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ORIGINAL ARTICLE

The Effect of Swimming Training on Some Biochemical Parameters of Young Swimmers

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ABSTRACT
Aim: In this study, the effects of 4-week swimming training applied to swimmers aged 19-26 on HDL, LDL, VLDL, cholesterol, alkaline phosphatase, protein, lactate dehydrogenase, urea and phosphorus parameters were investigated.
Methods: . 22 swimmers with an average age of 24.5±2.46 years and a mean age of 5.12±1.1 for sports participated in the study. A swimming training program was applied to the participants for 4 weeks/3 days. All tests and measurements were performed before starting the 4-week training program and after completing the 4-week program.
Results: The data obtained from the study were analyzed using the SPSS 15.0 package program. The normality distribution of the data was made using the shapiro-wilk test. Participants' pre-post test measurements were analyzed with the Wilcoxon signed-rank test. According to the results of the data, there was a statistically significant difference between BW, HDL, LDL and ALP pre-post test data ($p<0.05$).
Conclusion: As a result, it can be said that the swimming training program applied regularly for 4 weeks can affect the performance positively with the changes in some biochemical parameters.
Keywords: protein, alkaline phosphatase, urea, phosphorus, cholesterol

INTRODUCTION

Considering the circulatory system of swimming, it can be said that it is performed in a suitable position for blood flow. The absence of gravity facilitates circulation as it also increases the amount of blood returning to the heart. Interestingly, in those who do regular swimming training, excessive blood flow to the heart and increased tension on the lung surface during breath-holding trigger cardiac hypertrophy1. This situation, which can only occur in high altitude exposure, actually contributes to the reduction of hypertension and cardiovascular risk factors in swimmers.

Cholesterol is a very important lipid for our body. They are used in the structure of the cell membrane, in the formation of bile acids and in the synthesis of steroid hormones. Plasma lipoproteins are divided into five main classes based on their density: chylomicrons, very low-density lipoproteins (VLDL), medium-density lipoproteins (IDL), low-density lipoproteins (LDL), and high-density lipoproteins (HDL)2,3. Measurements have shown that total cholesterol levels are around 100-150 mg/dL, and LDL levels are around 50-75 mg/dL in healthy individuals, and that atherosclerosis does not develop even when they reach the age of 70-804. LDL levels in newborns and many mammalian species have been found to be around 20-40 mg/dL. These levels are considered to be physiologically appropriate levels5. It is possible to say that the risk of developing atherosclerosis increases when these levels are exceeded. Epidemiological studies show that serum lipids increase or decrease the risk of atherosclerotic cardiovascular disease from a certain limit[6].

Total Alkaline Phosphatase (tALP) is a collection of enzymes that hydrolyze a phosphoric ester bond from organic and inorganic substrates at alkaline pH and is located in the cell membrane7. It has four isoenzymes: placental, intestinal, germinal and liver-bone-kidney. ALP secreted from liver-bone-kidney constitutes 95% of circulating ALP. ALP is a good marker for bone mineralization and formation in patients with normal liver function8. Physiologically, serum levels increase during childhood, adolescence and old age. Bone Specific ALP (B-ALP), B-ALP is found on the extracellular surface of the osteoblast membrane and is secreted during bone matrix formation. Alkaline phosphatase (AP) is a group of isoenzymes found in bones, osteoblasts, intestines, liver, kidney, and placenta. For the diagnosis of osteoporosis, it is necessary to measure the enzyme part originating from osteoblastar, namely bone alkaline phosphatase. Serum alkaline phosphatase activity assay is the most commonly used marker for the determination of bone formation. In adults, half of the amount normally circulating is found in the bones. Therefore, the specificity of serum alkaline phosphatase is low in mild increases such as in osteoporosis. In addition, a moderate increase in serum alkaline phosphatase may indicate a bone mineralization defect and may be related to an increase in the hepatic part of this enzyme. B-ALP is higher in children than adults, reaches its highest level at puberty, then decreases to adult level in the second decade. B-ALP accounts for 75-90% of total ALP in growing children over the age of four. After puberty, the BALP rate drops to 50%. B-ALP has a half-life of 1-2 days, with little diurnal variation9. Blood can be drawn for measurement at any time of the day. In cases where bone formation is increased (Paget's Disease, primary or secondary bone tumors, primary hyperparathyroidism, hyperthyroidism, fractures, serum levels increase during rapid growth periods of children[10,11].

Fatigue occurs when lactic acid, a waste iron, reaches high levels in muscle and blood with exercise. The existing acid causes the pH value in the environment to decrease. However, it inhibits the work of enzymes in the mitochondria and decreases the breakdown rate of carbohydrates, which must be broken down for energy. Lactic acid, which is formed with sufficient oxygen during exercise, causes extreme fatigue and exhaustion in the body[12].

After the physical activity is finished, this lactic acid must be removed from the body in order to ensure full recovery. It takes approximately 20-25 minutes for half of the lactic acid formed after a vigorous exercise to be removed from the body, while removal of 95% takes place in about 1 hour13.

Scientists continue to work on the subject of which energy metabolism is affected in swimming sports, as a research subject14,15. Biochemical changes that may occur in metabolism with applied training are important in terms of sportive performance16. Based on this information, the effect of the applied 4-week swimming training on some biochemical parameters was investigated.

MATERIAL & METHODS

A total of 22 athletes (male n=10, female n=12) with a mean age of 24.5±2.46 participated in the study. The average sports age of the participants was 5.12±1.1. The trainings were carried out under the supervision of expert trainers. Participants were informed about possible risks before starting the study. All participants signed a "voluntary consent form" declaring that they voluntarily participated in the study.

Training Protocol: Swimming training was applied to the participants for 2 hours a week for 4 weeks/3 days. The exercises started with 20 minutes of warm-up exercises. Warm-up exercises consist of 10 minutes of warm-up run, 10 minutes of mobility and flexibility exercises. The main working phase of the training lasted 60-80 minutes. 20 minutes were finished with cooling movements (Table 1).

Table 1. Swimming training program

Days	Program
Monday	Dynamic Warm-up 6 moves 15 reps with thera-band for 5 minutes Major Phase 12x50m 1x50m Butterfly 1x50m Back 6x200m Free max. swimming (within 3min) 4x100m Breaststroke technique slow swimming 30 seconds rest between 100m cooling down 100m Breaststroke & 25m backstroke slow swim
Wednesday	Dynamic Warm-up 6 moves 15 reps with thera-band for 5 minutes Major Phase 1x2000m freestyle technique 3 min break after 1000m 4x50m 1min x butterfly max swimming, 1 min x back technical swimming 15 min 4x100m breaststroke technique slow swimming 100m. 30 sec rest between cooling down 100m Breaststroke & 25m backstroke slow swim
Friday	Dynamic Warm-up 6 moves 15 reps with thera-band for 5 minutes Major Phase 1 minute rest between 8 x 25m sets 2 min rest between 8 x 50m free sets 3 minutes rest between 4x100m free sets cooling down 100m Breaststroke & 25m backstroke slow swim

Anthropometric Measurements: In our study, height was measured with a Seca 769 (Hamburg, Germany) and body weight with a Tanita (Innerscan BC532/ Japan) device.

Blood Measurement: Biochemical tests were performed with venous blood samples (9 ml) taken by experts in the Public Health Laboratory of Siirt Training and Research Hospital between 08:00 and 08:30 in the morning after 12 hours of fasting. In the samples taken; HDL, LDL, VLDL, cholesterol, ALP, protein, LDH, urea and phosphorus tests were studied. Serum and plasma samples separated by centrifugation were stored at -80 °C and were studied collectively.

Statistical analysis: The data obtained from the study were analyzed using the SPSS 15.0 package program. The normality distribution of the data was made using the shapiro-wilk test. Participants' pre-post test measurements were analyzed with the Wilcoxon signed-rank test. All parameters of the participants were shown as minimum, maximum, mean and standard deviation. The significance value was accepted as $p<0.05$.

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RESULTS

The descriptive parameters of the participants are shown in Table 2.

Table 2: Descriptive Parameters of Participants

Parameters	Minimum	Maximum	Mean ± SD
Age (years)	19.00	26.00	24.5±2.46
Height (cm)	165.00	192.00	182.1±7.12
Body Weight (kg)	53.45	81.14	74.5±14.65

The comparison of the pre-test and post-test values of the 4-week swimming training program is shown in Table 3. According to this; There was a statistically significant difference between VA, HDL, LDL and ALP pre-post test data ($p<0.05$).

Table 3. Comparison of Participants' Pre- and Post-Test Values

Parameters	Pre Test		Post Test		p
	Min-Max.	Mean ± SD	Min-Max.	Mean ± SD	
BW (kg)	53.45-81.14	74.5±14.65	52.14-81.0	72.11±6.42	.009*
HDL (mg/dl)	34.1-56.6	42.75±6.54	36.74-62.3	56.5±2.4	.005*
LDL (mg/dl)	52.1-67.4	59.3±5.66	47.6-61.2	51.4±4.78	.010*
VLDL (mg/dl)	11.1-18.1	14.6±3.3	10.2-19.55	15.2±4.2	.135
Cholesterol (mg/dl)	99-126	108±.45	101-138	118±.14	.156
ALP (U/L)	81-89	84±21.44	73-87	79±24.1	.010*
Protein (gr/L)	62.2-77.4	69.67±12.2	71.1-82.1	77.1±15.22	.165
LDH (U/L)	165-181	172 ±.12	167-183	177±15.2	.324
Urea (mg/dl)	19.2-23.2	21.4 ±4.4	21.41-29.3	27.1 ±2.2	.265
Phosphorus (mg/dl)	2.9-4.1	3.2 ±16.2	3.5-4.6	4.5±1.1	.452

$p<0.05$

DISCUSSION

In this study, the effects of swimming training applied to athletes aged 19-26 on some serum biochemical parameters were investigated. The aim of this study is to investigate the effect of training applied to elite male swimmers on biochemical changes. After 12 weeks of training in 60 male swimmers, an increase in serum urea and HDL ($p < 0.05$) was observed, while a decrease in blood lactate, cholesterol and LDL ($p < 0.05$) was reported17.

In another study, the effects of different exercise loads (short, medium and long swimming distances) on serum lipid profiles in male professional swimmers were investigated. While significant changes were observed in cholesterol and HDL values after exercise ($p < 0.001$), no significant difference was reported between the groups in terms of LDL values (p=0.07)[18].

Kaynak et al. (2016) conducted a training match equivalent to a kickboxing match to 23 volunteers between the ages of 15-46 who were engaged in kickboxing. It was reported that there was a statistically significant increase in ALP, serum total cholesterol, HDL and LDL levels in blood samples taken from athletes before and after training[19].

In the study of Jonathann et al. (2010); investigated the acute effects of intense aerobic exercise on ALP in which 10 male participants (mean age 28 ± 4 years) were applied at 55-65-75% of KASYmax for 60 minutes. ALP increased on days 3 and 4 after exercise[20].

In another study, it was aimed to examine the effect of endurance training on some serum lipid levels of female ski runners. 24 volunteers participated in the study. It has been reported that there is a statistically significant increase in HDL values of elite female athletes compared to sedentary athletes ($p<0.05$). There was no statistically significant difference between the two groups in LDL and Cholesterol values ($p>0.05$). As a result of the research, it was reported that long-term endurance training caused an increase in the serum HDL level of female ski runners, but had no significant effect on LDL and Cholesterol, which are other serum lipids[21].

CONCLUSION

In this study, an increase in HDL and a decrease in LDL and ALP values were observed after 4 weeks of training. Considering the intensity and frequency of the applied training, it can be said that the changes in serum lidips and ALP support the literature. Moreover, the applied training program was effective for improving the biochemical parameters selected for swimmers and can also be used to monitor training.

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