

MORPHOLOGICAL CHARACTERISTICS OF YOUNGER SCHOOL AGE GIRLS DEFFERENT PHISICAL INVOLVEMENT

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(Original scientific paper)

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Abstract

Physical activity is of essential value for healthy and balanced developments of children and young adolescents. Regular exercise brings many benefits for physical and mental health, as well as social functioning of children. The problem of this research was examining the effects of different models of physical exercise on changes in the morphological status on young girls. The goal of the paper was to determine the morphological characteristics of girls engaged in modern dance, as well as developmental gymnastics, for at least a whole year in continuity, and compare them to the morphological characteristics of girls the same age who have never been engaged in any organized physical activity. For the realization of this goal, we have used a battery with eight anthropometric gauges which estimate the voluminosity and body mass as well as subcutaneous adipose tissue of the subjects, as the use of means of physical activity can alter these characteristics most effectively. The results of the research show a substantial statistical difference between subjects of all age categories, and in favor of the girls engaged in developmental gymnastics and modern dance. The difference reflects in a morphological status of better quality, defined by less volume, body mass and less subcutaneous adipose tissue, which leads to the conclusion that engagement in developmental gymnastics and modern dance is very desirable and advisable for proper growth and development of young girls, especially in this very receptive stage.

Key words: *morphological characteristics, girls, modern dance, development gymnastics*

Introduction

Physical activity is crucial for healthy and balanced development of children and youth. This has a lot of benefits not only for health in general, but for social behavior of children as well. Pre-school and younger-school age is an especially sensitive period for development of motor abilities. Besides, this period is also significant for regular physical development of the whole organism and it is important not to miss the advantages it brings in formation of motor abilities' base. Thus, the choice of adequate movement activities is of a high interest (Popović, 2010).

Specific characteristics of an athlete in a certain sport's discipline represent a result of selection and influence of training. Selection is based on abilities and skills of crucial influence on sports performance. However, trainings' effects are constraint while some of characteristics and abilities are genetically determined and thereby cannot be affected by training to a large degree. Consequently, it is very important to know the equation of sports activity specification in order to recognize all factors that are decisive for success in a certain sports' discipline. On the basis of knowledge about genetics influence on their development, it can be precisely determined which characteristics and abilities can be affected by training.

Literature describes desirable model characteristics of the top athletes in the form of basic anthropometric dimensions, their interrelations, body composition components and somatotypes. Body size and body build contribute significantly to performance in many sports, particularly in aesthetic sports such as all kinds of dances, rhythmic and artistic gymnastics, aerobics, figure skating as well as ballet. These sports pose high specific demands upon the functional, energy, motor and psychological capacities of athletes; but also upon the size, body build and composition of the performers, particularly of elite level females.

Some similar researches in this area have already been done and should be mentioned here. For example, classic and modern ballet dancers have lower body mass, lower amount of adipose tissue, but also higher bone density compared with non-dancers (Van MarkenLichtenbelt, W. D. et al, 1995; Yannakoulia, et al., 2000; Cieřlicka, et al. 2012, Misigoj-Duraković, 2012; Suzović&Porčić, 2012) mainly due to more intensive muscle strain during long-time training. Research of morphological characteristics of twins showed that gymnastics' training can affect body mass, shoulder width, circumference of chest, while exogenous factors do not have influence on body height and arm length. Besides, some relative data are of high importance in anthropometry, i.e. arm/leg length correlated to body height (Čuk et al., 2007). Although gymnastics is a sport involving short bouts of physical activity, young children are exposed to relatively high physical demands. So far, effects of gymnastics training on fat mass development have not been widely researched; however, elite gymnasts have been consistently portrayed as being lighter and having a decreased fat mass compared to other sporting groups and reference populations (Laing et al., 2002; Filaire and Lac, 2002; Gurd and Klentrou, 2003; Zanker et al., 2003).

In this research the effects from application of different physical activity models on changes in morphological status of younger-school aged girls were examined. The aim was to determine morphological characteristics of girls involved with modern dance as well as developmental gymnastics for at least one year continuously and to compare them with girls of the same age who were never involved with organized physical activity.

Material & methods

The sample consisted of younger-school aged girls (7-11 years of age). Based on decimal age of examinees two groups were formed (Table 1).

Table 1. Age groups of girls

Group of respondents	age	Group 1 7,00-8,99	Group 2 9,00-11,00	Σ
Girls not involved with organized training		75	72	147
Girls involved with development gymnastics		79	69	148
Girls involved with modern dance		65	61	126
	Σ	219	202	421

The sample of anthropometric characteristics is chosen based on twodimensional morphological model made by Bala (1980). This model is characterized by one factor that merges longitudinal and transversal dimension of skeleton, which stands for the system of bones and another one, which defines volume and body mass and subcutaneous adipose tissue. This battery of anthropometric characteristics used for evaluation of morphological characteristics consisted of the following measurements: *for the assessment of dimensionality of skeleton*: 1. Body height (mm); *for the assessment of volume and body mass*: 2. Body weight (kg), 3. Circumference of chest (chest girth)(medium) (mm), 4. Circumference of upper arm (midarm girth)(in a relaxed position) (mm) and 5. Circumference of lower arm (forearm girth) (mm) and *for the assessment of subcutaneous adipose tissue*: 6. Skinfold of upper arm (triceps skinfold) (0.2mm), 7. Skinfold of back (subscapular skinfold) (0.2mm) i 8. Abdominal skinfold (0.2mm). All of the anthropometrical measurements were conducted in accordance with IBP standard.

Program of developmental gymnastics as well as modern dance for girls of younger-school age includes 60-90 minutes training, 2-3 times a week, which depends on the age. These trainings are conducted from September to June of the next year. During the public appearances and competition periods the number of training is often increased to five a week. The sample of this research consisted only of the girls who are involved in one of presented programs of organized exercising for at least one year continuously. For the assessment of quantitative differences of anthropometric variables' systems of

three groups of respondents multivariate analysis of variance (MANOVA) was used. For the assessment of differences between every single anthropometric characteristic for both age groups analysis of variance (ANOVA) was applied. The level of statistical significance was $P=0.05$. All data were analysed by SPSS 20 software.

Results

The analysis of differences in anthropometric variables of 3 groups of 7-9-year old girls is shown in Table 2. For better understanding of differences between the groups basic statistics for both groups of respondents are given. For the assessment of quantitative differences of anthropometric variables' systems of three groups of respondents multivariate analysis of variance (MANOVA) was used. Then, the analysis of variance (ANOVA) was applied to determine differences between every single anthropometric characteristic.

Table 2. Analysis of anthropometric variables of three groups of 7-9-year-old girls

VARIJABLES	Gr	AM	S	f	p	p*	
1. Body height (mm)	1	1296,94	65,77	2,31	0,09	1-2	0,71
	2	1292,23	68,03			1-3	0,17
	3	1310,97	66,26			2-3	0,14
2. Body weight (kg)	1	27,95	4,89	11,59	0,00	1-2	0,00
	2	25,63	3,89			1-3	0,81
	3	27,79	4,64			2-3	0,00
3. Circumference of chest (chest girth) (mm)	1	597,99	40,73	0,91	0,40	1-2	0,24
	2	603,29	37,23			1-3	0,30
	3	604,23	40,79			2-3	0,88
4. Circumference of upper arm (mm)	1	211,04	21,97	45,96	0,00	1-2	0,00
	2	191,02	16,59			1-3	0,00
	3	193,60	17,07			2-3	0,38
5. Circumference of lower arm (mm)	1	190,90	13,55	25,66	0,00	1-2	0,00
	2	180,64	11,96			1-3	0,00
	3	184,93	11,46			2-3	0,03
6. Skinfold of upper arm (0,2mm)	1	106,27	57,50	21,15	0,00	1-2	0,00
	2	70,83	40,32			1-3	0,01
	3	86,27	35,81			2-3	0,04
7. Skinfold of back (0,2mm)	1	76,36	31,14	18,37	0,00	1-2	0,00
	2	59,05	21,77			1-3	0,00
	3	62,47	18,77			2-3	0,39
8. Abdominal skinfold (0,2mm)	1	110,49	33,62	17,30	0,00	1-2	0,00
	2	90,99	26,93			1-3	0,00
	3	94,40	27,64			2-3	0,46

F = 19,19

P = 0,00

Gr – groups of respondents:

- 1) not involved with organized training
- 2) involved with development gymnastics
- 3) involved with modern dance

AM – arithmetic mean

SD – standard deviation

f – f-test of analysis of variance

p – level of statistical significance for f

p* – level of statistical significance for f between every group of respondents

F – F-test of multivariate analysis of variance

P – level of statistical significance for F

Based on multivariate analysis of variance results, statistically significant differences (on the highest level of statistical inference, i.e. $P=0.00$) between anthropometric variables' systems of the groups were determined. The results of analysis of variance indicate that there are differences between respondents of this age in majority of examined anthropometric variables on the level of statistical significance of

$p=0.00$. The exception is the variable for the assessment of the chest circumference, for which statistically significant differences between three groups of respondents were not found.

By the partial observation of every single anthropometric variable between every combination of two examined groups statistically significant differences between majority of the variables in control group and both experimental groups were found. This does not refer to body height, body weight and abovementioned circumference of chest in the case of control group and girls involved with modern dance. By the analysis of partial differences between two experimental groups statistically significant difference in body weight, body height, circumference of lower arm (forearm girth) and abdominal skinfold were clearly observed.

Differences between anthropometric variables of three groups of 9-11-year-old girls are given in Table 3. Results of multivariate analysis of variance pointed to statistically significant differences in anthropometric variables' systems of examined groups. The level of the statistical inference of $P=0.00$. The similar results were also found for the groups of younger girls. Most of variables showed also individual statistically significant differences between the groups on the highest level of statistical inference. The exception in this case is variable for the assessment of dimensionality of skeleton – body height, where no statistically significant difference between three groups of respondents was found.

Table 3. Analysis of anthropometric variables' differences of three groups of 9-11-year-old girls

VARIJABLES	Gr	AM	S	f	p	p*	
1. Body height (mm)	1	1429,1	73,09	2,12	0,12	1-2	0,12
	2	1414,9	82,44			1-3	0,08
	3	1404,9	75,93			2-3	0,47
2. Body weight (kg)	1	35,97	6,59	6,07	0,00	1-2	0,01
	2	33,88	6,62			1-3	0,00
	3	32,61	6,12			2-3	0,27
3. Circumference of chest (chest girth) (mm)	1	651,58	52,42	4,52	0,01	1-2	0,04
	2	664,46	56,36			1-3	0,17
	3	638,51	48,21			2-3	0,01
4. Circumference of upper arm (mm)	1	229,85	28,85	37,88	0,00	1-2	0,00
	2	208,83	19,74			1-3	0,00
	3	201,61	19,61			2-3	0,09
5. Circumference of lower arm (mm)	1	205,15	16,35	23,74	0,00	1-2	0,00
	2	194,34	14,69			1-3	0,00
	3	191,34	14,19			2-3	0,27
6. Skinfold of upper arm (0,2mm)	1	143,52	77,47	25,86	0,00	1-2	0,00
	2	94,08	50,85			1-3	0,00
	3	94,44	35,70			2-3	0,97
7. Skinfold of back (0,2mm)	1	90,28	41,36	19,86	0,00	1-2	0,00
	2	68,39	25,26			1-3	0,00
	3	65,56	17,55			2-3	0,62
8. Abdominal skinfold (0,2mm)	1	121,58	40,22	19,50	0,00	1-2	0,00
	2	97,05	27,66			1-3	0,01
	3	105,56	30,86			2-3	0,16

F = 17,94 P = 0,00

Partial analysis of individual anthropometric variable between every combination of two examined groups showed that there are statistically significant differences between most of variables in control and both experimental groups. Body height and circumference of chest were exceptions in this case. By the analysis of partial differences of two experimental groups, the only statistically significant difference was found for the circumference of chest variable.

Discussion

From the results of arithmetic mean for every variable in both age groups it can be seen that majority of examined variables have higher values in case of girls not involved in any kind of organized training. It

means that girls involved in developmental gymnastics and modern dance have lower values of body mass circumference of lower and upper arm and amount of subcutaneous adipose tissue in general compared with girls of the same age not involved in organized physical activity. Thus girls from both experimental groups have better quality of soft tissue. Lower values of circumference of lower and upper arm is direct consequence of lower amount of subcutaneous adipose tissue in those body segments. These results are expected while the requests for gracile morphological structure of girls are emphasized due to ease of performance of dance, acrobatic and all the other elements of choreography but also the visual experience and impression they leave on judges especially in dance. Therefore in training process correction of nutrition, decrease of body mass and subcutaneous adipose tissue in all body segments occupy a special place. This implies better status of motor abilities as well as specific morphological structure these girls have latter in life. (Van MarkenLichtenbelt, W. D. et al, 1995; Yannakoulia, et al., 2000; Laing et al., 2002; Filaire and Lac, 2002; Gurd and Klentrou, 2003; Zanker et al., 2003; Čuk et al., 2007; Kostić, Zagorc and Uzunović, 2004, Viskić-Štalec et al. 2007; Steinberg et al., 2008, Cieślicka, et al. 2012, Misigoj-Duraković, 2012; Suzović and Porčić, 2012).

Results show that there is no any statistically significant difference between the respondents of both age groups in body height. This unambiguously prove the fact that body height is not a limiting factor for successful training in developmental gymnastics and modern dance which is important for the selection in those two sport activities. However, elite gymnastics implies much lower body height and lower values of longitudinal dimensionality of skeleton. In this research the emphasis is on the population of girls involved with developmental, recreational gymnastics, adopted for every age and body constitution of girls and boys.

It is interesting to mention the absence of statistically significant differences between younger respondents in variable circumference of chest, where higher values had girls from experimental groups while in the case of older group those values for girls involved with developmental gymnastics were significantly higher than in other two groups. This fact as well as the above mentioned skinfold brings the conclusion that circumference of chest in group of girls involved with developmental gymnastics has higher values due to muscle mass. It is expected concerning the fact that training in gymnastics consists of learning and exercises of gymnastic elements and combinations on different apparatus in many arm-stand positions, specific hang positions etc. Which include hypertrophy of muscles and thereby the increase of volume especially in the chest area. The same conclusion was presented by (Madić, Mikalački and Popović, 2008; Madić, Popović and Kaličanin, 2009; Popović, 2010).

Analysis of differences in anthropometric variables of two experimental groups showed lower values of all of the examined characteristics in younger group. However some of these differences are not statistically significant. Girls involved in developmental gymnastics are shorter, weight less and have lower volume and amount of subcutaneous adipose tissue in comparison with girls of the same age involved with modern dance. This type of body structure originates from specific requests of training in those two groups. Namely, modern dance for younger girls emphasizes adoption of basic ballet technique which is usually static, learning of simple combination of dancing elements and less demanding jumps, basic spin technique etc. All these elements are performed in gently movement so the training is of mild intensity. Unlike modern dance, in developmental and especially elite gymnastics the intensity of training is high from the very beginning and this includes general physical preparedness, large number of repetition of exercises, jumps, vaults etc. Thus, specific morphological status of girls involved in developmental gymnastics is formed in the youngest age.

However, beside abovementioned variables for the assessment of circumference of chest, in older group there are no other statistically significant differences between two experimental groups. It can be explained by the increase of training's intensity for older dancers. Duration of training is changed from 60-90 minutes and fourth training a week is often included especially for soloists and requests are far more serious than in younger age. This unambiguously implies the formation of specific morphological structure of dancers that is similar to the one for girls involved in developmental gymnastics.

Conclusions

It can be concluded that the program of developmental gymnastics and modern dance had influence on morphological status of younger school-aged girls especially on characteristics that define volume and body mass and subcutaneous adipose tissue. Comparative analysis of morphological characteristics of girls involved in developmental gymnastics and modern dance and characteristics of girls not involved in

any kind of organized training showed statistically significant difference in quality of morphological status defined by lower volume, body mass and subcutaneous adipose tissue. This points to which morphological type of younger-school aged girls is the most suitable for successful training in developmental gymnastics and modern dance. These results confirm the results of other authors that emphasized the significance and advantages of organized physical activities (dancing and gymnastics in the first place) for better morphological characteristics of pre-school and younger-school aged children (Blažević, Katić and Zagorac, 2002; Laing et al., 2002; Filaire and Lac, 2002; Gurd and Klentrou, 2003; Madić, Mikalački, Popović, 2008; Madić, Popović, Kaličanin, 2009; Popović, 2010; Uzunović, Kostić and Živković, 2010). These programs are recommended for better quality of morphological characteristics of children but also for all the other anthropological dimensions of pre-school and younger-school aged children.

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