Analyzing the effects of 16 weeks swimming exercises of children aged 7-13 on anthropometric measurements and somatotype

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Abstract

By the carried study, it's aimed to expose the effects of 16 weeks swimming exercises of sedentary girl and boys aged 7-13 on anthropometric measurements and somatotype components. In total 114 children, healthy 53 girls, the average age 9.35±2.14 years and 61 boys, the average age 9.56±2.74 years under the summer school joining to swimming lessons participated to this research. Height, body mass, chest, waist and hip circumference measurements and 10 anthropometric measurements of research group necessary for somatotype calculation has taken before and after the 16 weekly swimming program. Somatotype calculations evaluated by Heath-Carter somatotype method. Data tested in p<0.05 significance level via Paired Samples t-Test. With the data obtained before and after swimming exercises, as compared to boys and girls separately, all the data apart from height, medial calf skinfold, waist/hip ratio, mesomorph coefficient in girls and all the data apart from height and waist/hip ratio are significantly different in boys. Somatotype values in preliminary test of girls changed from 4.99-3.64-2.35 to 4.45-3.78-2.8 and of boys changed from 4.67-3.72-2.24 to 3.92-4.15-2.38. The findings of the study show that swimming exercises have effects on the decrease in body mass and increase in muscle mass. Given the characteristics of the investigated age group, the period of pre-adolescent girls tend to increase the lubrication, swimming exercises to be held in this age group would benefit for weight control and create a healthier future generation. Swimming exercises are important for preventing weight gain and deal with existing problems of technology and inactivated lifestyle especially in the puberty period children.

Keywords: Anthropometric measurements, boy, girl, swimming exercise.

INTRODUCTION

In today's conditions, especially beside received excess calories because of fast food, widespread use of machines and tools in the field of industrial and household chores, transport facilities, the use of the vehicle even for short distances, place the television and the computer receiving social activities because decreased energy expenditure. This situation especially in childhood causes an increase in obesity for the next generation and consequently the increase of physical, psychological and social problems. Obesity is seen in the increasing rates as well as in developed countries in underdeveloped and developing countries. In the whole world in 2010, the number of underweight children less than 5 years were determined over 43 million. Weight of 12 age group girls is recorded as 45.1 kg and weight of boys is recorded 44.3 kg and attention is drawn to the graphics that draw increasing numbers (27).

An increased amount of adipose tissue means obesity and obesity, carries the risk of death. Visceral fat is associated with insulin resistance and makes obesity as a disease that makes health risk. Thus, visceral obesity is closely related to diabetes, hypertension and hyperlipidemia and it carries a greater risk of mortality than general increase of fat tissue. For not experiencing all these adverse conditions and order to prevent an unhealthy society yet in childhood and puberty periods it is necessary to take measures to combat obesity (35).

Administration of an excess rate simple carbohydrates and high fat content diet (fast-food type) as "Westernization" type diet in nutrition models of children living in the city center and children's turn on the television and computer games away from the physical activity are most important known risk factors for obesity (1,29).

Child training is related to an object, with multi-movement types and a training to prepare the child to a particular sport. It is known that the distinctive character of trainings of children and young people because the content of the training of children and young does not represent a limited adult training done in accordance with its terms and

conditions. Studies conducted on the sport of swimming have increased with the spread of swimming sports as of the introduction to the Olympics. In particular, research on improving the performance and health of athletes is very much present (7,11,14,17,28).

Swimming; fun, relaxing, and is a sport that use almost all the muscle groups. Besides the mental and physical benefits, swimming is used in a wide range of rehabilitation activities that people with physical limitations restrictive to some other land sports can easily do as from heart disease to pregnant women, in the treatments of from osteoporosis patients to patients who have had an accident. It has been proven by many studies of exercise in adolescence that has positive effects on bone tissue (4,8,10,22). Swimming is a popular sport for all ages and it provides a very good cardiovascular condition without the need for weight stressful activities on musculoskeletal system. Therefore swimming is a great form of exercise for obese children. Besides develop corruption as a negative feature and to spend calories swimming whether sufficient density requires a certain skill (36).

Somatotype; is to elucidate the physical type shown by the people. In another define somatotype is formed composition regardless of the body shape and size. Whether the relationship between success in sport and physical structure is long time since a matter that sports scientists and researchers engaged sports indirectly. Referring to studies it's seen that they mostly dealt with the morphological characteristics of the athletes. Morphological descriptions are more given in the form of anthropometric measurements (5). As the exercises have impact on somatotype, somatotype components are effective on the performance of people (18,20).

Studies show that in swimming, in terms somatotypes, girls show early development. Looking at the distribution of somatotype of swimming branches; it was observed that between 1960-1980 somatotypes values of swimmers in the top position are in the frame of 2.5-5-3 (5).

By the carried study, it's aimed to expose the effects of 16 weekly swimming exercises of sedentary girl and boys aged 7-13 on anthropometric measurements and somatotype components. The findings of the study show that swimming exercises can prevent and combat with physical, psychological and sociological problems caused by inactivity carried with technology and changing lifestyles of children.

MATERIALS & METHOD

Participants

In total 114 children, healthy 53 girls, the average age 9.35±2.14 years and 61 boys, the average age 9.56±2.74 years under the summer school in Ankara Ziya Ozan Swimming Pool joining to swimming lessons participated to this research voluntarily and with the permission of their families.

Measurements

To determine anthropometric measurements of subjects, in accordance with international standards, the height with anthropometric, body mass with 100 gr sensitive electronic scale (34). Body mass index (BMI) was calculated as the body mass per (height)^2 in kg/m^2 as the general anthropometric variables. Chest, waist and hip girths were measured according to anthropometric standard by an anthropologist.

Ten anthropometric dimensions are needed to calculate the anthropometric somatotype: stretch stature, body mass, four skinfolds (triceps, subscapular, supraspinale, medial calf), two bone breadths (biepicondylar humerus and femur), and two limb girths (arm flexed and tensed, calf). The following descriptions are adapted from Carter and Heath (5, 13).

Somatotypes calculation,

*I. Endomorph*y= -0.7182+0.1451 (X) − 0.00068 (X^2) + 0.0000014 (X^3)

X= sum of triceps, subscapular and supraspinale skinfolds. For height-corrected endomorphy, multiply X by 170.18/height in cm.

II. Mesomorphy= [(0.858 x humerus breadth) + (0.601 x femur breadth) + (0.188 x corrected arm girth) + (0.161 x corrected calf girth)] − (height x 0.131) + 4.50

III. Ectomorphy= HWR x 0.732 − 28.58

Height- weight ratio (HWR) = height/cube root of weight

If HWR is less than 40.75 but more than 38.25, Ectomorphy = (HWR x 0.463)-17.63. If HWR is equal to or less than 38.25 give a rating of 0.1 (5).

Exercise program

The basic swimming exercises were applied to research group in the scope of summer school, of 1,5 hours in 5 days of 16 weeks. In the first three weeks of the study basic breathing and limb movement s were exercised in the small pool and after that exercises are performed associated with swimming techniques in the Olympic pool. Before the swimming warm-up exercises were performed in 20 minutes.

Statistical analysis

Statistical analyses were carried out using a statistical package for social sciences (SPSS 22.0 for windows). Pre-test and post-test values of subjects were compared with Paired Samples t – test. The results were tested in $p<0.05$ significance level.

RESULTS

The results of Paired Samples t – test of data obtained before and after swimming exercises for girls show that all data apart from height, medial calf skinfold, waist/hip ratio, mesomorphy coefficient are significantly different. Test results are presented in Table 1.

The mean and standard deviation values and Paired Samples t – test results of the data obtained before and after swimming exercises are shown in Table 2. It's determined that in boys all the data are significantly different apart from height and waist/hip ratio.

Table 1. Comparison of the mean and standard deviation values of anthropometric measurements and results of pre-test – post-test in girls.

Variables	Mean ± SD		t	p
	Pre-test	Post-test		
Height (cm)	134.28 ± 14.71	134.77 ± 15.22	0.896	.893
Body Mass (kg)	33.65 ± 11.82	31.97 ± 11.90	9.996	.000*
BMI(kg/m²)	18.04 ± 2.79	17.18 ± 2.88	12.226	.000*
Chest girth (cm)	62.61 ± 10.22	66.51 ± 10.52	-19.507	.000*
Waist girth (cm)	62.00 ± 9.16	58.78 ± 8.52	14.487	.000*
Hip girth (cm)	74.98 ± 11.40	70.87 ± 10.42	12.718	.000*
Upper arm girth (cm)	19.57 ± 2.95	19.97 ± 3.22	-2.564	.013*
Calf girth (cm)	24.73 ± 3.16	25.95 ± 3.14	-4.616	.000*
Triceps skinfold (mm)	15.57 ± 4.31	13.90 ± 2.40	8.347	.000*
Subscapular skinfold (mm)	12.26 ± 6.24	10.64 ± 6.49	17.597	.000*
Supraspinale skinfold (mm)	14.15 ± 7.77	11.88 ± 8.05	20.176	.000*
Medial calf skinfold (mm)	15.46 ± 5.78	15.33 ± 5.74	0.668	.507
Waist/hip ratio	0.83 ± 0.05	0.83 ± 0.04	-0.780	.439

* $p<0.05$

Table 2. Comparison of the mean and standard deviation values of anthropometric measurements and results of pre-test – post-test in boys.

| Variable	Mean±SD		t	p
	Pre-test	Post-test		
Height (cm)	137.27 ± 14.71	137.54 ± 17.91	0.954	.867
Body Mass (kg)	37.70 ± 14.83	33.99 ± 12.31	3.645	.001*
BMI(kg/m²)	19.17 ± 4.04	18.68 ± 3.67	4.456	.000*
Chest girth (cm)	66.47 ± 9.70	71.50 ± 10.54	-23.007	.000*
Waist girth (cm)	66.79 ± 10.40	64.16 ± 10.65	17.937	.000*
Hip girth (cm)	78.26 ± 12.25	74.87 ± 12.30	37.259	.000*
Upper arm girth (cm)	20.12 ± 3.70	21.85 ± 4.06	-5.654	.000*
Calf girth (cm)	25.20 ± 2.88	27.29 ± 3.70	-5.846	.000*
Triceps skinfold (mm)	15.13 ± 5.76	11.13 ± 3.45	4.393	.000*
Subscapular skinfold (mm)	15.32 ± 7.44	7.77 ± 3.18	5.430	.000*
Supraspinale skinfold (mm)	15.67 ± 9.11	7.59 ± 4.04	5.723	.000*
Medial calf skinfold (mm)	15.95 ± 6.66	13.32 ± 4.76	3.584	.001*
Waist/hip ratio	0.83 ± 0.05	0.83 ± 0.04	-0.780	.439

* $p<0.05$

Table 3. Comparison of the mean and standard deviation values of somatotype components and results of pre-test – post-test in girls and boys.

Variable	Boys				Girls			
	Mean ± SD		t	p	Mean ± SD		t	p
	Pre-test	Post-test			Pre-test	Post-test		
Endomorphy	4.67 ± 1.84	3.92 ± 1.46	7.015	.000*	4.99 ± 1.55	4.45 ± 1.69	19.450	.000*
Mesomorphy	3.72 ± 0.83	4.15 ± 1.01	-7.547	.000*	3.64 ± 1.46	3.78 ± 1.85	-1.073	.288
Ectomorphy	2.24 ± 1.65	2.38 ± 1.63	-3.321	.002*	2.35 ± 1.17	2.80 ± 1.28	-9.390	.000*

* $p<0.05$
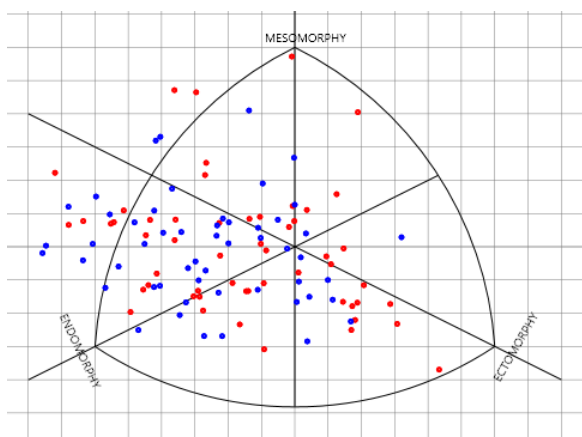
Figure 1. Somatochart view of girls

● Pre-test, ● Post-test
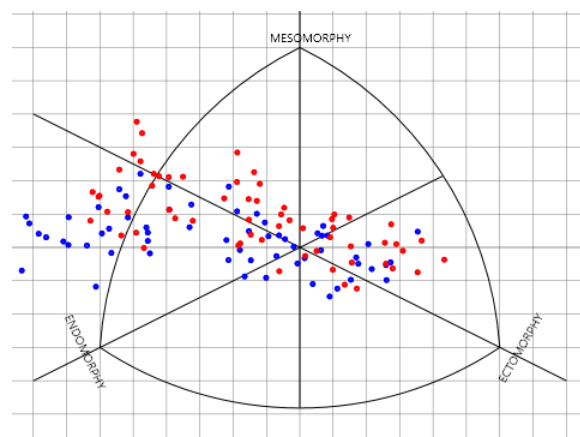
Figure 2. Somatochart view of boys

● Pre-test, ● Post-test

Somatotype values in preliminary test of girls changed from 4.99-3.64-2.35 to 4.45-3.78-2.8 and of boys changed from 4.67-3.72-2.24 to 3.92-4.15-2.38. In Table 3, it's shown that according to the Paired Samples t – test all the parameters in boys are significantly different but there isn't a significant difference in the mesomorphy component of girls. Pre-test and post-test somatochart views of girls and boys are shown in Figure 1 and Figure 2.

DISCUSSION

The data of the study indicates that swimming exercises applied to girls and boys in 16 weeks decreased weights and BMI in a significant level.

In the study which is examining the relation between anthropometric variables and propulsive force of arm in 56 young male swimmers in average age of 14.4±1.8 years. Moura et al. (26) found the subjects' mean of body height as 167.1±11.6 cm, mean of body mass as 55.8±11.2 kg, average of triceps skinfold as 10.2±3.5 mm and average of subscapular skinfold as 9.4±2.7 mm. Cochrane et al. (7), in the study that applied on 30 male swimmer average age of 12.4±2.7, identified mean of body height as 152.6±16.4 cm, mean of body mass as 44.3±13.8 kg, average of triceps skinfold as 0.92±0.3 cm, upper arm circumference as 21.6±3.0 cm.

In their study applied to 178 male and 85 female between 12-14 years old Geladas et al. (14) measured boys' mean of body height as 165.5±07 cm, mean of body mass as 54.1±07 kg, mean of chest circumference as 82.5±05 cm; girls' mean of body height as 161.2±06 cm, mean of body mass as 48.3±06 kg, mean of chest circumference as 80.6±05 cm and they identified significant relation between the values measured by the swimming performance particularly in boys. Similarly in another study examined with 24 swimmers in the age of 12-14 years the findings: mean of body height as 162.5±6.3 cm, mean of body mass as 52.3±8.4 kg, average of triceps skinfold as 8.4±2.4 mm, subscapular skinfold as 8.4±2.9 mm (33).

Cicchella et al. (6) divided 10-12 years old boys into three groups as normal, overweight and obese and calculated body height as 149.5±7.7 cm, body mass as 43.3±11.9 kg and BMI as 19.2±4.2 kg/m². The average age of 15.2±3 years 40 male and 28 female swimmers' anthropometric measurements were for male: body height as 168.55±5.18 cm, body mass as 56.45±4.82 kg and BMI as 19.57±2.10 kg/m²; for female: body height as 160.70±4.32 cm, body mass as 49.67±3.82 kg and BMI as 18.98±1.38 kg/m² and it's determined to have similarity with study's post-test data (31). In another study applied to 25 male

swimmer aged 15.2±1.9 years, the measurements: body height as 176.55±0.9 cm, body mass as 63.3±10.9 kg and BMI as 20.2±2.2 kg/m^2 and found parallel as this study's male research group's data (23).

Santos et al. (30) compared 84 female swimmers and 81 control group aged 9-17 years and found the adolescent swimmers' average triceps skinfold as 15.5±14.3 mm, body fat percentage as 25.2±5.9 and fat mass as 8.7±3.5 kg; in the similar age of control group's average triceps skinfold as 20.1±7.0 mm, body fat percentage as 28.4±6.0 and fat mass as 9.8±3.7 kg and determined significant difference.

In their study applied to 22 male and 14 female swimmers Martínez et al. (25) found girls' body height as 164.5±1.7 cm, body mass as 56.9±2.2 kg and BMI as 20.3±0.8 kg/m^2, triceps skinfold as 10.8±0.6 mm, subscapular skinfold as 9.7±1.2 mm, abdominal skinfold as 15.3±0.9 mm and femur skinfold as 13.9±0.9 mm; boys' body height as 171.2±1.9 cm, body mass as 61.9±3.3 kg and BMI as 21.5±0.8 kg/m^2, triceps skinfold as 7.8±1.0 mm, subscapular skinfold as 8.2±1.1 mm, abdominal skinfold as 8.9±1.0 mm and femur skinfold as 10.2±1.4 mm and these are in lower values than this study.

Guillén et al. (16) analyzed anthropometric features, body compositions and somatotypes of 39 male athletes in the mean age of 24±4.5 years and measured athletes' muscle ratio as %45.27±3.29, fat rate as %10.22±2.92, bone ratio as %16.65±1.34. In another study, in a school period there was a training in different branches applied to 18 female and 35 male students and at the end of the season it's found out that respectively female and male swimmers lost 1.8 kg and 2.7 kg; and the amount of the muscle is respectively 2.4 kg and 1.8 kg increased (32). Lätt et al. (22) followed the change in anthropometric parameters of 26 young female swimmers in two years period and determined significant difference depending on the sport branch in height, body mass, body fat percentage parallel to this study's data.

Mean of chest circumference of study group in female increased %6.24 and in male increased %7.63. This situation preoccupies the development in thorax caused by breathing exercises in swimming. In the studies, it's identified that regular swimming exercises causes significant differences in respiratory capacity and developed thorax sizes (12,19,21). Courteix et al. (9) applied 12 hours swimming exercises to 5 girls in the mean age of 9.3±0.5 years in

a year and after comparing with control group they found out that static and dynamic lung volumes were increased.

In a study, applied to 9 Iranian national runners, the anthropometric circumference measurements were: arm flexed and tensed as 25.57 cm, chest as 90.91cm, waist as 73.98 cm, hip as 89.74 cm, calf as 35.93 cm and waist/hip ratio as 0.82 (2). In another study circumference measurements: arm flexed and tensed as 23.8±3.6 cm, chest as 74.2±8.2 cm, waist as 65.1±9.4 cm, hip as 78.2±9.0 cm, mid-thigh as 42.6±6.0 cm, thigh as 46.1±7.2 cm, calf as 30.3±3.6 cm, waist/hip ratio as 0.83±0.05 and the findings are parallel to this study (6). Avlonitou (3) applied to 231 swimmers in both sexes in 12-13 years old obtained data related that different swimming techniques'' effects (like sprint group in both sexes is the tallest, long distance athletes are lower weight, hip width of butterfly floating girls are different from the others) on body compositions and anthropometric developments of children (3).

Somatotype values in preliminary test of girls changed from 4.99-3.64-2.35 to 4.45-3.78-2.80 and of boys changed from 4.67-3.72-2.24 to 3.92-4.15-2.38. Martínez et al. (25) measured somatotypes of male swimmers as 3.1-4.2-3.3 and female swimmers as 3.5-3.7-3.0 and these findings support this study's post-test data. In their study, Guillén et al. (16), measured somatotypes of athletes as 2.18-3.63-2.75 (ecto-mesomorph); Arazi et al. (2) measured somatotypes of athletes as 1.43-4.10-3.63 (ectomorphic mesomorph). Because they measured individuals have long been engaged in sports, endomorph efficiency is lower than this study.

In the study applied to 16 female athletes aged 18.8 - 32.8 years, Leake and Carter (24) compared swimmers and runners and found somatotype values as 3.1-4.3-2.6 (endomorphic mesomorph). Kandel et al. (18) analyzed the relation between performance and somatotype components of 165 male and 22 female athletes and put forth that if endomorphy is lower and ectomorphy is higher the performance will increase in male. Godoy et al. (15) measured anthropometric and biochemical parameters of 12 college basketball players' and found out BMI as 24.6 kg/m^2, somatotype as 5.5-3.1-2.0 (endo-mesomorph). Zinuga et al. (37) compared somatotype and anthropometric features of 38 male swimmers in an average age of 11.03±2.29 years and 31 female swimmers in an average age of 10.45±2.29 years and determined significant difference only between fat percentage and endomorph coefficient.

As a result they found out as to prove this study that particularly in female swimming exercises are effective on decreasing body fat ratio.

By the carried study, it's aimed to expose the effects of 16 weekly swimming exercises of sedentary girls and boys aged 7-13 on anthropometric measurements and somatotype components. According to the results of this study swimming exercises are important for preventing and combat with physical, psychological and sociological problems caused by inactivity carried with technology and changing lifestyles of children.

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