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EVALUATION OF LOWER EXTREMITY POSTURE OF YOUNGER SCHOOL-AGE CHILDREN[1]

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Abstract: Economic development of countries in transition has indirectly led to a change in the quality and way of life, and has influenced the instruction of physical education in schools. One of the problems encountered in physical education lessons is improper posture of younger school-age children. Monitoring posture status has an important role both in the prevention of deformities and in the smooth instruction at this age. The aim of the study was to investigate lower extremity posture of younger school-age children with an average age of 7.34±0.38 from Belgrade. The evaluation was carried out on a total sample of 68 pupils divided into two equivalent subsamples: 34 boys and 34 girls. Non-experimental research design, more precisely, ex post facto design was used. The χ^2 test was used to test the distribution of frequencies. The research results indicated the absence of gender-related statistically significant differences ($p>0.05$) concerning the shape of legs ("X" and "O" type of legs), as well as the shape of foot arches. However, the results of the study are alarming, because 20.2% of participants have mild forms of knee deformity (16.2% "X" type of legs and 4.4% "O" type of legs), while 52.9% of the analysed sample have developed early stages of flat feet, which can significantly compromise physical education classes in the future. It can be assumed that this is a consequence of insufficient physical activity, insufficient engagement of the muscles of the lower extremity, genetic predisposition (hereditary) and inadequate footwear in early childhood, as well as the lack of preconditions for exhibiting biotic motor skills in schools and the environment in which they grow up.

Key words: evaluation, legs, foot arches, gender, differences, physical education

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INTRODUCTION

Bad posture of younger school-age children is often an indicator of health issues. These problems can become very serious if bad posture or bad position of foot arches is not corrected in time (McEvoy, & Grimmer, 2005). These types of problems often go unnoticed in the earlier stages. At a later age, these problems lead to serious health problems, starting with decreased physical activity in physical education classes on the part of the affected pupils. It would be highly beneficial if teachers noticed the first signs of bad posture, lower extremity and foot arches problems, and passed this information on to parents. A proper assessment of posture plays an important role in the prevention of deformities in children of both preschool and younger school age and preschool and school teachers have the necessary knowledge to perform this assessment. Timely evaluation of this segment of the anthropological status of children can prevent further progression of bad posture and contribute to an early detection of problems, thus allowing timely action.

Over the past decade, a rapid development of the Internet has brought a new, modern lifestyle which has its positive effects but has also caused some negative impacts (a lack of exercise, fast food, stress and obesity). The World Health Organization (WHO, 2000) classified physical inactivity as a risk factor and equated it with the risk carried by hypertension and obesity (Pelemis, Pavlovic, Nikolic, & Ujsasi, 2020). It is alarming that all these negative influences were noticed in members of the younger population. All of the above-mentioned problems further create preconditions for posture disorders and leg and feet deformities. The goal of posture evaluation is to create an efficient self-sustaining system in which, using advanced methods, problems related to posture, leg and feet deformity, which have become more frequent due to urbanization, will be detected early on and then corrected with programmed physical activity in schools. The first specific goal of this evaluation is to improve the assessment of posture and properly identify sensorimotor problems. Another specific goal is to raise awareness among target groups about the importance of timely detection and prevention of sensorimotor problems in children. According to previous studies, a level of physical activity on a global scale is continuously declining. The education system and physical activity incorporated into the curriculum in transition countries are declining dramatically. This is caused by the fact that economic development in countries in transition has indirectly led to a change in the quality of life and affected both parents and children.

The issue of detection and evaluation of posture disorders, including the evaluation of legs and feet, has been dealt with by many authors who obtained different results. Radisavljevic, Ulic, & Arunovic (1997) indicate that

15% of boys and 16.25% of girls had a lighter "X" type of leg, while a more severe form of this issue was observed in 3% of boys and 29.5% of girls, whereas flat feet were noticed in 75 % - 79% of students. Bigovic & Krsmanovic, (2006) indicate that the lack of children's play without shoes in urban areas certainly leads to reduced engagement of feet muscles and causes flat feet in both genders. Sabo, (2006) points to a better condition of foot arches in girls, while Miloševic, & Obradovic, (2008) indicate the fact that foot arches were in a good shape in a higher percentage of survey participants of both genders. Mihajlovic, Solaje, & Petrovic, (2010) indicate that 90% of children have the first degree of flat feet (at that age they have an extremely poor initial shape of the feet). Djokic, Medjedovic, & Smiljanic, (2011) state that scoliosis and flat feet are the most common deformities in primary schools. Studies also show that the "O" type of legs are found in boys in a slightly higher percentage than the "X" type of legs. The "O" type of legs was observed in 19.8% of boys, while the "X" type of legs was seen in 16.4% (Jovovic, & Canjak 2012). It was also found that the "O" type of legs is more frequent than the "X" type of legs, and that the "X" type of legs is more common among the obese children, while the "O" type of legs is more frequently found in children who weigh less (Vlaskalic, Bozic-Krstic, Obradovic, & Srdic, 2006).

Based on the above, the aim of the research was defined: to determine whether there are any significant gender differences in the condition of foot arches of children between 7 and 8 years of age from Belgrade, as well as the overview of the results obtained by direct measurement and comparison of the tested population of similar age in Serbia.

METHOD

Non-experimental research design - *ex post facto* research design was used in this paper. This design was chosen because the changes in the analyzed variables occurred earlier, and the conclusion is made *post facto*. For the purposes of the research, the population of participants from the first grade of the primary school "Vuk Karadžić" in Belgrade was selected. The total sample of 68 subjects was divided by gender into two equivalent subsamples: (34 boys and 34 girls). Only those first-grade pupils whose parents gave their written consent in accordance with the Declaration of Helsinki were included in the research (Declaration of Helsinki, 2013).

The research was conducted in September 2019 at the beginning of the school year. The evaluation of posture was described as a posture status assessment during one school year and was of a formative nature. This evaluation was aimed at improving teaching practice and introducing additional

physical education classes intended for corrective purposes, i.e. meant to improve children's health. A prior needs assessment was performed (conducted before the implementation of the physical education curriculum to establish the existing physical preparation level of pupils, as well as to identify specific target groups) in order to gain insight into students' needs regarding physical education. The evaluation was performed using the somatoscopic method by Napoleon Wolanski. Various segments of posture status were observed, including the following: 1. *shape of the legs (the "X" and "O" type of legs)* and 2. *foot arches (flat feet).* According to this methodology, grade zero (0) indicated that the observed segments were in normal state; grade one (1) represented a smaller deviation from the normal position (first degree of deviation), and grade two (2) represented a greater deviation from the normal position (second degree of deviation). It is a method by which the body of an examinee is observed as a whole from a distance of 2 meters, from the front, rear and lateral sides.

The "X" type of legs: grade 0 - legs are straight, knees and feet slightly touching; grade 1 - there was a deviation in the area of the ankles. The distance between them is greater than the width of participant's two fingers; grade 2 - there was a deviation in the area of the ankles. The distance between them is greater than the width of participant's three fingers.

The "O" type of legs: grade 0 - legs are straight, knees and feet slightly touching; grade 1 - there was a deviation in the area of the knees. The distance between them is greater than the width of participant's fingers; grade 2 - there was a deviation in the area of the knees. The distance between them is greater than the width of participant's three fingers.

Foot arches: grade 0 - the inner foot arches are good; grade 1 - the inner foot arches are not high enough and show a tendency to lower when standing on one leg; grade 2 - the feet are flat.

Statistical analysis of the data included a non-parametric χ^2 test, more precisely cross-tabulation, where marginal frequencies were obtained for each combination of pairs of variable categories for all examined variables of posture status, at the level of statistical significance of $p \leq 0.05$.

RESULTS

Tables 1, 2 and 3 show frequencies of the assessments of the leg shape and the condition of foot arches in relation to the gender of the examinees. The values of the χ^2 test in Table 1 indicate that there is no statistically significant difference between the two subsamples of subjects, boys and girls in the "X" type of legs category ($p = 0.323$). Subjects of different gender had a similar

condition of the observed segment of posture status, which can be assessed as generally good. The total number of survey participants with good posture was 57 or 83.8%, 27 of which were boys (39.7%) and 30 girls (44.1%). There were 7 boys (10.3%) and 4 girls (5.9%) with posture deformities - grade 1. The data indicate good posture of the knee joint, which is a total of 16.2%. The data indicate correct posture of the knee joint, with a total of 16.2%. The results from the same table also indicate the absence of structural disorders in the knee joint in both examined subsamples of participants, because there are no recorded grades 2 (0%).

Numerically, more boys had a knee joint disorder than girls of the same age. Weakness of the leg muscles and ligaments of the knee joint are characteristic of this degree of deformity. In these examinees, general ligamentous laxity was observed, especially the medial collateral ligament (inner, lateral), and these children were somewhat obese. It can be concluded that the condition of the knee joint is satisfactory in both subsamples.

Table 1. Contingency table for the "X" type of legs in relation to survey participants' gender

Posture status assessment		Gender		Total
		M	F	
0	Number	27	30	57
	% in relation to "X" type of legs	47.4%	52.6%	100.0%
	% in relation to gender	79.4%	88.2%	83.8%
1	Number	7	4	11
	% in relation to "X" type of legs	63.6%	36.4%	100.0%
	% in relation to gender	20.6%	11.8%	16.2%
Total	Number	34	34	68
	% in relation to the "X" type of legs	50.0%	50.0%	100.0%
	% in relation to gender	100.0%	100.0%	100.0%

χ^2=.976 p=0.323

Legend: χ^2–Chi-square test value; p-value of statistical significance for the Chi-square test.

Similar data were obtained by analyzing the numerical and percentage representation of the "O" type of legs variable in different gender subjects in Table 2. Moreover, similar values (p=0.555) recorded for both subsamples indicate that there were no statistically significant differences observed

between the subsamples of examinees regarding this variable related to the assessment of the knee joint condition. There was also no structural deformity observed in both subsamples, while posture deformity (grade 1) was found in only 2 girls (5.9%) and 1 boy (2.9%). Therefore, it can be highlighted that this deformity is not present or is very little present in the examined sample of children.

Table 2. Contingency table for the "O" type of legs in relation to survey participants' gender

Posture status assessment		Gender		Total
		M	F	
0	Number	33	32	65
	% in relation to "O" type of legs	50.8%	49.2%	100.0%
	% in relation to gender	97.1%	94.1%	95.6%
1	Number	1	2	3
	% in relation to "O" type of legs	33.3%	66.7%	100.0%
	% in relation to gender	2.9%	5.9%	4.4%
Total	Number	34	34	68
	% in relation to the "O" type of legs	50.0%	50.0%	100.0%
	% in relation to gender	100.0%	100.0%	100.0%

χ^2=.349 p=.555

Legend: χ^2–Chi-square test value; p-value of statistical significance for Chi-square test.

No statistically significant differences between examinees of different gender were observed in the third analyzed variable - *Foot arches* (Table 3) (p=0.614). Similar conditions of foot arches in boys and in girls contributed to such results. It should be highlighted that there were a total of 21 examinees (30.9%) with proper postures; 36 subjects (52.9%) had grade 1, that is, damage in the form of weakened ligaments and muscles holding the longitudinal arch of the foot; and, 11 examinees, which accounted for a total of 16.2%, had a structural disorder in the form of completely flat feet - *pes planovalgus*.

Table 3 also shows the percentage of representation of the variable *Foot Arches*. A slightly higher prevalence of good posture for this segment was observed in the subsample of girls (11 girls, or 32.4% had grade 0) compared to their peers of the opposite gender - 10 boys or 29.4%. There were 17 boys (as many as 50%), which is an extremely poor and devastating result, and 19 girls (as many as 55.9%) had grade 1, that is, their foot position can

be characterized as *pes planus* – a foot position with weak and insufficient musculature. From the aspect of subsamples, almost half of the examinees, regardless of gender, had an initial degree of lowered foot arches. As indicated by the subsamples, almost half of the survey participants, regardless of gender, had an initial degree of lowered foot arches. A total of 7 boys (20.6%), which is almost one fifth of all male examinees and 4 girls (11.8%), which is almost a tenth of the analyzed sample had grade 2, i.e. completely lowered arch foot arches or flat feet. If we were to summarize the results, we could say that 11 subjects, out of 68 in total, had flat feet, which represents 7.48% of the total sample. The evaluation indicated a need for regular, daily systematic exercise in health care institutions, schools or classrooms for corrective gymnastics.

Table 3. Contingency table for foot arches in relation to survey participants' gender

	Posture status assessment	Gender		Total
		M	F	
0	Number	10	11	21
	% in relation to Foot arches	47.6%	52.4%	100.0%
	% in relation to gender	29.4%	32.4%	30.9%
1	Number	17	19	36
	% in relation to Foot arches	47.2%	52.8%	100.0%
	% in relation to gender	50%	55.9%	52.9%
2	Number	7	4	11
	% in relation to Foot arches	63.6%	36.4%	100.0%
	% in relation to gender	20.6%	11.8%	16.2%
Total	Number	34	34	68
	% in relation to Foot arches	50.0%	50.0%	100.0%
	% in relation to gender	100.0%	100.0%	100.0%

χ^2=.977 p=.614

Legend: χ^2–Chi-square test value; p-value of statistical significance for the Chi-square test

DISCUSSION

The research results obtained on a sample of 68 survey participants of both genders and of younger school-age from Belgrade, indicated a similar

condition of posture components, that is, the shape of the legs and foot arches. No statistically significant differences were found between the subjects who were divided into two subsamples on the basis of sexual dimorphism, which indicates a similar condition of the observed components. The results of this study confirm a part of earlier findings from a study related to the condition of the knee joint by Radisavljevic, Ulic, & Arunovic (1997), who also found that differences in the shape of the knee joint do not exist, but that there are examinees with impaired posture in the form of the "X" or "O" type of legs in both genders. The data obtained by evaluating the posture of the lower extremity in tested children in schools are alarming and indicate the need for permanent action in the field of physical education and detection of physical deformities. This is particularly true in cases of flat feet, because respondents with grade 1 can quickly find themselves in the group of examinees with grade 2, i.e., they can have complete weakness of the muscles and ligamentous laxity of the feet and lower leg muscles. In this way, such pupils would be subjects to an even greater number of deformities that would affect other posture components, primarily the knee joint and the spine. The consequences of such conditions, which can still be eliminated with an additional program of physical activities in schools, would be visible at a later age. At this stage, there is a pain in the spine, which is difficult to treat, and many psychological factors that students would be affected with, which could also cause changes in students' personality traits, i.e., conative characteristics. It has to be highlighted that there is a concern for a large number of students in this age group with foot deformities in the form of lowered foot arches. With the progression of flat foot deformity, if not adequately treated, there is the intense pressure on the inside of the foot when walking. This problem would not be tied to the feet only, it could cause certain issues with the support of lower extremities and problems with the "X" type of legs later in life. Until the age of five, the "X" type of legs can be considered a normal stage of development and growth of the child and does not require any special therapy. Prevention and therapy for flat feet also influences the prevention of the "X" type of legs, and, later on, spine deformities which can result out of this deformity. Parents often do not notice flat foot deformities and are more worried about the "X" type of legs after the progression of foot deformity has already started.

In both subsamples, the percentage of functional deformities is on a slight increase in all three examined variables. Based on the results obtained, it can be concluded that the number of foot deformities is similar for both genders. Based on these results, it can be concluded that children at that age have extremely unsatisfactory initial state of their feet, which is manifested through extremely weak leg muscles, especially the muscles supporting the

longitudinal foot arches (muscles of the front and back part of the lower leg, and foot muscles - plantar and dorsal foot flexors). A lack of muscle strength, insufficient physical activity, a lack of movement, and even less directed physical activity can cause flat feet in children of younger school age. The inability of children to freely engage in sports activities because they have to pay certain membership fees in sports clubs, pupils avoiding physical education classes in schools, and most of all, the reduction of the total amount of physical activity during the day as a result of lifestyle changes in younger population, contribute to high percentage of deformities in the form of flat feet (16.2% grade 2) and functional stage of deformity (52.9% grade 1) in the tested sample of children from Belgrade. These research findings are in line with the findings of Pelemis, Ujsasi, Pelemis, Mitrovic, & Lalic, (2015).

The deformities of foot arches are most probably the consequence of muscle weakness, short sole muscles and lower leg muscles. A child is born with flat feet which are brought to a normal state with walking and spontaneous physical activity, and the longitudinal and transverse foot arches develop. Reduced physical activity in this developmental phase leads to insufficient formation primarily of the longitudinal foot arches. These research results are also in line with the results presented by Mihajlovic, Solaja, & Petrovic, (2010). The percentage of foot arch deformities is lower compared to the results presented by (Zivkovic, 2009; Mihajlovic, & Toncev, 2008).

Physical education teachers in primary schools should provide their own programs for additional work with children in terms of corrective exercises. In order to prevent the progression of deformities and correct them, it is necessary for children to do corrective exercises to strengthen feet muscles. Exercises should be done every day for 10-15 minutes. This activity should be planned for before or after classes in small groups. Only sufficiently strong and correctly performed corrective physical exercises can provide satisfactory results (Momcilović, 2007). Therefore, it would be necessary to teach parents as well so they would be able to supervise their children doing the same exercises at home. It would be especially desirable to include such children and their parents in school projects and apply at their request and on their behalf to the institutions in charge which could provide the appropriate equipment, as well as to raise awareness about physical education in general. Thus, regular monitoring of posture could be performed, which would contribute to the detection of body deformities and their correction. An individual approach to working with students would thus be provided resulting in a better syllabus of physical education classes (forming new groups of students and implementing corrective physical exercises in school).

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