CHANGES OF BODY COMPOSITION IN 12-13 YEARS OLD SWIMMERS AFTER 4-MONTH TRAINING LOAD

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Abstract:
This work evaluated the differences in body composition after a 4-month training load of 122 to 13 years old swimmers without sports practice. The file consisted of 20 girls - 10 swimmers (SG) (age - 12.6 ± 0.8 years, sport age - 3.8 ± 0.4 years). The control group consisted of 10 girls (CG) (age - 12.6 ± 0.4 years) without sports practice. We used the anthropometer to obtain data for the height (cm) of the groups. Body composition was evaluated using the InBody 230 instrument. Selected body composition parameters were monitored in two evaluation periods (pre- and post-test): height (cm); body mass (kg); body mass index (BMI, kg / m²); body fat (kg; %); fat mass arms, trunk and legs (kg); lean mass (kg); muscle mass arms, trunk and legs (kg); skeletal muscle mass (kg). We used Mann-Whitney U test to compare the differences between input and output measurements between groups. Statistically significant differences between somatic parameters were not recorded. In selected parameters of the body composition, the statistical significance of the differences was expressed on the output of body fat percentage ($p = 0.021$), the body weight of the fat mass arms ($p = 0.034$), the amount of muscle mass arms ($p = 0.005$), trunk (0.009) and the skeletal muscle mass ($p = 0.038$). The Wilcoxon test was used to compare input and output data measurements of monitored groups. Statistically significant differences in somatic parameters we recorded in height in both groups (P - $p = 0.027$, KS - $p = 0.027$), and in the body weight ($p = 0.016$) and BMI ($p = 0.007$) in CG. Statistical significance of differences in selected body composition parameters were expressed in percent ($p = 0.007$) and weight ($p = 0.028$) of body fat, fat mass arms ($p = 0.028$) and legs ($p = 0.028$), in total lean mass ($p = 0.008$), muscle mass arms ($p = 0.007$) and trunk ($p = 0.007$), in skeletal muscle mass ($p = 0.017$). In CG statistical significance of the differences was signified only in fat mass legs (0,017). Finally, we can say that we found lower percentage and total fat mass, higher values of total lean mass, lean mass arms and trunk as well as quantity of skeletal muscle mass in SG after 4 month of training load compared to CG, while these results being influenced by swimming, in particular by the total training volume.

INTRODUCTION

Body constructure, body size and body composition among to the major factors of motor performance and physical fitness. External body construction refers to study of bones , muscles and fatty tissue during the growth and development [3], where is body composition generally expressed in two models, as a percentage of fat mass and lean mass [9, 10]. Regularly monitoring of body composition in sport is important indicator of health and

physical development in adolescent athletes [10], such as identification of eating disorders, overtraining, disease or to compare body composition with sports performance. Rating of body constructure is also part of identification, selection and development of young talented athletes [8], such as identifying the basic elements in body composition for the needs of sport. There are currently a number of methods to assess the body composition of adolescent athletes from timeless with low-cost and practical aspects (anthropometry) to time-consuming and costly, such as DSM-BIA ((bioelectrical impedance analysis) or DEXA (dual-energy X-ray absorptiometry). Fat mass is the most variable component of body weight. [1] refers, that high amounts of subcutaneous fat has negative effect on performance in most sports. It reduces mobility, relative strength, getting worse the economy of movement, and in some sports sectors affect increase body volume and resistance of environment when moving. In young athletes is the level of BMI and fat mass lower than common population, what is given especially the type of practiced sport [12, 9]. Bioelectric impedance measurement indicates that the lower limit of fat mass is in the period between 7 and 18 years in the range from 15 to 17% of body weight [6].

THE AIM OF THE WORK

Currently, there is a lack of studies evaluating changes in body composition associated with the training of girls in older school age. The aim of the work was to identify and assess changes in the body composition of 12 to 13 year-old swimmers of ŠKP Košice after 4 months of training load.

THE MATERIAL AND THE METHODOLOGY

The object of the research during the monitored period was 20 girls, which were divided into two groups. The group of swimmers consisted of 10 girls (SG) (age - 12.6 ± 0.8 years, sport age - 3.8 ± 0.4 years), which form the membership base of the Police Sports Club in Košice. The control group consisted of 10 girls (CG) (age - 12.6 ± 0.4 years) of primary school in Košice, who do not perform any sport activity.

The research was organized in September-December (2016) for a period of 15 weeks in the interior of the City's covered swimming pool and the primary school in Košice. Pre-test measurement of the swimmers fell 9.9. 2015 o 06.00 am. The admission measurement of the girls in primary school was realized next day on September 10, 2016 at 08.00. Post-test measurements were made 2-3. 12. 2016 under the same conditions as input measurements. Measurements were organized by two examiners in the presence and co-operation of the coach and teacher respectively. Measurement took place on an empty stomach.

Pre-test - the swimmers had a two-month post-season period and the pupils of the primary school had a two-month summer vacation. Swimmers and pupils were thoroughly informed during the training for testing and measurement issues. First, we measured the body height using an anthropometer. Then they stood on the spot electrodes on the Inbody 230. In the upright position, they grasped the handles of the device where the other electrodes were located. Consequently, the measurement was started on the computer connected to the device. The measurement lasted for a few seconds and ended with a beep.

Intervention - Intervention was performed for 15 weeks, with an average weekly number of days of loading being 5, load units 7, total hours of loading 14, of which water was 12 hours and dry preparation for 2 hours (Table 1).

Table 1 General training indicators in swimmers winter season

Period	Weeks	TD (Σ/week)	TLO (Σ/week))	TW(hod.) (Σ/week)	TL(hod.) (Σ/week)	Mileage(km) (Σ/week)
1. General preparation phase	4	18/4,5	26/6,5	39/9,75	11/2,75	129/32,25
2. Specific preparation phase	4	19/4,75	34/8,5	53/13,25	10/2,5	161/40,25
3. Race preparation phase	5	23/4,6	38/7,6	65/13	13/2,6	193/38,6
4. Race preparatoin phase - special	2	8/4	13/6,5	21/10,5	4/2	53/26,5

Legenda: TD – training days, TLO- Training load, TW - training in wtaer, TL – training in land

Post-test - testing consisted of the tests we applied to Pre-tests measurements.

We used the anthropometer to obtain the body height (cm) of monitored file. In addition, we used InBody 230 to measure the body composition. This is a DSM-BIA human body analyzer and confirmed in clinical trials with the DEXA device's results in lean mass (FMM - n = 731, r = 0.974, SEE = 2.481 kg) (Inbody, 2006). Body composition analysis using InBody 230 is very complex and extensive. The output was a graphical report of the detailed results of the body composition analysis with the overall evaluation of the current state of the investigation. In our case these body composition parameters were checked: body weight (kg), total fat mass (%, kg), fat mass trunk, arms and legs (kg), total lean mass (kg), lean mass trunk, arms and legs (kg), skeletal muscle mass (kg).

For the processing and evaluation of the research data, we used the InBody 230 program, which registered us the data on the composition of the body of swimmers and pupils. The values of the selected parameters from Inbody 230 were processed using Microsoft Office Excel 2010 and Statistica 12.0, where we used the arithmetic mean and the standard deviation from the basic statistical characteristics. To compare the pre-test and post-test data of the monitored groups, we used the Wilcoxon test. Mann-Whitney U test we used to compare differences between pre-test and post-test measurements across groups. The statistical significance of the monitored parameters was evaluated at 5% level of statistical significance. The primary method of processing primary data was an inter-individual methodology. Tables were used to evaluate processed research data.

RESULTS

In Table 2 we present the basic somatic characteristics on the pre-test and post-test measurements between the SG and CG groups, where we did not detect any statistically significant differences. In the following Table 3 we present the basic somatic characteristics of SG and CG on the pre-test and post-test measurements, where the statistically significant difference was recorded in the body height of both groups (SG p = 0.027, CG p = 0.027), body weight (p = 0.016) and BMI (p = 0.007) in CG.

Table 2 Somatic characteristics in the two assessment periods between participants

Variable	Test	SG	CG	U	*p*
Height (cm)	Pre	119.5	90.5	35.5	0.289
	Post	120.5	89.5	34.5	0.256
Body mass (kg)	Pre	112.0	98.0	43.0	0.623
	Post	109.0	101.0	46.0	0.791
BMI (kg/m^2)	Pre	103.0	107.0	48.0	0.909
	Post	103.0	107.0	48.0	0.909

Note: BMI – body mass index; SG- gril swimmers; CG – grils without sport practice; cm – centimeter; kg – kilogram; m – meter

Table 3 Somatic characteristics of the participants in the two assessment periods

Variable	Subgroups	Pre	Post	t	*p*
Height (cm)	SG	157.3 ± 7.1	158.3 ± 7.0	0.00	0.027
	CG	153.6 ± 8.3	154.5 ± 7.7	0.00	0.027
Body mass (kg)	SG	47.0 ± 8.3	47.7 ± 8.1	12,00	0.114
	CG	46.8 ± 13.8	47.7 ± 13.8	4,00	0.016
BMI (kg/m^2)	SG	19.0 ± 2.1	18.9 ± 2.1	22,00	0.575
	CG	19.6 ± 4.6	19.7 ± 4.6	0,00	0.007

Note: BMI – body mass index; SG- gril swimmers; CG – grils without sport practice; cm – centimeter; kg – kilogram; m – meter

Table 4 presents the mean of fat mass, lean mass and muscle mass on the pre-test and post-test measurements between SG and CG, where the statistical significance of the differences was expressed on the post-test measurement between groups in percentage of body fat (p = 0.021), fat mass arms (p = 0.034), muscle mass arms (p = 0.005), trunk (p = 0.009) and skeletal muscle mass (p = 0.038).

In the last Table 5 we present the results of body fat, total lean mass, and total muscle mass of the SG and CG groups on the pre-test and post-test measurement. The statistical significance of the differences was manifested in the SG group in percent (p = 0.007) and weight (p = 0.028) of body fat, further in the fat mass arms (p = 0.028) and legs (p = 0.028), total lean mass (p = 0.008), muscle mass arms (p = 0.007) and trunk (p = 0.007), in the skeletal muscle mass (p = 0.017). In CG, the statistical significance of the differences was reflected only in fat mass legs (0.017).

Table 4 Fat mass, lean mass and muscle mass in the two assessment periods between participants

Variable	Test	SG	CG	U	*p*
Percent body fat (%)	Pre	79.0	131.0	24.0	0.054
	Post	74.0	136.0	19.0	0.021
Total fat mass (kg)	Pre	91.0	119.0	36.0	0.308
	Post	88.0	122.0	33.0	0.212
Fat mass arms (kg)	Pre	83.5	126.5	28.5	0.112
	Post	76.5	133.5	21.5	0.034
Fat mass trunk (kg)	Pre	92.0	118.0	37.0	0.345
	Post	90.0	120.0	35.0	0.273
Fat mass legs (kg)	Pre	90.0	120.0	35.0	0.273
	Post	83.5	126.5	28.5	0.112
Total lean mass (kg)	Pre	124.0	86.0	31.0	0.162
	Post	123.0	87.0	32.0	0.186
Muscle mass arms (kg)	Pre	127.0	83.0	28.0	0.104
	Post	143.0	67.0	12.0	0.005
Muscle mass trunk (kg)	Pre	127.0	83.0	28.0	0.104
	Post	140.0	70.0	15.0	0.009
Muscle mass legs (kg)	Pre	120.0	90.0	35.0	0.273
	Post	129.0	81.0	26.0	0.076
Skeletal muscle mass (kg)	Pre	126.0	84.0	29.0	0.121
	Post	133.0	77.0	22.0	0.038

Note: SG- gril swimmers; CG – grils without sport practice; cm – centimeter; kg – kilogram; m – meter

Table 5 Fat mass, lean mass and muscle mass of the participants in the two assessment periods

Variable	Subgroups	Pre	Post	t	*p*
Percent body fat (%)	SG	17.9 ± 4.1	16.7 ± 4.2	1.00	0.007
	CG	25.8 ± 9.5	27.0 ± 9.8	3.00	0.063
Total fat mass (kg)	SG	8.6 ± 2.9	8.1 ± 2.9	4.00	0.028
	CG	12.84 ± 7.2	13.1 ± 7.2	9.50	0.234
Fat mass arms (kg)	SG	1.1 ± 0.3	1.0 ± 0.3	0.00	0.028
	CG	1.9 ± 0.9	2.0 ± 1.0	1.00	0.017
Fat mass trunk (kg)	SG	3.7 ± 1.8	3.6 ± 1.9	10.00	0.263
	CG	5.8 ± 4.0	5.8 ± 4.0	10.00	0.263
Fat mass legs (kg)	SG	2.9 ± 0.7	2.7 ± 0.7	0.00	0.028
	CG	4.3 ± 2.1	4.4 ± 2.1	8.00	0.161
Total lean mass (kg)	SG	38.4 ± 6.0	39.4 ± 6.0	1.50	0.008
	CG	34.0 ± 8.0	34.6 ± 8.2	9.00	0.059
Muscle mass arms (kg)	SG	3.7 ± 0.8	4.0 ± 0.8	1.00	0.007
	CG	2.9 ± 1.0	2.7 ± 0.9	19.00	0.678
Muscle mass trunk (kg)	SG	17.0 ± 2.8	18.1 ± 2.7	1.00	0.007
	CG	14.7 ± 3.3	14.1 ± 2.9	25.50	0.839
Muscle mass legs (kg)	SG	11.0 ± 2.1	11.2 ± 2.0	19.00	0.386
	CG	9.9 ± 2.9	9.3 ± 2.5	19.00	0.386
Skeletal muscle mass (kg)	SG	20.8 ± 3.6	21.3 ± 3.6	4.00	0,017
	CG	18.06 ± 4.8	17.1 ± 4.2	21.00	0.859

Note: SG- gril swimmers; CG – grils without sport practice; cm – centimeter; kg – kilogram; m – meter

DISCUSION

This study presented changes in body composition before and after 4 months of training for the swimmers in the older school age. The main findings of this study was, that the percentage and weight of body fat as well as the fat mass arms and legs were lower and the total lean mass, muscle mass arms and trunk as well as the skeletal muscle mass were higher at the post-test in swimmers, which may have been caused by the total volume of training load. Our results were consistent with findings from other authors who also found a lower percentage and weight of body fat in young athletes [9, 10, 12]. Sport and physical activity are considered important long-term benefits in body composition [5]. The disadvantage of this study was that during the period under review, that swimmers nutrition was not controlled, which could also affect the body composition.

Nevertheless, the monitored groups did not make any significant changes in their diet throughout the study. On the other hand, we found a statistically significant difference between the control group and the swimmers on the post-test in the percentages of body fat and fat mass arms, these differences being given by the selected physical activity and physical development, especially in the body fat increase in primary school pupils in older school age. From the basic somatic characteristics, the statistically significant difference in the pre-test and post-test was confirmed in the body height of both groups, while the control group of primary school also had a significant difference in body weight and BMI as a result of the physical development of older school age. Similar somatic characteristics of the swimmers were also measured in other studies [2, 11, 13].

CONCLUSIONS

In conclusion, we can say, that we have found a lower percentage and weight of body fat and higher total lean mass, muscle mass arms and trunk and skeletal muscle mass in swimmers after 4 months of exercise load compared to the control group, while the results

were influenced by swimming, namely by total training volume. Higher percentages of body fat indirectly correlate with sports performance. This parameter as well as the others mentioned are an important indicator of the body composition of athletes, especially during their season. In a further study, we would like to focus on assessing the relationship between selected body composition parameters and sport performance in swimming.

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