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Impact of a 14-week basic swimming program on liver enzymes and plasma lipids in adult women

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Abstract

This study aimed to investigate some liver enzymes and blood lipids in adult women after 14 weeks of swimming training. The study was voluntarily participated by 28 women students between the ages of 18-24 studying at the faculty of sports sciences. Participants were divided into two groups experimental and control groups. The experimental group received basic swimming training 2 days a week for 14 weeks. Each study session was planned for 90 minutes. The control group did not participate in any study. Blood samples were taken from the experimental and control groups before and after the start of the training program. Shapiro-Wilk test was applied to determine whether the obtained data showed normal distribution and it was determined that the data showed normal distribution. Therefore, Paired Samples T Test and Independent Samples T Tests were used. Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), Gamma Glutamyl Transferase (GGT), Urea, Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL), Triglyceride (TG), and Cholesterol values of the experimental and control groups were compared according to the values obtained from the blood samples. There were significant differences between the post-test measurements of Triglyceride and Cholesterol values in the comparison between the groups. The intra-group comparison showed significant differences in HDL and triglyceride values in the experimental group. As a result, it was observed that 14 weeks of basic swimming training in adult women had positive effects on some plasma lipid levels but did not show any significant changes in liver enzymes.

Keywords: Blood lipids, liver enzymes, swimming, women

Temel yüzme eğitiminin yetişkin kadınlarda karaciğer enzim ve plazma lipit düzeylerine etkisi

Öz

Bu araştırmanın amacı 14 haftalık yüzme eğitiminin yetişkin kadınların bazı karaciğer enzimleri ve kan yağlarının incelenmesidir. Çalışmaya spor bilimleri fakültesinde okuyan 18-24 yaş arası 28 kadın öğrenci gönüllü olarak katılmıştır. Katılımcılar çalışma grubu ve kontrol grubu olarak ikiye ayrılmıştır. Çalışma grubu 14 hafta boyunca haftada 2 gün temel yüzme eğitimi almıştır. Her çalışma seansı 90 dakika olarak planlanmıştır. Kontrol grubu ise herhangi bir çalışmaya katılmamıştır. Eğitim programı başlamadan önce ve sonra deney ve kontrol gruplarından kan örnekleri alınmıştır. Elde edilen verilerin normal dağılım gösterip göstermediğini belirlemek için Shapiro-Wilk testi uygulanmış ve verilerin normal dağılım gösterdiği tespit edilmiştir. Bundan dolayı Paired Samples T Tesit ve Independent Samples T Testleri kullanılmıştır. Alınan kan örneklerinden elde edilen değerlere göre çalışma grubu ve kontrol gruplarının Aspartat Aminotransferaz (AST), Alanin Aminotransferaz (ALT), Gama Glutamil Transferaz (GGT), ÜRE, Düşük Yoğunluklu Lipoprotein (LDL), Yüksek Yoğunluklu Lipoprotein (HDL), Trigliserit (TG) ve Kolesterol değerleri karşılaştırılmıştır. Gruplar arası karşılaştırmada Trigliserit ve Kolesterol değerleri son test ölçümleri arasında anlamlı farklılık olduğu görülmüştür. Grup içi karşılaştırma sonucunda ise çalışma grubu HDL ve Trigliserit değerinde anlamlı farklılıklar görülmüştür. Sonuç olarak, yetişkin kadınlar üzerinde yapılan 14 haftalık temel yüzme eğitiminin bazı plazma lipit düzeyleri üzerinde olumlu etkileri olduğu, karaciğer enzimleri üzerinde ise herhangi bir anlamlı değişiklik göstermediği görülmüştür.

Anahtar Kelimeler: *Kadın, kan yağları, karaciğer enzimleri, yüzme*

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INTRODUCTION

The swimming branch has been reported to be accepted as a technical practice performed by individuals to cover the distance in water using certain techniques. In terms of a sports concept, it can be defined as covering a certain distance underwater in the breaststroke, freestyle, backstroke, and butterfly styles (Hannula & Thornton, 2001).

Studies show that regular exercise has significant beneficial effects on plasma lipid levels, such as an increase in HDL and a decrease in TG, cholesterol and LDL (Kraus et al., 2002; de Munter et al., 2011). Exercise has been reported to be effective on HDL plasma density along with genetic factors. Exercise has also been reported to affect HDL maturation and composition, cholesterol efflux, and cholesterol delivery to receptors (reverse cholesterol transport). The positive effect of exercise is mostly seen on triglycerides (TG), while exercise has a specific effect on low-density lipoprotein cholesterol (LDL) and total cholesterol (TC). Much evidence supports the effects of exercise on the levels of certain blood lipids (HDL and TG) (Trejo et al., 2007). Most studies suggest that exercise increases HDL levels by 5 to 10 mg, which reduces the risk of disease by 20-40%. Recent studies have reported that aerobic exercise contributes to a 5-15% increase in HDL cholesterol. The intensity of the exercises and weekly energy expenditure values are also important (Uğraş & Aydos, 2001).

It has been reported that AST and ALT values generally increase with exercise duration and intensity. Blood concentrations of aminotransferase have been reported to increase after intense exercise (Deveci, 2016). In general, regular physical activity reduces triglyceride, cholesterol and LDL levels while increasing HDL levels. However, there is no consensus in the literature about the effect of exercise on liver enzymes. The most important factors affecting liver enzyme activity are variables such as type, intensity and duration of exercise (Taşkın, 2007).

When the literature is examined, it is seen that there are not enough studies examining the effect of swimming training on liver enzymes and blood lipids. The aim of this study is to examine the effect of 14 weeks of basic swimming training on liver enzymes and some blood lipids in adult women. In this context, the aim is to fill this gap by implementing a structured swimming program and drawing inferences regarding health outcomes.

METHOD

Participants

Twenty-eight women students studying at Batman University, Faculty of Sport Sciences participated in the study voluntarily. The students were randomly divided into two groups and the students in the experimental group participated in 14 weeks of swimming training, while the students in the control group did not participate in any study. Before the study, women students were informed and a voluntary consent form was obtained.

Data collection tools

Height Measurements: The participants' heights (cm) were measured using a Seca brand mechanical scale with a height meter. During the measurement, care was taken to ensure that the participants were barefoot, and their bodies were in an upright position.

Body Weight Measurements: Body weight measurements were measured on a Seca brand digital scale. During the measurement, participants were asked to be shoeless and wear light clothing. Body Mass Index (BMI): Calculated with the formula weight (kg)/height $(m)^2$.

Measurement of Blood Values: Hematologic blood samples were collected from both groups (control and experimental) for some liver enzymes and blood lipids measurements by health personnel at Batman Training and Research Hospital. It was analyzed in the laboratory at the same hospital. Fasting blood samples of the participants were taken between 09:00 and 10:00 in the morning. It was ensured that blood samples were drawn at the same time in the pre-test and post-test. Participants were careful not to consume stimulants such as alcohol and caffeine 24 hours before the blood samples were taken.

Training procedure

Among the groups participating in the study, the students in the experimental group were given basic swimming training 2 days a week, with the first 2 training sessions of the week being 90 minutes and the last training session of the week being 60 minutes. After the warm-up in the training, technical drills, interval sets, foot-arm exercises and freestyle swimming technique exercises were done and finished with a cool-down. At least 2000 m distance was swum in each workout. The load and rest intervals in the training were planned by paying attention to the students not overtraining. The women in the control group continued their routine daily lives and did not participate in any additional exercise or training program.

Research ethics

This study was approved by the Batman University Scientific Research and Publication Ethics Committee with the decision dated 14.05.2024 and numbered 2024/03-06.

Statistical analysis

SPSS 25 package program (IBM) was used for data analysis. Shapiro-Wilk test was applied to determine whether the data showed normal distribution and it was determined that the data showed normal distribution. Therefore, Paired Samples T Test was used to compare dependent groups, and Independent Samples T Test was used to compare independent groups. In statistical analyses, the data were considered in the context of the 95% confidence interval (0.05 margin of error).

RESULTS

Table 1. Demographic characteristics of the experimental and control groups

	Experimental Mean ± SD	Control Mean ± SD
Height (cm)	161.00 ± 4.25	159.00 ± 5.02
Weight (kg)	57.26 ± 3.77	56.96 ± 3.86
BMI (kg/cm^2)	21.98 ± 2.01	22.15 ± 2.23
Age (year)	20.64 ± 2.78	23.32 ± 2.65

Table 1 shows that the mean height of the experimental group was 161 ± 4.25 cm, the mean weight was 57.26 ± 3.77, the mean BMI was 21.98 ± 2.01, and the mean age was 20.64 ± 2.78. In the control group, the mean height was 159 ± 5.02 cm, the mean weight was 56.96 ± 3.86, the mean BMI was 22.15 ± 2.23, and the mean age was 23.32 ± 2.65.

Table 2. Intergroup comparisons of liver enzyme and plasma lipid levels

	Tests	Experimental Mean ± SD	Control Mean ± SD	P
AST	Pre-Test	20.65±3.78	19.67±4.44	0.981
	Post-test	21.48±3.94	19.28±5.41	0.645
ALT	Pre-Test	17.08±3.88	18.32±2.97	0.087
	Post-test	19.91±3.04	19.25±2.86	0.173
GGT	Pre-Test	11.96±2.37	12.66±3.63	0.237
	Post-test	12.09±1.98	12.04±3.16	0.665
Urea	Pre-Test	19.81±8.46	21.10±3.27	0.744
	Post-test	20.86±6.47	21.51±3.16	0.828
LDL	Pre-Test	97.22±6.15	107.28±8.52	0.072
	Post-test	92.98±7.63	106.97±7.34	0.263
HDL	Pre-Test	61.03±8.90	59.46±5.56	0.637
	Post-test	70.06±4.09	62.08±6.35	0.294
TG	Pre-Test	82.24±33.42	90.87±26.08	0.786
	Post-test	73.32±29.01	92.45±27.14	**0.000***
Cholesterol	Pre-Test	155.92±23.92	167.19±24.96	0.064
	Post-test	146.03±42.46	162.81±29.33	**0.000***

Table 2 shows that there are significant differences between the post-test measurements of triglycerides and cholesterol in the experimental and control groups. On the other hand, no significant difference was observed in AST, ALT, GGT, Urea, LDL, and HDL values in both experimental and control groups.

Table 3. Intragroup comparisons of liver enzyme and plasma lipid levels

	Tests	Pre-Test Mean ± SD	Post-test Mean ± SD	P
AST	Experimental	20.65±3.78	21.48±3.94	0.888
	Control	19.67±4.44	19.28±5.41	0.945
ALT	Experimental	17.08±3.88	19.91±3.04	0.698
	Control	18.32±2.97	19.25±2.86	0.837
GGT	Experimental	11.96±2.37	12.09±1.98	0.203
	Control	12.66±3.63	12.04±3.16	0.552
Urea	Experimental	19.81±8.46	20.86±6.47	0.649
	Control	21.10±3.27	21.51±3.16	0.924
LDL	Experimental	97.22±6.15	92.98±7.63	0.255
	Control	107.28±8.52	106.97±7.34	0.467
HDL	Experimental	61.03±8.90	70.06±4.09	**0.039***
	Control	59.46±5.56	62.08±6.35	0.520
TG	Experimental	82.24±63.42	73.32±29.01	**0.020***
	Control	90.87±26.08	92.45±27.14	0.956
Cholesterol	Experimental	155.92±23.92	146.03±42.46	0.264
	Control	167.19±24.96	162.81±29.33	0.473

Table 3 shows that there were significant decreases in HDL and TG values in the experimental group, while no difference was observed in the control group. Besides, no significant difference was observed in AST, ALT, GGT, Urea, LDL, and Cholesterol values in both experimental and control groups.

DISCUSSION AND CONCLUSION

This study was conducted to examine the effect of basic swimming training on liver enzymes and some plasma lipid levels in adult women. No significant changes were observed when the liver enzymes of the experimental and control groups were compared at the end of the study (Table 2).

Similarly, Gözaçık (2024) did not find any significant difference in AST, ALT, and Urea values in both lower and upper extremity groups as a result of the French contrast method applied to young male basketball players. In a study conducted by Hürmüz et al. (2007) to determine the effect of continuous and intermittent running programs applied for 8 weeks on urea levels, it was determined that there was no statistically significant change in urea levels as a result of the training sessions. In the study conducted by Wilber et al. (2000), it was found

that 12 days of altitude training caused an increase in ALT and AST values, but this increase was not statistically significant.

However, there are also studies in the literature showing that exercise increases liver enzyme activity. Çakmakçı and Pulur (2007) found that a four-week training program increased AST and ALT levels of elite female taekwondo players. Similarly, Kaynar et al. (2016) found that AST, ALT, and GGT values of kickboxers increased significantly ($p<0.05$) with the effect of short-term, vigorous, and intense physical activity. In a study conducted on blood samples routinely taken from 100 elite athletes in different branches, it was reported that AST and urea levels were significantly higher ($p<0.05$) (Fallon, 2008). In their study, Kratz et al. (2002) reported a significant increase ($p<0.05$) in AST and ALT plasma levels after exercise. Sarıakçalı et al. (2021) found a significant difference in the AST value of the experimental group as a result of 4-week applied training ($p<0,05$).

AST, ALT and GGT values are used to evaluate liver functions. These enzymes, which are normally stored in the liver, mingle with the blood when damage occurs in the liver (Gencer et al., 2015). It has been stated that enzymes such as ALT and AST increase due to muscle damage rather than liver damage. The simultaneous change in these parameters shown in the current study may be due to muscle damage rather than hepatic damage. (Hammouda et al., 2012). The absence of any increase in liver enzymes shows that the intensity and severity of the training applied during our training did not cause tissue trauma.

In general, the literature shows that regular physical activity decreases triglyceride, cholesterol, and LDL levels while increasing HDL levels. The exercise-induced increase in the ability of HDL to bind to cholesterol shows the positive effect of exercise on plasma lipid levels (Taşkın, 2007). Similarly, a significant increase in HDL level and a significant decrease in triglyceride level were observed in our study. Non-significant reductions in LDL and cholesterol were observed (Table 3). In a study conducted by Mashiko et al. (2004), according to the results obtained from the blood samples taken after the 20-day camp period training applied to a determined group of athletes, it was determined that there were significant decreases in the total cholesterol and triglyceride values of the athletes. In the study conducted by Akbulut (2019), the effects of different exercise practices on some biochemical parameters were examined. The study found significant decreases in cholesterol, triglycerides, and LDL and a significant increase in HDL. When these differences were analyzed in percentages, it was observed that the greatest change in cholesterol and triglyceride levels occurred in the aerobic

exercise group, HDL cholesterol in the Interval, and LDL cholesterol in the Resistance exercise group. In a study conducted by Koç & Tamer (2008) in which 54 healthy men participated voluntarily, it was reported that aerobic and anaerobic training programs applied 3 days a week for 8 weeks led to an increase in HDL cholesterol and a decrease in LDL cholesterol, resulting in positive effects. Similarly, Bhat et al. (2018) reported that exercise reduced cholesterol, LDL cholesterol, and triglyceride levels in sedentary obese students aged 18-25 years.

Çolak et al. (2003) reported a statistically significant increase in triglyceride and total cholesterol values in the control group in the post-test comparison of the female and male subjects who participated in the studies and the female and male control groups who did not participate ($p<0.05$).

As a result, it was observed that 14 weeks of basic swimming training in adult women had positive effects on some plasma lipid levels but did not show any significant changes in liver enzymes. Liver enzymes such as AST and ALT do not increase only when there is a problem in the liver. After various exercises and sports competitions, liver enzyme levels increase due to muscle damage. Our findings show that baseline swimming training causes positive changes in blood lipids without a significant increase in liver enzyme activity at the end.

The results show that basic swimming training, planned for 90 minutes 2 days a week, can be used as an alternative method for regulating blood lipids without causing muscle damage. Future studies, programs of different duration and intensity, programs longer than 14 weeks can be implemented, and the effects can be investigated by conducting studies on people with different demographic characteristics.

Limitations

First, the participants were limited to young women aged 18–24. Therefore, the results may not be generalizable to other age groups or to men.

The swimming training was limited to 14 weeks, which may not fully capture the long-term effects on liver enzymes and plasma lipid levels.

The physical activity levels of the control group outside the study were not monitored. Additionally, the study focused solely on basic swimming training.

Finally, the biochemical analyses were restricted to liver enzyme and plasma lipid levels, excluding other potential biomarkers.

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Tasarım *Design*	Yöntem ve araştırma desenini tasarlamak *To design the method and research design.*	Burcu YENTÜRK Nuri Muhammet ÇELİK
Literatür Tarama *Literature Review*	Çalışma için gerekli literatürü taramak *Review the literature required for the study*	Burcu YENTÜRK Nuri Muhammet ÇELİK
Veri Toplama ve İşleme *Data Collecting and Processing*	Verileri toplamak, düzenlemek ve raporlaştırmak *Collecting, organizing and reporting data*	Burcu YENTÜRK Nuri Muhammet ÇELİK Mihraç KÖROĞLU
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