of a Chronic Exercise Program on Body Composition and Selected Biochemical Parameters in Children with Down Syndrome*

Burcu YENTÜRK[1A], Evrim ÇAKMAKÇI[2B]

[1] *Batman University, Sport Science Faculty, Coach Education Department, Batman, TÜRKİYE*
[2] *Selcuk University, Sport Science Faculty, Coach Education Department, Konya, TÜRKİYE*

*Address Correspondence to Burcu YENİTÜRK: e-mail: burcu.yenturk@batman.edu.tr*
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A: Orcid ID: 0000-0003-1551-447X B: Orcid ID: 0000-0003-1043-901X

**Abstract**

This study aims to examine the effect of an 8-week chronic exercise program on body composition and some biochemical parameters in individuals with Down Syndrome. Individuals with Down Syndrome were included in the study and divided into two groups experimental and control groups. The experimental group participated in a chronic exercise program lasting 75 minutes per session, conducted 4 days a week over 8 weeks. Before and after exercise, body composition and some biochemical parameters were obtained from both experimental and control groups. For statistical analysis of the data, SPSS 25 package program was used. Since the data were normally distributed, parametric tests were used in statistical analyses. For intra-group comparisons, Paired Samples T Test and for inter-group comparisons, Independent Samples T Test were applied. Comparison of the pre-test and post-test values of the experimental and control groups revealed no statistically significant difference (P>.05) in BMI, FP, WC, WHR, preperitoneal adipose tissue, subcutaneous adipose tissue, glucose, HDL, LDL, triglycerides, AST and ALT values of the experimental group. In the control group, only a significant increase was observed in triglyceride value (P<0.05). There was no statistically significant difference in any of the measured parameters as a result of intergroup comparison (P>0.05). Consequently, the 8-week chronic exercise program did not have statistically significant results in body composition and some biochemical parameters of individuals with Down Syndrome.
**Keywords:** Biochemical Parameters, Down Syndrome, Exercise, Body Composition.

**Özet**

**Down Sendromlu Çocuklarda Uygulanan Kronik Egzersiz Programının Vücut Kompozisyonu ve Bazı Biyokimyasal Parametreler Üzerine Etkilerinin İncelenmesi**

Bu çalışmanın amacı Down Sendromlu bireylere uygulanan 8 haftalık kronik egzersiz programının vücut kompozisyonu ve bazı biyokimyasal parametrelere etkisinin incelenmesidir. Çalışmaya Down Sendromlu bireyler dahil edilmiş, deney ve kontrol grubu olarak ikiye ayrılmıştır. Deney grubuna 8 hafta boyunca haftada 4 gün 75'er dakikalık kronik egzersiz programı uygulanmıştır. Egzersiz öncesi ve sonrası hem deney hem de kontrol gruplarından vücut kompozisyonu ve bazı biyokimyasal parametreler alınmıştır. Verilerin istatiksel analizinde SPSS 25 paket programı kullanılmıştır. Verilerin normal dağılım göstermesinden dolayı istatiksel analizlerde parametrik testler kullanılmıştır. Grup içi karşılaştırmalar için Paired Samples T Testi, gruplar arası karşılaştırmalar için de Independent Samples T Testi uygulanmıştır. Deney ve kontrol grubunun ön test son test değerleri karşılaştırıldığında deney grubunun vücut kompozisyonu parametrelerinden VKİ, YY, BÇ, BKO, preperitonal yağ dokusu ve subkutan yağ dokusu, biyokimyasal parametrelerden glukoz, HDL, LDL, trigliserid, AST ve ALT değerlerinde istatiksel olarak anlamlı farklılık bulunamamıştır (P>,05). Kontrol grubunda ise sadece trigliserid değerinde anlamlı bir artış görülmüştür (P<0,05). Gruplar arası karşılaştırma sonucunda ise ölçülen parametrelerin hiçbirinde istatiksel olarak anlamlı farklılık görülmemiştir (P>0,05). Sonuç olarak 8 haftalık kronik egzersiz programının Down Sendromlu bireylerin vücut kompozisyonunda ve bazı biyokimyasal parametrelerinde istatiksel olarak anlamlı sonuca ulaşılamamıştır.

**Anahtar Kelimeler:** Biyokimyasal Parametreler, Down Sendromu, Egzersiz, Vücut Kompozisyonu.

## INTRODUCTION

Down Syndrome (DS), first described by John Langdon Down in 1887, affects roughly 1 in every 700 live births. Nevertheless, the rate changes with the age of the mother, increasing to one in 30 live births for mothers aged 45 and over. DS is caused by the presence of an extra copy on chromosome 21 (1, 2).

Body composition is an important indicator of health at all ages, especially in childhood and adolescence. It is observed that individuals with DS have an unhealthy body composition with high-fat mass and low lean mass compared to their mentally disabled or normal peers (3, 4). One reason for being overweight in individuals with DS is low activity levels (5) and given that 45% of men and 56% of women with DS are overweight, children with DS must meet the minimum recommended activity guidelines (6). The most common health problems of individuals with DS are sleep apnea and obesity. Both of these problems hurt their lives. Moreover, it has been reported that individuals with DS have lower physical work capacity than their peers with intellectual disabilities (7).

Although preperitoneal adipose tissue is not classified as visceral adipose tissue, it shows a strong correlation with intra-abdominal visceral adipose tissue thickness and has been linked to an increased risk of cardiovascular disease (CVD) (8). A study on obese children found that preperitoneal adipose tissue exhibited a stronger association with hyperinsulinemia compared to visceral and subcutaneous adipose tissue (9). Subcutaneous adipose tissue thickness is associated with dyslipidemia in a few studies and is also associated with serum leptin levels (10). Besides, another study concluded that increased preperitoneal fat accumulation in non-insulin-dependent diabetic patients was closely associated with obesity, hypertension, and hyperinsulinemia (11).

Regular exercise has benefits that include being protective alongside calorie restriction and increasing lean muscle mass. It is particularly effective in reducing visceral adipose tissue and waist circumference, thereby providing a protective effect against cardiometabolic risk factors. When lifestyle changes lead to a negative energy balance in the body, visceral fat stores are easily mobilized and exert a beneficial effect (12).

Effects of chronic exercise on biochemical parameters may vary depending on individual characteristics, physical fitness, duration and intensity of exercise, and different lipid values. It has been reported that triglyceride levels are lower in individuals who engage in different types of exercise over long periods compared to sedentary individuals (13).

In this context, the aim of this study is to examine the effect of an 8-week chronic exercise program applied to individuals with Down Syndrome on body composition and certain biochemical parameters.

## METHOD

### Participants

Nineteen students with DS aged 12-15 years with moderate intellectual disabilities attending Batman Special Education Application Center (I., II., and III. Level) participated in the study. In the study, a pre-test post-test control group quasi-experimental design was used. Individuals with DS were divided into two groups experimental group (n=10) and control group (n=9) according to exercise participation and health status. However, 5 individuals with DS (3 experimental and 2 control) were excluded from the study because their measurements could not be taken. Statistical data were evaluated as 7 experimental groups and 7 control groups. Before the study, participants were informed not to take any medication or engage in strenuous exercise. The Ethics Committee Report was obtained from the Selçuk University Faculty of Sport Sciences Ethics Committee. Before the study, parents were informed and a signed parental consent form was obtained. Necessary permissions were also obtained from the Batman Provincial Directorate of National Education for the study to be conducted in the relevant school.

**Exercise Protocol**

The exercise program spanned 8 weeks, consisting of 75-minute sessions conducted 4 days per week. Each unit study consists of a 10-minute warm-up, a 60-minute main study, and a 5-minute cool-down period. Animal imitations, strength exercises with their own body weight, step exercises, medicine ball exercises, track work, and games were included in the main work section. During the implementation of each training unit, care was taken to ensure that the training was fun and playful. In addition, 3 assistant trainers were present in the study area to help the students perform the movements correctly.

**Height, Body weight, BMI, Body Fat Percentage Measurement**

The height of the individuals with DS participating in the study was measured in an anatomical posture, barefoot, using a tape measure with 0.01 cm precision. The values obtained were recorded in cm. TANITA BC-418 (Japan) Segmental Bioelectrical Impedance analyzer was used to determine body composition. Before each measurement, the height, age, gender, athletic, and sedentary status of the experimental and control groups were entered into the screen of the analyzer. The weight of 0.5 kg of clothing was deducted by paying attention to the light weight of the clothes of the individual to be measured. During the measurement, it was ensured that the individuals did not have any metal objects on them and that they stood on the platform of the analyzer with bare feet. Body composition measurement was completed by holding the arms of the device with the right and left hands (14).

**Waist Circumference and Waist-to-Hip Ratio Measurement**

For waist circumference measurement, the thinnest point between the iliac cristae and the end of the costume was measured. The hip was also measured at the widest part of the hip. In these measurements, an inelastic tape measure was used and the tape measure was kept parallel to the ground. The measurement taken while the individuals were standing upright was recorded in cm. The waist-hip ratio was obtained by dividing the waist circumference by the hip circumference (15).

**Sonographic Measurements**

Ultrasound measurements were performed by a specialist physician at Batman Training and Research Hospital. The GE P5 Logiq system was utilized to measure the thickness of subcutaneous and preperitoneal fat. The thickness of subcutaneous fat is defined as the distance between the anterior aspect of the linea alba and the fat-skin barrier. Preperitoneal fat extends from the anterior aspect of the liver (left lobe) to the posterior aspect of the linea alba (8).

During the measurement, students lying on a flat surface were asked to take a deep breath. All measurements were performed after a quiet exhalation with minimal pressure without affecting fat thickness. The thinnest subcutaneous adipose tissue thickness between the skin and the linea alba and the thickest preperitoneal adipose tissue thickness between the linea alba and the liver were measured between the xiphoid and the navel, approximately 5 cm from the navel.

**Measurement of Biochemical Parameters**

Blood samples were taken from the elbow vein twice from all subjects before and after the 8-week exercise program. Blood samples of individuals with DS were collected and analyzed at Batman Training and Research Hospital. The blood samples were centrifuged at 4000 rpm in an Elektromag centrifuge and the serum samples were analyzed in a Beckman Coulter autoanalyzer.

**Statistical Analysis**

In the statistical analysis of the data, arithmetic averages and standard deviations of all data were calculated using the SPSS 25 package program. The distribution of the data was assessed using the Shapiro-Wilk test, and the skewness and kurtosis values of the two datasets that did not initially show normal distribution were examined, confirming that they followed a normal distribution. Therefore, parametric tests were used in the analyses. Paired Samples T Test was used to determine the differences in dependent groups and Independent Samples T Test was used for intergroup comparisons.

## FINDINGS

**Table 1.** Descriptive statistics of the experimental and control groups participating in the study.

| Variables | Time | N | Mean | SD |
|---|---|---|---|---|
| Age (years) | Experimental | 7 | 13.86 | 0.50 |
| | Control | 7 | 13.29 | 0.60 |
| BW (kg) | Experimental | 7 | 58.65 | 13.58 |
| | Control | 7 | 49.62 | 15.30 |
| Height (cm) | Experimental | 7 | 144.42 | 3.73 |
| | Control | 7 | 143.14 | 8.57 |

Table 1 shows the descriptive statistics of the individuals with DS who participated in the study. The mean age of the experimental group was 13.86±0.50 years, body weight was 58.65±13.58 kg, and height was 144.42±3.73 cm. The mean age of the control group was 13.29±0.60 years, body weight was 49.62±15.30 kg and height was 143.14±8.57 cm.

**Table 2.** Comparison of in-group body composition values of experimental and control groups.

| Variables | Time | Pre-Test Mean±SD | Post-test Mean±SD | P |
|---|---|---|---|---|
| BW (kg) | Experimental | 58.65±13.58 | 58.37±12.37 | .703 |
| | Control | 49.62±15.30 | 50.10±14.34 | .646 |
| BMI (kg/m²) | Experimental | 28.21±7.09 | 28.07±6.55 | .680 |
| | Control | 23.85±5.95 | 24.14±5.72 | .594 |
| Fat Percentage (%) | Experimental | 26.32±9.60 | 25.28±9.07 | .225 |
| | Control | 21.81±5.39 | 22.05±5.11 | .370 |
| Waist circumference (cm) | Experimental | 89.28±11.01 | 88.00±10.47 | .27 |
| | Control | 81.71±11.27 | 82.00±11.13 | .68 |
| Waist - Hip Ratio | Experimental | 0.90±0.02 | 0.91±0.03 | .225 |
| | Control | 0.92±0.01 | 0.92±0.01 | 1.000 |
| Preperitoneal Fat Tissue (mm) | Experimental | 10.84±4.07 | 10.52±3.77 | .386 |
| | Control | 11.04±3.91 | 10.48±4.20 | .170 |
| Subcutaneous Fat Tissue (mm) | Experimental | 10.88±3.88 | 10.94±4.49 | .862 |
| | Control | 11.22±4.34 | 11.47±4.15 | .447 |

Table 2 shows the pre-test - post-test comparisons of body weight, BMI, fat percentage, waist circumference, waist-hip ratio, preperitoneal adipose tissue, and subcutaneous adipose tissue values of the experimental and control groups. According to the findings, there was no statistically significant difference between the pre-test and post-test values of the experimental group (P>0.05). There was no statistically significant difference when the values of the control group were compared (P>0.05).

**Table 3.** Comparison of in-group biochemical values of experimental and control groups.

| Variables | Time | Pre-Test Mean±SD | Post-test Mean±SD | P |
|---|---|---|---|---|
| Glucose (mg/dL) | Experimental | 98.85±8.13 | 96.57±7.18 | .649 |
| | Control | 96.00±8.71 | 99.14±16.20 | .709 |
| HDL (mg/dL) | Experimental | 50.85±4.18 | 44.85±9.28 | .078 |
| | Control | 50.71±7.97 | 48.57±8.92 | .115 |
| LDL (mg/dL) | Experimental | 63.28±13.13 | 68.57±12.60 | .412 |
| | Control | 80.14±30.82 | 85.42±18.91 | .504 |
| Triglycerides (mg/dL) | Experimental | 104.14±58.30 | 126.28±61.64 | .206 |
| | Control | 124.85±28.36 | 173.71±61.74 | **.038*** |
| AST (U/L) | Experimental | 24.71±5.58 | 23.85±3.23 | .771 |
| | Control | 27.28±6.57 | 26.28±3.90 | .774 |
| ALT (U/L) | Experimental | 21.71±6.65 | 27.14±9.92 | .225 |
| | Control | 23.14±5.11 | 21.71±3.35 | .529 |

**P<0.05**

Table 3 shows the pre-test - post-test comparisons of in-group glucose, HDL, LDL, triglyceride, AST, and ALT values of the experimental and control groups. According to the findings, there was no statistically significant difference between the pre-test and post-test values of the experimental group (P>0.05). As a result of the pre-test and post-test comparisons of the control group, a significant increase was observed only in the triglyceride value (P<0.05), while no statistical difference was observed in other variables (P>0.05).

**Table 4.** Comparison of inter-group body composition values of experimental and control groups.

| Variables | Time | Experimental Mean±SD | Control Mean±SD | P |
|---|---|---|---|---|
| BW (kg) | Pre-Test | 58.65±13.58 | 49.62±15.30 | .266 |
| | Post-test | 58.37±12.37 | 50.10±14.34 | .270 |
| BMI (kg/m$^2$) | Pre-Test | 28.21±7.09 | 23.85±5.95 | .237 |
| | Post-test | 28.07±6.55 | 24.14±5.72 | .256 |
| Fat Percentage (%) | Pre-Test | 26.32±9.60 | 21.81±5.39 | .300 |
| | Post-test | 25.28±9.07 | 22.05±5.11 | .428 |
| Waist circumference (cm) | Pre-Test | 89.28±11.01 | 81.71±11.27 | .228 |
| | Post-test | 88.00±10.47 | 82.00±11.13 | .320 |
| Waist - Hip Ratio | Pre-Test | 0.90±0.02 | 0.92±0.01 | .062 |
| | Post-test | 0.91±0.03 | 0.92±0.01 | .349 |
| Preperitoneal Fat Tissue (mm) | Pre-Test | 10.84±4.07 | 11.04±3.91 | .927 |
| | Post-test | 10.52±3.77 | 10.48±4.20 | .984 |
| Subcutaneous Fat Tissue (mm) | Pre-Test | 10.88±3.88 | 11.22±4.34 | .879 |
| | Post-test | 10.94±4.49 | 11.47±4.15 | .823 |

Table 4 shows the pre-test and post-test comparisons of body weight, BMI, fat percentage, waist circumference, waist-to-hip ratio, preperitoneal adipose tissue, and subcutaneous adipose tissue values between the groups. According to the findings, there was no statistically significant difference between the groups in both pre-test and post-test values (P>0.05).

**Table 5.** Comparison of intergroup biochemical values of experimental and control groups.

| Variables | Time | Experimental Mean±SD | Control Mean±SD | P |
|---|---|---|---|---|
| Glucose (mg/dL) | Pre-Test | 98.85±8.13 | 96.00±8.71 | .538 |
| | Post-test | 96.57±7.18 | 99.14±16.20 | .708 |
| HDL (mg/dL) | Pre-Test | 50.85±4.18 | 50.71±7.97 | .967 |
| | Post-test | 44.85±9.28 | 48.57±8.92 | .460 |
| LDL (mg/dL) | Pre-Test | 63.28±13.13 | 80.14±30.82 | .208 |
| | Post-test | 68.57±12.60 | 85.42±18.91 | .073 |
| Triglyceride (mg/dL) | Pre-Test | 104.14±58.30 | 124.85±28.36 | .415 |
| | Post-test | 126.28±61.64 | 173.71±61.74 | .176 |
| AST (U/L) | Pre-Test | 24.71±5.58 | 27.28±6.57 | .446 |
| | Post-test | 23.85±3.23 | 26.28±3.90 | .229 |
| ALT (U/L) | Pre-Test | 21.71±6.65 | 23.14±5.11 | .660 |
| | Post-test | 27.14±9.92 | 21.71±3.35 | .195 |

Table 5 shows the pretest-posttest comparisons of glucose, HDL, LDL, triglyceride, AST, and ALT values between the groups. According to the findings, there was no statistically significant difference between the groups in both pre-test and post-test values ($P>0.05$).

## DISCUSSION AND CONCLUSION

In this study, 8-week exercise practice was performed, and measurements of body composition and blood parameters were taken before and after the exercise. As a result of the calculations, there were no significant changes in body weight, BMI, fat percentage, waist circumference, waist-to-hip ratio, preperitoneal adipose tissue, subcutaneous adipose tissue, glucose, HDL, LDL, triglyceride, AST and ALT values of the individuals with DS in the experimental and control groups ($P>0.05$), while there was a significant increase in triglyceride value only in the control group ($P<0.05$). When the values between the groups were compared, no significant difference was observed ($P>0.05$).

The results showed that body weight and BMI values were maintained in the experimental group, while there was a non-significant decrease in body fat percentage. However, there was a non-significant increase in body weight, BMI, and body fat percentage values of the control group. The reason for this is thought to be the sedentary lifestyle and diet in the control group. Similarly, Ordonez et al (16) did not observe any difference in the body mass index of the experimental (n=11) and control (n=9) groups in their study of 20 obese women with DS. In many studies, no significant difference was observed in body weight, BMI, and body fat percentage of individuals with DS (17, 18, 19, 20, 21). In contrast to our study, Ulrich et al., (22), Lin and Wuang, (23), Seron et al., (24), Ordonez et al., (25), Erol, (26), found that there were significant decreases in body weight, BMI, and body fat percentage as a result of exercise and training programs they applied.

Individuals with DS tend to gain weight due to hypotonia, metabolic diseases, or slow metabolism. Furthermore, individuals with DS have unhealthy eating habits and medications that contribute to excessive weight gain (27). Overweight gain and obesity are associated with an increased risk of hypertension, type 2 diabetes, and cardiovascular disease (28). This is why nutrition and exercise are important to have a healthy body composition in individuals with DS (29, 30). Considering the nutritional status of individuals with DS, it has been reported that their carbohydrate and protein consumption is above the recommended levels. This causes the energy intake to be more than needed. It was also found that sodium consumption was much higher than recommended due to the high consumption of ready-to-eat foods in this population. It has been reported that individuals with DS prefer chocolate, biscuits, and chips in snacks (31). Since we aimed to achieve a positive change in the body composition of individuals with DS, individuals with DS and their families were informed about a diet rich in fiber and low in calories and fat. It was observed that individuals with DS who participated in our study had a fondness for unhealthy diets and did not follow nutritional recommendations sufficiently.

The results showed that the waist circumference of the experimental group decreased while the waist circumference of the control group increased. Similarly, Cai and Beak (32) did not find a significant difference in the waist-hip ratio in the experimental and control groups after a 24-week exercise program. In the study by Seron et al (24), no significant difference was found in the waist circumference of adolescents with DS in the resistance group and the control group. Calders et al (20) found no significant difference in waist circumference in the combined training group, resistance training group, and control group in their study on children with intellectual disabilities.

In contrast to these studies, Suarez-Villadat et al (33) examined the effect of the swimming program on body composition in adolescents with DS. After 36 weeks of swimming exercise, significant decreases in waist circumference and waist-to-hip ratio were observed in the experimental group, while significant increases were observed in the control group. Küçükyetgin (34) conducted a study on overweight and obese individuals without DS and found significant decreases in waist-hip ratio and waist circumference in the resistance group. Again, in a study conducted on 40 obese women without DS, Sabir et al (35) obtained similar results by detecting decreases in waist-hip ratio and waist circumference.

A literature review did not reveal any studies on preperitoneal and subcutaneous adipose tissues in groups with DS. Donnelly et al (36) did not find a significant difference in subcutaneous adipose tissue in women in their 16-month exercise study on overweight men and women. Irving et al (37) performed computed tomography measurements of 27 obese women divided into a high-intensity exercise group, low-intensity exercise group, and control group and found no significant difference in subcutaneous adipose tissue in the low-intensity exercise group and the control group. Although there was no statistical significance in our study, it can be said that if a decrease can be achieved with exercise and diet, the risk of diabetes, insulin resistance, hyperinsulinemia, leptin, and metabolic diseases will be reduced.

Sabir et al. (35) compared the pre- and post-diet results in their study on 40 obese women and observed significant reductions in subcutaneous and preperitoneal fat tissue. Tsuzuku et al (38) exercised elderly people (aged 65-87 years) with their body weight for 12 weeks and found significant reductions in both preperitoneal and subcutaneous adipose tissue in the exercise group. Nishiwaki et al (39) examined the effects of 8 weeks of exercise under mild hypoxic conditions on body composition and circulating adiponectin levels in postmenopausal women and found no significant change in the values measured in the normoxic group after exercise.

Body fat distribution is an important factor in the treatment of obesity and its complications (38). This observation has been confirmed by many studies (41, 42, 43), which have shown that increased blood pressure is related to the distribution of body fat rather than the absolute amount of body fat. Preperitoneal fat, although not part of the visceral fat, is in anatomical contact with the peritoneum. Therefore, it is thought that preperitoneal fat may share some physiologic properties with visceral fat (44). There are also studies showing that diabetic patients have high levels of preperitoneal fat. It has been reported that high leptin levels in female patients are due to increased subcutaneous fat accumulation rather than preperitoneal fat accumulation (11). Previous studies have shown that hyperinsulinemia elicits leptin release from adipose tissues (45, 45). Increased preperitoneal fat deposition is closely associated with insulin resistance or hyperinsulinemia (47). In studies examining the relationship between body fat distribution and metabolic disorders in obesity, there is a need for methods to evaluate and monitor the ratio between intra-abdominal fat (visceral and preperitoneal) and extra-abdominal (subcutaneous) fat (35).

In our study, no significant difference was observed in glucose values when the experimental and control groups were compared ($P>0.05$). Again, no significant difference was found in HDL, LDL, and triglyceride values in the experimental group as a result of pre-test and post-test measurements ($P>0.05$). It is thought that this may be related to the duration and intensity of the exercise. On the other hand, no significant difference was found in HDL and LDL in the control group as a result of pre-test and post-test measurements, while there was a significant increase in triglyceride value ($P<0.05$). In the pre-test measurements, the triglyceride value, which was within the normal limits, exceeded the normal limit in the post-test measurement. This is thought to be due to the sedentary life and nutritional status in the control group.

Erol (26) divided two people with DS as exercise and control in his study. It was found that the pre-exercise HDL value of the individual participating in the exercise was 32 mg/dL and the post-exercise value was 40.3 mg/dL. The HDL value of the individual with DS selected as control was reported to be 46.8 mg/dL before exercise and 37 mg/dL after exercise. In addition, it was reported that the HDL value of the exercised individual, which was lower than normal before exercise, increased after exercise and was in the normal value range. The pre-exercise LDL value of 114 mg/dL and triglyceride value of 313 mg/dL were reported as 79 mg/dL and triglyceride value of 256 mg/dL after exercise. The pre-exercise LDL value was 77 mg/dL and the triglyceride value was 106 mg/dL, while the post-exercise LDL value was 90 mg/dL and the triglyceride value was 173 mg/dL in a non-exercised individual.

The changes that occur in the organism due to exercise vary according to the intensity and severity of the activity. It was reported that exercise performed at an optimum level causes an increase in plasma glucose levels. While glucose is derived from glycogen breakdown and amino acids in the liver during rest, plasma glucose concentration increases with the aid of catecholamines during physical activity. The glucose level in blood plasma is influenced by the intensity and duration of exercise (48). In our study, no significant changes were observed in the ALT and AST values following pre-test and post-test measurements in the experimental and control groups with DS. A literature review revealed only one study measuring liver enzymes in individuals with DS. De Gonzalo-Calvo et al. (49) included 248 adults with DS and 84 adults in the control group in their study to examine the biochemical and hematological findings of adults with DS and compare these values to the control population. The mean AST and ALT values in individuals with DS were reported as 21.0 U/L and 20.0 U/L, respectively. In the control group, these values were reported as 19.0 U/L and 19.0 U/L, respectively.

The effects of 8-week chronic exercise training on body composition and some biochemical parameters of individuals with DS were investigated in this study. As a result, the 8-week chronic exercise program did not cause significant differences in body weight, BMI, body fat percentage, waist circumference, waist-to-hip ratio, preperitoneal adipose tissue, subcutaneous adipose tissue, glucose, HDL, LDL, triglyceride, AST and ALT values of individuals with DS.

According to the results of the study, although there was no significant difference between the groups, body fat percentage showed a non-significant decrease in the experimental group and a non-significant increase in the control group during this process. In addition, the triglyceride value of the control group increased significantly in the final test, exceeding normal limits. This situation shows that a sedentary lifestyle can negatively affect the body composition and some biochemical parameters of individuals with DS. Therefore, future studies may be planned for longer periods.

The experimental and control groups included in our study consist solely of individuals with DS. In similar studies, individuals with DS can be compared with individuals with typical development and individuals with intellectual disabilities.

The reason why the training sessions are not effective may be related to the duration and intensity of the training. Therefore, training programs with different frequencies, durations, and intensities can be created for similar exercises.

In our study, only subcutaneous and preperitoneal fat tissue were measured in relation to abdominal fat. However, these two values are not sufficient for total abdominal fat. Therefore, in similar studies, visceral fat tissue can also be measured along with subcutaneous and preperitoneal fat tissue.

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