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Postural differences between girls who practice and who do not practice rhythmic gymnastics

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Abstract
The aim of this study was to detect differences in some postural characteristics that occur
under the influence outside of school physical education among the girls involved in rhythmic gymnastics, and those who are not involved in extracurricular sports activities, and are in early adolescence at the start of puberty. Sample for this study were 100 female students, third and fourth graders, who were divided into two groups. The first group included the students who are actively engaged in rhythmic gymnastics for at least two years (N = 50), and the second group consisted of the students who do not practice any sports (N = 50). The assessment of postural characteristics was analyzed based on a modified method of body posture assessment according to Wolanjski N. (1975). Applicable variables are as follows: the head posture (ADTDG), the shoulder posture (ADTDR), the posture of shoulder blades (ADTDL), the shape of the thorax (ADTGK), vertebral column (ADTKS), the abdomen posture (ADTDS), the shape of the legs (ADTON), feet in line (ADTSS), the overall assessment of body posture - a method per Wolanjski (ADTMW). Also, the height of the body (AVIS) and the body weight (ATEZ) of the students were measured, therefore the body size index was determined (INDEX). Discriminative analysis and T-test results show statistically significant differences in postural characteristics between girls who practice rhythmic gymnastics and schoolgirls who do not. These differences are in favor of gymnasts, as they have better body posture and lower levels of deformities in relation to the schoolgirls of the same age who are not involved in regular training.

Key words: **posture, rhythmic gymnastics, schoolgirls**

Sažetak
Cilj ovog rada bio je otkriti razlike u nekim posturalnim karakteristikama koje nastaju pod utjecajem izvanškolskog tjelesnog vježbanja između djevojčica koje se bave ritmičkom gimnastikom i onih koje se ne bave izvanškolskim sportskim aktivnostima, a nalaze se u ranoj adolescentskoj dobi na samom početku puberteta. Uzorka ispitanika za potrebe ovog istraživanja činilo je 100 učenica 3. i 4. razreda osnovne škole podjeljenih u dvije subskupine. Prvu skupinu su činle učenice koje se aktivno bave ritmičkom gimnastikom najmanje dvije godine (N=50), a drugu grupu učenice koje se ne bave aktivno sportom (N=50). Procjena posturalnih karakteristika izvršena je na osnovu modifikovane metode procjene držanja tijela. Primjenjene su slijedeće varijable: držanje glave (ADTDG), držanje ramena (ADTDR), držanje lopatica (ADTDL), oblik grudnog koša (ADTGK), kičmeni stub (ADTKS), držanje trbuha (ADTDS), oblik nogu (ADTON), svod stopala (ADTSS), ukupna procjena držanja tijela - metoda prema Wolanjski (ADTMW). Također je izmjerena visina tijela (AVIS), težina tijela (ATEZ) ispitanika, te je određen indeks tjelesne građe (INDEX). Diskriminativnom analizom i T- testom dobijene su statistički značajne razlike u posturalnim karakteristikama između grupe ritmičarki i školarki. Te razlike idu u korist ritmičarki, odnosno one imaju bolje držanje tijela i manji nivo deformiteta u odnosu na učenice istog uzrasta koje nisu uključene u redovni trenažni proces.

Ključne riječi: **posture, ritmička gimnastika, djevojčice**

Introduction

The child is not a small man and is significantly different in the anthropological and biological characteristics compared to an adult. One of the most important goals of kinesiology is to allow proper growth and development of children through appropriate kinesiology treatments. The time period in a child's life when it starts school to adolescence (6-10 yr.) is known as a period of middle childhood. Basic changes and leading activities of children in this age are related to a new motivation – the start of school and learning through new, enhanced, expanded and deepened understanding that brings greater responsibility for a child towards school and other obligations, as well as the joy of achievement. With starting school, the movement of a child significantly decreases. How important and significant is regular physical exercise at this early period of growth and development of the young body and whether it is justified by the need to increase the hours of physical exercise through the introduction of extra-curricular activities that will positively affect child's growth and development in this period? These are some of the important issues that deserve special attention of experts as well as scientific evidence.

Children this age very easily and quickly, easier and quicker than ever before or later in life, solve new motor tasks, regardless of what it specifically relates to, quickly improve their motor skills and perfectly adapt them to different conditions. The working capacity of the child in this period can be maintained for a relatively long time, longer than is usually assumed, provided that the physical exercise is in proportion to age and individual abilities of the child. Hardman (2008) as well as many other authors, emphasizes that this age is the most important- a crucial period in relations to the future of sports activities and that the missed exercise time can never be compensated.

At this period of growth and development, with their own specific personalities of mental and physical life, girls have desires towards the beauty and harmony. They are attracted by music and movement in rhythm. A rhythmic gymnastics develops the sense and the ability to consciously experience and express the beauty, and furthermore has a very positive influence on all physiological functions of the body (Ivančević, 1976). It is a complex educational process primarily directed towards health, beauty and ef-

fectiveness, which includes both straightening the body and body care, cultivation of movement with the development of music talent and creative imagination. All this enriches and improves personality, provides joy, pleasure and satisfaction. By doing a variety of physical exercises, the entire apparatus for movement gets trained and develops the meaning and sense of posture, brings the ability to understand and experience the beauty through the movement and music (Hume et al., 1993). The main goal of this study was to identify the differences in postural characteristics that occur under the influence of physical exercise outside of school between the girls in early adolescence at the start of puberty.

Methods

Sample of the examined

Sample for this study were 100 schoolgirls, third and fourth graders, who were divided into two groups. The first group was built of the students who are actively engaged in rhythmic gymnastics for at least two years (N = 50). A second group included the students who do not practice any sports (N = 50). Thus, the sample of respondents for this study case consists of girls aged eight to ten years. This age is the very beginning or the period just before the rapid growth and development of the typical adolescent age, being that the beginning and duration of puberty varies individually.

Sample of the variables

The assessments of postural characteristics were analyzed based on a modified method of assessing posture according to Wolanjski (1975). Applicable variables are as follows: the head posture (ADTDG), the shoulder posture (ADTDR), the posture of shoulder blades (ADTDL), shape of the thorax (ADTGK), vertebral column (ADTKS), the abdomen posture (ADTDS), the shape of the legs (ADTON), feet in line (ADTSS), the overall assessment of body posture - a method per Wolanjski (ADTM). Also, the height of the body (AVIS) and the body weight (ATEZ) of the students were measured, therefore the body size index was determined (INDEX).

Data analyzes methods

In all applied variables, the results of respondents were analyzed with standard descriptive procedures for single and multiple levels. At the single level, the differences were tested for each variable by using T-test for independent samples. On the multiple levels, the discriminative analysis was used in order to determine the difference between the two groups.

Results and Discussion

The analysis of differences between the group of rhythmic gymnasts' girls and the group of schoolgirls underwent T-test for independent samples. By looking at Table 1, it is clear that there are significant differences between most variables, at the level of significance
p = 0.00. Variables that do not show a statistically significant difference between these two groups were body weight, the head posture and the shape of the chest.

The body height is a basic parameter of the level and pace of the body size development. In this study, the girls who are engaged in rhythmic gymnastics are on an average 4 cm taller than the girls who are not involved in extracurricular activities; these differences are at the level of statistical significance (p = 0.04). It is clear that the growth in height in this period of development is not consistent. In the past 10 years in rhythmic gymnastics, there was a change in the morphological type of top ranked gymnasts. The top ranked gymnasts on the world stage are on an average 170 cm high, slender, with long arms and spindle-shaped muscle, with lower measures of the transverse dimensions and a small percentage of adipose tissue (Aleksander, 1991). However, in this research, the difference in height between gymnasts and schoolgirls can not be attributed to selection in rhythmic gymnastics, because the tested girls who are engaged in rhythmic gymnastics are the beginners and not selected competitors. Body weight is also a basic parameter of the level and pace of the body size development, but it belongs to the so-called dynamic-changing dimension, because it is susceptible to environmental influences and can demonstrate large variations, even during the day. In the variables for assessing body weight (ATEZ), there are no statistically significant differences between these two groups of girls.

However, girls differ in body mass index (INDEX), which is used to estimate fat ratio and lean body mass. This tells us that gymnasts in relation to the schoolgirls have a lower percentage of body fat. We may conclude that engaging in rhythmic gymnastics causes positive changes in the structure and composition of the body. Special attention should be paid to the statistically significant differences in the variables to evaluate spinal posture (ADTKS). Rhythmic gymnastics training increases the mobility of the spinal column, but through the exercises, it strengthens back muscles which have a positive effect on the spinal column posture (Bogić, 1995). The skeleton, particularly spine and feet, requires attention during schooling: straightening of the spine, gentle girls' muscles, improper position when sitting at the school desk, can easily lead to early change (deformations) that must be corrected with exercises. Flexibility of the spine hides two opposites. The first characteristic is positive, because the flexibility itself allows the most varied movements. And our efforts should go into that phase when ossification is not yet complete, but we also should not forget to maintain proper strength and to strengthen active and passive stabilizers of the spine (muscles, joints and ligaments).

From the set of variables to assess the body posture, variable for assessing head posture (ADTGK) and variable for assessing the chest shape (ADTGK) came into view, which showed no statistically significant difference between these two groups of girls. For schoolgirls, the least endangered status is the chest and head posture. The past body posture researches of preschool children also show that the chest posture is the least vulnerable (Hadžikadunić, 2005).

In order to determine the global quantitative differences found between the two groups, the discriminative analysis was applied. The discriminative analysis is a method that considers the size of some quantitative variables and their mutual relations. Discriminative model is a special type of a factor analysis in which the isolated orthogonal vectors in the space of manifest variables are best placed to separate the groups in the space of variables (Rađo and Wolf 2002).

Var.	Mean G1:1	Mean G2:2	t-value	df	p	Valid N G1:1	Valid N G2:2	Std.Dev. G1:1	Std.Dev. G2:2	F-ratio variancs	p variancs
ATEZ	39.06	38.94	0.06	98	0.94	50	50	9.93	8.83	1.26	0.42
AVIS	1.46	1.42	2.01	98	**0.04**	50	50	0.12	0.07	2.69	0.00
INDEX	18.05	19.15	-1.93	98	**0.05**	50	50	2.49	3.17	1.63	0.09
ADTDG	0.02	0.03	-0.38	98	0.70	50	50	0.10	0.16	2.51	0.00
ADTDR	0	0.27	-4.10	98	**0.00**	50	50	0.00	0.47	0.00	1.00
ADTDL	0.62	0.29	3.67	98	**0.00**	50	50	0.46	0.44	1.08	0.80
ADTDS	0.17	0.71	-4.81	98	**0.00**	50	50	0.30	0.74	6.17	0.00
ADTGK	0.20	0.23	-0.33	98	0.74	50	50	0.39	0.51	1.68	0.07
ADTKS	0.08	0.3	-2.59	98	**0.01**	50	50	0.27	0.53	3.80	0.00
ADTON	0.08	0.3	-3.33	98	**0.00**	50	50	0.19	0.43	5.36	0.00
ADTSS	0.3	0.88	-5.45	98	**0.00**	50	50	0.46	0.59	1.65	0.08
ADTMN	1.47	3.01	-5.22	98	**0.00**	50	50	0.94	1.86	3.93	0.00

Table 1. T-test differences

The criterion for the strength of applied discriminative variables was so-called Wilks' Lambda. In the analysis of the results in Table 2, it is shown that the discriminative function was obtained, which significantly differs gymnasts from schoolgirls on the basis of postural characteristics, indicating a high discriminative value that is confirmed by the canonical correlation coefficient of .678 (Table 2). It is clear that the rhythmic gymnastics program for girls 8-10 years of age has its positive effects in terms of proper posture, growth and development of the young body.

Reviewing the results in Table 3, it is shown that the largest contributions to discriminative function give the following variables: ATEZ-body weight, AVIS- body height, and INDEX-body mass index. Morphological status was described by three basic anthropometric factors: longitudinal dimension, mass and volume of the body and subcutaneous adipose tissue.

Based on the results in Table 4 (The structure of the discriminative functions), it can be seen that the highest correlation with discriminative function or variable that differentiates the maximum value of the results between the two groups (gymnasts and schoolgirls) has a test for assessing arch of the foot (**ADTSS**). Deformities of the feet have a decisive influence on the functional state of the locomotors apparatus especially on the lower extremities. In children this age, the foot deformities are very common and for most of these phenomena, the reason is insufficient attention devoted to the format and nurturing the feet from early childhood. The foot bears the heaviest load in the static and the dynamic function of the locomotors apparatus. Flatfoot deformity is very common and is manifested by the loss of normal, physiological arches of the feet. It can be congenital or acquired. From the acquired causes, the most common ones are the reduced amount of the foot muscles use, the weak muscles of the legs, and the excessive obesity lifestyle. Through rhythmic gymnastics training, a special attention is devoted to feet exercises, so it is quite logical that the biggest difference between gymnasts and schoolgirls appeared at the variable for assessing the arch of the foot.

The following variables are: the entire posture (**ADTMNW**), the abdomen posture (**ADTDS**) and the blades posture (**ADTDL**). In the analysis of the distance group of centroids (Table 5), it can be seen that the results of the gymnasts are on the negative side of the discriminative function (in the assessment of body posture, lower score indicates better body posture), and the results of schoolgirls are on the positive side of the discriminative function.

Table 2. Isolated discriminative function

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	,852	100,0	100,0	,678

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	,540	56,988	11	,000

Table 3. Standardized discriminative coefficient

Variable	Function 1
ATEZ	-2,556
AVIS	1,185
INDEX	1,522
ADTDG	-,001
ADTDR	,483
ADTDL	-,398
ADTDS	,307
ADTGK	-,300
ADTKS	,189
ADTON	,182
ADTSS	,461
ATEZ	-2,556

Table 4. Structure of discriminative function

Variable	Function 1
ADTSS	,596
ADTMN	,572
ADTDS	,527
ADTDR	,449
ADTDL	-,402
ADTON	,365
ADTKS	,283
AVIS	-,221
INDEX	,211
ADTDG	,042
ADTGK	,036
ATEZ	-,007

Table 5. Centroid Group

Group	Function 1
1,00	-,914
2,00	,914

Conclusion

Proper body posture is the basic prerequisite of good health, normal growth and development of a person in general, so it is very important to apply the proper body posture at an early age (Hadžikadunić & Balta, 2000). Deformities that occurr in childhood can have enormous consequences, which can cause permanent damage to the body. During the sensitive period of growth and development of the young body, it is of great importance to be involved in physical activity that will affect the proper growth and development. Poor body posture prevails among a large number of people, children, especially school youth. Therefore it is necessary to conduct decisive measures against poor body posture from an early age. Long-term static stress, mainly in a sitting position, in the development of the young body, has a tendency to create an imbalance between the physiological strength, as well as the function of certain body muscles. This indicates to be the first step in the formation of poor body posture.

It is necessary to act on the active part of the locomotors apparatus to be properly selected, based on the appropriate age and regular exercises. It is crucial for the development of movement to go along with the emotional development in children's lives. Rhythmic gymnastics best suits psycho-physical development of young female body. This study demonstrated, that rhythmic gymnastics program for girls 8-10 years of age, has positive effects on proper body posture, growth and development of the young body. With all this, the fact is that the health of each child contributes to the society advancement as a whole. The need to increase the number of physical and health education classes from the very beginning of schooling and the introduction of extra-curricular physical activities is justified.

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