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The Effect Of Different Training Methods On The Biomotoric and Respiratory Parameters Of Adolescent Swimmers

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Abstract

Aim: In this study, the effect of water and thera-band training with flipper outside water on selected physiological and biomotoric properties of adolescent swimmers was investigated. Method: The volunteers who participated in the study on the basis of their personal identifying information were randomly divided into two groups as training and control groups. The 38 volunteers in the training group participated in the training program for eight weeks, 19 of them used hand flippers inside water three days a week, while 19 of them used thera-band outside water three days a week. The participants using hand flippers, swam along 25 meters long lanes in the swimming pool for 8x25m, 4x100m 4x200m, 4x100 and 4x25m. The participants using thera-bant outside water make 12 repetitions with yellow resistance bands for 3 sets. The volunteers in the control group (n=19) participated in swimming training only. Height, body weight, respiratory functions, strength and flexibility parameters were measured and the data were evaluated in SPSS 22.0 statistical package program. The t-test was used to determine the difference between before-training (BT) and after-training (AT) measurements. $p<0.05$ was considered as statistically significant. Results: In the experimental groups, the differences between the variables of flexibility, back strength, leg strength, hand grip strength, vital capacity, forced vital capacity and forced expiratory volume were statistically significant before and after the training ($p<0.01$).Conclusion: As a result, considering the findings obtained it was seen that regular swimming exercises were effective in the development of physiological and biomotoric characteristics of the children.

Key Words: Swimming, hand flipper, thera-band, training

INTRODUCTION

Swimming, which is one of the oldest sports activities of human beings, is a branch of sports which is widely done with great pleasure in many parts. Swimming is a branch of sports, contains the biomotoric characteristics such as strength, speed, endurance, mobility, agility, coordination, in which performance and technical skills are at the forefront [25]. In swimming, performance is highly dependent on muscular force, speed and explosive power [13,16]. The trainings that improve the biomotor properties and be done outside water are also important in order to improve swimming performance and get a better result against time [1].

Trainings other than swimming being done outside water are called "land exercises" or land training. These trainings are performed to improve the physical fitness level of athletes. The trainings inside water should be done after land trainings and should be done to support land trainings [20]. Land exercises can be done with body weight or by using different tools and equipments. One of these equipment is thera-band. Thera-band exercises not only increase strength, but also contribute to the development of other biomotoric properties [8]. Thera-bands provide the advantage of being able to feel the movement made at all angles by means of multi-directional movement. The all-age usability of thera-bands is another reason to prefer to use them in training [17]. In swimming, different training programs are applied, the intensity of the training in water is high. In swimming in which the gravity is almost zero, all muscles should work in harmony. Since it is done against water resistance, it increases body resistance without wearing down [18].

In swimming, the position of the body is horizontal. Swimmers have to overcome the existing passive resistance of water to move on in the water. In order to overcome this resistance, they must form more effective resistance in the opposite direction to the direction in which they swim, especially with hands, arms and feet surfaces. The idea of greater contribution of hand and foot surface areas to increase this resistance made use of materials that could create additional resistance in swimming training widespread. In swimming sport, there are exercises using different materials (pedal, flippers, pull-buoy and resistance rubber) in the water in order for the swimmer to reach higher speed and to maintain this speed [26]. In the study conducted to determine the effects of the use of palette in swimming, it was found that the energy expenditure in the swimming using hand flippers was lower than that in normal swimming. This situation positively influences swimming performance [29].

In order to be successful in swimming, athletes should start to swim at a young age, the most effective element in the training of athletes is coaches with high technical knowledge. The most important strategy for the success of an athlete in swimming is the regular application of training programs [6].

Swimming is a sport doing against water resistance and therefore the muscles in the body work symmetrically. The most active parts of the body in swimmimg are the arms and legs. Therefore, it is a sport that plays an active role in the development of body composition and obtaining an appropriate posture [10]. It is effective in the formation of a suitable physical structure since it does not cause a local pressure on a particular area in the formation of body composition.

The age of 10, which is the subject of our study, is generally the beginning of the changes in movements, thinking and physical structure. This age, which is now considered as pre-puberty, may be different for some children. Adolescence, which is defined as the stage of maturation, is a physical and psychological transition period between childhood and adulthood. The significant changes in three fields such as fast physical growth, sexual development and psychosocial development are observed in adolescence, which is a transition period from childhood to adulthood [9]. In this study, the effects of different training methods applied with hand flipper and thera-band on swimming performance were investigated.

MATERIALS AND METHODS

The participants in the study were informed verbally and in written about the study and measurements to be performed. The ages of the children participating in the study were determined based on their personal identifying information. 57 children aged 10 years participated in the study voluntarily. These children were randomly divided into three groups as 2 training groups and a control group. Each group (swimming thera-band group (STG), swimming hand flipper group (SHFG), control group (CG)) consisted of 19 children. The children in the CG had a mean age of 10.60±0.69 years, a mean height of 1.51±0.03 cm and a mean body weight of 47.70±2.83 kg. The children in the SHFG had a mean age of 10.42±0.60 years, a mean height of 1.55±0.03 cm and a mean body weight of 45.85±3.31 kg. The children in the STG had a mean age of 10.60±0.80 years, a mean height of 1.54±0.02 cm and a mean body weight of 47.00±2.70 kg.The swimmers in the SHFG did training using hand flippers (figure 1) in addition to swiming exercises while the swimmers in the STG did land training using thera-bands (figure 2) in addition to swimming exercises. The children in the control group did not participate in any additional training except the swimming training program.

The delta hand flippers (fig. 1), which were made of hard plastic material, were used for the group trainings of swimming with hand flippers, while thin and yellow Busso brand thera-bands (figure 2), which were suitable for low intensity studies, were used in thera-band trainings.

Figure 1. Hand Flipper

Figure 2. Thera-band

The children in the SHFG and STG groups participated in the training program for eight weeks, three days a week. After the warm-up period with active and passive flexibility exercises, the land trainings group with yellow thera-bands (STG) were done by repeating 12 over 3 sets.

The swimming training group were done with hand flippers (SHFG) by using the appropriate flippers, in 25 meters long swimming pool for 8x25m, 4x100m 4x200m, 4x100, and 4x25m. The swimming exercises were applied between 14:50 and 43:06 seconds depending on the distance change. Full rest principle applied. Children in the control group participated in only freestyle swimming sessions. Trainings were held between 18:00 and 20:00.

The training were done in Ankara Swimming Facilities under the supervision of the researcher and a swimming coach. The measurements were made with the measurement tools provided from the laboratory of Gazi University Faculty of Sport Sciences.

The statistical analysis was performed by taking measurements from the groups before and after the training periods. The length measurements were recorded in cm by measuring the distance between the vertex of the head and the soles of the foot 1 mm with the Rodi Super Quality brand tape measure after a depth inspiration, while the participants were bare foot, their heads were in the upright position and in the frankfort plane. Children's body weight was measured with a Tanita BC 418 MA (Tokyo, Japan) brand scale with a precision of 100 grams (g). Body mass indexes (BMI) of the children were calculated using the formula of BMI = body weight (kg)/squre of height (m2) for body weight and height measurements taken from the swimmers participating in the study.

Lung volumes and capacities such as vital capacity (VC), forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) were measured by a Cosmed brand spirometer [23]. During the measurement of respiratory parameters, the children were standing, placing the spirometer mouthpiece into their mouths, attaching pegs to their noses in order to avoid air escaping, and the respiratory parameters were measured after a deep inspiration. This process was repeated three times and the best value was recorded [12].

A Takei brand digital dynamometer (camry) was used for power measurements. In the hand grip strength measurement, the measurements were taken by keeping the arm 10-15 degrees away without bending the arm and without touching it to the body. The measurements were taken from the dominant side. The best value in kg was recorded after two measurements. Many researchers have reported that the use of dynamometers is reliable in measuring leg strength [23]. The leg strength measurement was made by placing the feet of the participants on the dynamometer stand by bending their knees when their arms were stretched, their backs were straight and their bodies slightly bent forward. They grasped the dynamometer bar with their hands and vertically pulled it up by using their legs at the maximum rate.

The back strength measurement was performed by pulling the dynamometer bar up after being grasped it with their hands by using their backs at the maximum rate, when their arms were stretched and their backs were straight [4,23].

The sit-and-reach test was applied to all volunteers for flexibility measurement. A 35 cm long, 45 cm wide and 32 cm high sit and reach test table was used as a measurement tool. During the test, the participants took off their shoes and sat down on the floor, placed the soles of their feet on a flat position on the face of the sit-and-stand table, facing them. The participants were asked for pushing the measuring grid slowly forward, by reaching out forward as far as they could with bending her body without bending her knees. They also asked for waiting two seconds at the farthest distance without stretching forward or backward when their hands, arms and legs were straight. The test was repeated 3 times for each individual and the best result was recorded as the flexibility value [23].

SPSS 22.0 statistical package program was used to evaluate the data obtained from the measurements. Shapiro-Wilk test was used to determine whether the data showed a normal distribution or not. The measurement results were given as mean (X) and standard deviation (Sd). paired t-test was performed to compare pre-training and post-training measurements. p<0.05 was accepted as statistically significant.

RESULTS

Table 1. The distribution of the participants' BT and AT physical measurements

Variables		SHFG (n=19)					STG (n=19)				CG(n=19)				
		X	Ss	t	p	Cohen d	X	Ss	t	p	X	Ss	t	p	Cohen d
Age (year)	BT	10.42	0.60	-	-		10.60	0.84	-	-	10.60	0.69	-	-	
	AT	10.42	0.60				10.60	0.84			10.60	0.69			
Height (cm)	BT	1.55	0.03	-	-		1.54	0.02	-	-	1.51	0.03	-	-	
	AT	1.55	0.03				1.54	0.02			1.51	0.03			
Weight (kg)	BT	45.84	2.31	-9.436	0.00**	0.76	47.00	2.70	-6.530	0.000**	47.70	2.83	0.480	0.64	
	AT	47.73	2.62				50.40	1.83			47.50	3.37			
BMI (kg/m²)	BT	19.09	1.07	-9.375	0.00**	0.68	19.63	1.02	-6.409	0.000**	20.80	1.45	2.558	0.03*	0.31
	AT	19.88	1.22				21.06	0.87			20.33	1.57			

**P<0.05 **p<0.01*

BT: before test; AT: after test, STG: swimming thera-band group: SHFG: swimming hand flipper group SHFG, CG: control group

When the table was examined, the difference between the body weight and BMI measurements of the volunteers in the SHFG and STG groups was found to be statistically significant (p<0.01). In the control group, only the difference between the BMI measurements was found to be statistically significant (p<0.05).

Table 2. The distribution of the measurements of the Biomotoric Characteristics of the Participants

Variables		SHFG (n=19)					STG (n=19)				CG(n=19)				
		X	Ss	t	p	Cohen d	X	Ss	t	p	X	Ss	t	p	Cohen d
Flexibility (cm)	BT	25.31	1.66	-9.962	0.00**	0.61	27.80	2.04	-13.038	0.000**	27.60	2.36	-3.873	0.004**	0.43
	AT	26.26	1.76				31.90	2.33			28.60	2.22			
Back Stenrgth (kg)	BT	35.13	2.50	-15.204	0.00**	0.27	35.51	2.05	-15.886	0.000**	33.39	3.41	-14.525	0.000**	0.24
	AT	35.80	2.43				36.90	2.18			34.34	3.39			
Leg Strength (kg)	BT	40.68	3.26	-9.939	0.00**	0.48	39.32	3.76	-10.485	0.000**	39.40	3.68	-2.333	0.045*	0.20
	AT	42.26	3.28				41.60	3.53			40.10	3.28			
Hand Grip Strength (kg)	BT	15.74	1.98	-10.377	0.00**	0.32	14.96	1.26	-19.218	0.000**	15.11	1.50	-5.288	0.001**	0.61
	AT	16.47	2.04				16.87	1.37			15.96	1.25			

**P<0,05 **P<0.01*

BT: before test; AT: after test, STG: swimming thera-band group: SHFG: swimming hand flipper group SHFG, CG: control group

When the table was examined, the differences between the values of flexibility, back stenrgth, leg strength and hand grip strength were found to be statistically significant (p<0.05).

Table 3. The distribution of the BT and AT Respiratory Parameters of the Participants

Variables		SHFG (n=19)					STG (n=19)				CG(n=19)			
		X	Ss	t	p	Cohen d	X	Ss	t	p	X	Ss	t	p
Vital Capacity (VC) (ml)	BT	3.34	0.01	-2.64	0.016*	0.89	3.34	0.02	-2.811	0.020	3.24	0.34	1.000	0.343
	AT	3.41	0.11				3.40	0.05			3.21	0.33		
Forced Vital Capacity (FVC) (ml)	BT	2.66	0.06	-5.64	0.000**	0.30	2.67	0.05	5.237	0.001**	3.04	0.47	0.497	0.631
	AT	2.68	0.07				2.66	0.04			2.95	0.67		
Forced Expiratory Volume (FEV_1) (ml)	BT	2.44	0.02	-12.69	0.000**	1.17	2.46	0.02	-0.999	0.344	2.46	0.06	-1.957	0.082
	AT	2.47	0.02				2.70	0.65			2.53	0.11		

*$p<0.05$ **$p<0.01$*

BT: before test; AT: after test, STG: swimming thera-band group: SHFG: swimming hand flipper group SHFG, CG: control group

When the table was examined, the differences between the first measurement values and second measurement values of vital capacity, forced vital capacity and forced expiratory volume were statistically significant (p<0.05) in the volunteers in the SHFG. For the STG, the differences between the measurements of vital capacity and forced vital capacity, forced expiratory volüme were not statistically significant (p>0.05) For the CG, the difference between the first and second measurements of forced expiratory volume was not statistically significant (p> 0.05).

DISCUSSION

In the study, the differences between the forced expiratory volumes, body weights, vital capacities, forced vital capacities and forced expiratory volumes were not significant in the STG (p>0.05). The differences between the other variables were found to be significant in all three groups (p<0.05).

In the study of Atar, the mean age, height and boody weight of the participants in the swimming exercise group were 10.53 ± 0.83 years, 136.60 ± 6.93 cm, and 34.68 ± 9.57 kg, respectively. In the group consisting of the individuals that did not swim, the mean age, height and body weight were 10.86 ± 0.83 years, 139.60 ± 6.11 cm, and 38.33 ± 5.81 kg, respectively. The difference between numerical values was not found to be statistically significant [2].

We examined the studies conducting with children in the literature. Yazarer et al. found that the mean height of the participants was 142.4 cm in 11-year-old children [27]. When the results in the literature were compared with our findings, it was seen that the mean height is higher. The main reason for this was thought to be due to the differences between the age and nutritional habits of the children participating in the other studies and the children participating in our study.

Selçuk determined that the pre-test and post-test BMI were 16.08 kg/m2, 15.83 kg/m2 in the STG, respectively. The pre-test and post-test BMI were found as 17.75 kg/m2 and 18.29 kg/m2 in the SG, respectively. The differences beween the pre-test and-posttest BMI values of the groups in the study were not significant [20]. Saygın et al. calculated the BMI value as 18.12 ± 3.08 kg/m2 in the age group of 11-16 years [19].

When the results of this study were compared with our findings, it was seen that our BMI values are high. The main reason for this is thought to be due to the fact that the nutritional habits and physical activity levels of the children participating in the other studies and the children participating in our study were different.

In our study, the differences between the measurements of flexibility, back strength, leg strength and hand grip strength were found to be statistically significant (p <0.05). In the swimming hand flipper group, differences in elasticity, back strength, leg strength, and hand grip strength were found to be statistically significant.

In a study on strength development, girls and boys aged 7-12 years done 10-15 repetitions and one set of strength training. It was stated that 1-2 times a week strength training increased the strength of the children. In this study, it was emphasized the idea that muscle strength can be improved at a young age [5]. Ziyagil et al compared the hand grip strengths of the children aged 11 years who swam and who did not, they found that children who did sports had higher hand grip strength than those who did not [30]. Selçuk stated that the swimming+thera-band (STG) and swimming group (SG), groups had a significantly higher grip strength after training while there was no improvement in the control group [20]. Although these lithareture findings are in line with our findings, they support the hypothesis that participating in swimming training increase the grip strength of children significantly. The use of hand flippers and the positive resistance of water are thought to have a positive effect on the hand grip strength.

Muratlı stated that depending on the development profile between the ages of 7 and 18, strength improvement was limited at the end of school age and club activities caused significant strength differences between children in this period [14]. In the literature, it was stated that muscle strength in children may improve during childhood in accordance with the principle of appropriate loading. The studies also reported that moderate strength trainings with high repeat numbers were more efficient in the adaptation process [3]. In many studies, it was emphasized that exercise participation increased hand grip strength in children [7,21,27].

In different studies in the literature, they stated that there were significant improvements in muscle strength of children with different exercise models applied to children in parallel with our study findings. In the age group of 10-14 years, Sevinç found leg strength as 84.85±40.06 kg and 105.65±42.73 kg in in the pre-test and post-test, respectively [21]. Şahin found leg strength in the experimental group consisting of 12-14 years old children as 74.93 ± 23.34 kg in the pre-test, 83.17 ± 23.20 kg in the post-test [22]. These results are not parallel with the findings of our study. These results are higher than our findings. This difference is thought to be the result of the applied training methods, the materials used and the characteristics of the study group.

Ozmun et al. conducted a study with 10-14 years old boys and girls and applied a training program that improved maximal strength for 3 days a week, 7 repetitions, and 3 sets for 8 weeks. As a result of their study, they observed a significant increase in the muscle strength of children [15].

Yolcu conducted a study for improving strength in children with resistance machines and rubber bands, and stated that the strength of the group training with resistance machines was higher than that of children training with rubber bands. However, Yolcu also expressed that there was a numerical increase in stregth of the children using rubber bands [28].

In our study, the improvement of elasticity was recorded in the swimming group, the groups training with thera-bands and hand flippers. However, some studies in the literature reported that there is no linear relationship between swimming and the development of elasticity. Selçuk compared the values of elasticity and shoulder elasticity of the STG for pre-test and post-test, and determined that there was a significant increase in both the STG and SG while there was no improvement in the control group [20].

It was found that swimming exercises applied to children positively contributed to their elasticity, hand grip strength, leg strength and back strength values and the exercises were effective on the basic motoric characteristics of children. From this point of view, it reveals the necessity of more systematic and regular application of swimming for the physical, physiological and performance development of children.

The difference between the measurements of vital capacity, forced vital capacity, and forced expiratory volume in the SHFG volunteers were statistically significant (p0.05) in our study. The differences between vital capacity and forced vital capacity, forced expiratory volume for the STG were not statistically significant ($p>0.05$). The difference in forced expiratory volume between the first and second measurements in the CG was not statistically significant ($p> 0.05$).

The differences between the vital capacity and forced vital capacity measurements of volunteers in swimming thera-band group were statistically significant ($p<0.05$). The difference between the forced expiratory volume measurements was not statistically significant ($p>0.05$).

Tunay et al. found that pulmonary function test results as FVC: 1.65±0.32 lt., FEV1: 1.62±0.31 lt. in the sedentary children while FVC: 2.48±0.49 lt., FEV1: 2.37 ± 0.41 lt. in the basketball playing children [24]. When our findings are compared with those of Tunay, it seems that our findings are higher than other results. This is probably because of the positive effects of swimming exercises and trainings on respiratory parameters. It has been thought that swimming has a positive effect on respiratory parameters due to the pressure of water which makes breathing more difficult. The literature knowledge supports this result [11].

As a result, considering the findings obtained it was seen that regular swimming exercises were effective in the development of physiological and biomotoric characteristics of the children. Swimming is a sports branch in which all muscles are used. As it is a sport doing against water resistance, it also contributes to the balanced development of all body muscles and thus to the development of strength. It is considered that all muscles work in harmony and water resistance is thought to affect the increase in body resistance considering the low gravity during swimming. In line with these studies, it should be ensured that children should be participated in regular swimming trainings for the development of physical and basic motoric functions. It is recommended that such studies should be carried out with multiple repetitions and with multiple subjects and measure different parameters, and the results of these studies should be shared with the practitioner coaches in order to create norms and to make contributions to sports science.

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