

ESTABLISHMENT OF THE FOOT ARCH INITIAL STATUS IN PRE-SCHOOL CHILDREN

Ilona Mihajlović and Ivan Tončev

Faculty of Sport and Physical Education, University of Novi Sad, Serbia

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Abstract

One of the primary factors or reasons for the unsatisfactory postural status in pre-school children is their deformed feet. The great prevalence of foot deformity in pre-school and school children is a fact their parents and teachers have to face with on a daily basis. During their leisure time the majority of children reduce their physical activities to playing computer games and using PC. The postural status of the children population of this age is exposed to great risks. This study has established the deformity of the foot arch in pre-school 4- to 6-year-old boys and girls by the computerised and digitalised podography (CDP) method. The aim of this study was to reconstruct and establish the functioning of the initial postural status, that is foot status in pre-school children and to present the obtained results before the relevant institutions in order to provide much needed preventive treatment. Based on the obtained study results the following conclusion may be drawn: as much as 93% of the examined children had deformed feet, while only 7% had normal feet, without any deformity.

Key words: initial status, deformity, foot, children

Introduction

Based on the statistical data provided by the World Health Organisation, it has been concluded that the postural status of pre-school children is unsatisfactory. One of the primary factors or reasons for this finding is foot deformity. The prevalence of bad posture and bodily deformities in pre-school and school children is a fact which parents and teachers have to be faced with on a daily basis. Results of numerous studies indicate that the largest prevalence of deformities in orthopedics is the deformities of a particular segment of foot and spinal column. The causes of the postural disorder may be congenital and acquired, internal and external, topological, social, psychological, environmental and so on. Also, it is well known that hypokinesia is manifested as an ultimate result of both the increased standard of living and decreased physical activity. During their leisure time, the majority of children reduce their physical activities to the minimum only to play computer games and use their PC. Such lifestyle endangers other vital functions as well. The postural status of children population of this age is exposed to great risks. Bad posture is the result of poor phylogenetic adaptability to the upright posture, and weak skeleton and muscle structure. When diagnosing the postural

status in children, it is, among other things, necessary to establish their foot status. The feet may be evaluated in a number of ways. Certainly, the most detailed information is provided during podoscopic examination using the computerised and digitalised podography (CDP) method which has been applied in this study.

Objectives and tasks

The aim of this programme and study was to reconstruct and establish the functioning of the initial postural status, that is foot status in pre-school children, and to present the obtained results before the relevant institutions in order to provide much needed preventive treatment. In order to meet the goal, the following tasks had to be performed:

- Making a diagnose in order to establish the initial (current) feet status in terms of correct or potentially deformed feet;
- Planning – to determine major directions (of tasks and goals) to be followed by children during a specified time interval; the directions are set depending on the established initial (current) feet status in pre-school children;
- Programming – to establish the means and methods for the

implementation of the planned corrective measures under specific conditions and with the application of adequate loads in particular segments of physical exercise (organised corrective exercise) and time intervals.

Methods

The study has been implemented in the "Radosno detinjstvo" kindergarten institution in the territory of the City of Novi Sad. A total of 559 children were included using the random choice method. The children were divided into two sub-groups based on the gender criterion. The boys group included a total of 287 boys aged 4-6 years; the girls group included a total of 272 girls of the same age. The variable pattern included the following: body height (TELVIS); body weight (TELMAS); collapsed transversal arch (PESTRAN); generalised joint laxity (CALVAL); high arch foot (PESCAVUS); four degrees of pes planus – pes planus 1 (PP1); pes planus 2 (PP2); pes planus 3 (PP3); pes planus 4 (PP4); and foot without deformity (BO). The foot deformity was measured by using the computerised and digitalised

podography (CDP) method; the podoscope device consists of a box with a glass top illuminated by fluorescent lights, a digitalised video camera, a PC with a video card, adequate software, and color printer. The main features of CDP are the following:

- measures and records the pressure points of the patient's feet in both static and dynamic mode;
- shows the calibrated values of the exerted pressure;
- shows the examined foot in time intervals;
- generates the image of the maximum exerted pressure;
- prints diagnostic reports.

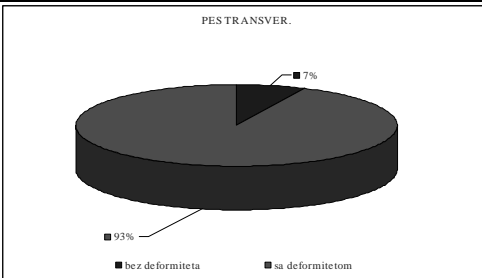
The measurements were made and interpreted by competent professionals capable of both diagnosing the foot deformity and creating the foot deformity correction programme.

Results

The obtained results of this study are presented in the form of tables and graphs. First we are going to deal with numerical (n) and percent (%) of occurrences of the evaluated deformity types.

Table 1. Occurrence of the evaluated PES TRANSFERSOPLANUS foot deformity

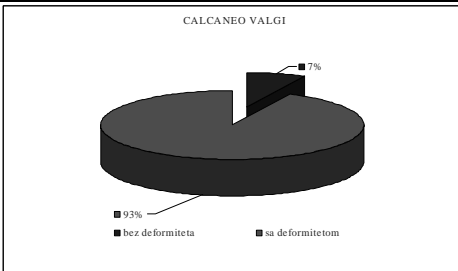
	Deformity	
	w/o	with
n	39	520
%	6.98	93.02



The pie chart, titled 'PESTRANSVER.', shows the distribution of foot deformity. The legend indicates 'bez de formiteta' (without deformity) at 93% and 'sa de formitetom' (with deformity) at 7%.

Table 2. Occurrence of the evaluated CALCANEO VALGI foot deformity

	Deformity	
	w/o	with
n	41	518
%	7.33	92.67



The pie chart, titled 'CALCANEO VALGI', shows the distribution of foot deformity. The legend indicates 'bez de formiteta' (without deformity) at 93% and 'sa de formitetom' (with deformity) at 7%.

Table 3. Occurrence of the evaluated PES PLANUS 1 foot deformity

	Deformity	
	w/o	with
n	482.	77.
%	86.23	13.77

Table 4. Occurrence of the evaluated PES PLANUS 2 foot deformity

	Deformity	
	w/o	with
n	412	147
%	73.70	26.30

Table 5. Occurrence of the evaluated PES PLANUS 3 foot deformity

	Deformity	
	w/o	with
n	420	139
%	75.13	24.87

Table 6. Occurrence of the evaluated PES PLANUS 4 deformity

	Deformity	
	w/o	with
n	473	86
%	84.62	15.38

Table 7. Occurrence of the evaluated WITHOUT DEFORMITY status

	Deformity	
	with	w/o
n	520	39
%	93.02	6.98

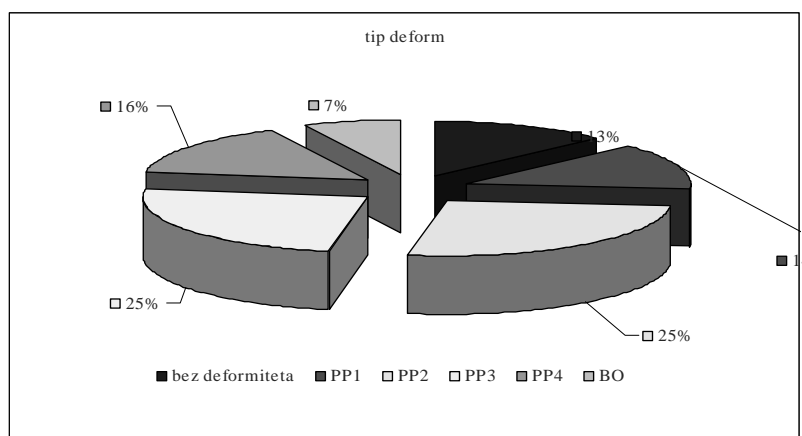


Figure 1. Occurrence of flatfoot deformity types in the overall sample

Table 8. Numerical (n) and percent (%) of occurrence of deformity types per gender

	w/o deformity		PP1		PP2		PP3		PP4		BO	
	n	%	n	%	n	%	n	%	n	%	n	%
Boys	32	11.1	25	8.7	79	27.5	76	26.5	55	19.2	20	7.0
Girls	40	14.7	51	18.8	68	25.0	62	22.8	32	11.8	19	7.0

Table 8 shows that the most frequent deformity in boys was PP2, reported in 79 cases (27.5%) out of a total number of 287 boys, which is a significantly higher number of cases when compared with PP4 which occurred in 55 cases (19.2%), $p=.018$. The absence of pes planus deformity is recorded in 32 cases (11.1%), $p=.000$; PP1 occurred in 25 cases (8.7%), $p=.000$, whereas no deformity (BO) was reported in 20 cases (7.0%), $p=.000$.

As for girls, the occurrence of PP2 was reported in 68 cases (25.0%), which is a significantly higher number of cases when compared with the occurrence of PP1 reported in 51 cases (18.8%), $p=.078$. The absence of any pes planus deformity was reported in 40 girls (14.7%), $p=.003$; PP4 was reported in 32 cases (11.8%), $p=.000$, and no deformity (BO) was reported in 19 girls (7.0%), $p=.000$.

The difference regarding gender of the examined children: no pes planus deformity is a diagnose more frequently made in the *girls* group (14.71%); PP1 is also more frequent in the *girls* group (18.75%); its occurrence is significantly higher than in the *boys* group (8.71%, $p=.001$). PP2 is the most common deformity in the *boys* group (27.53%); PP3 is also more frequent in the *boys* group (26.48%); PP4 is more frequent in the *boys* group (19.16%) as well, where

its occurrence is significantly higher than in the *girls* group (11.76%, $p=.016$). The importance of the differences between the genres (boys and girls), when examined against the 4 evaluated feet deformity types, is shown.

Table 9. The significance of the differences between the genres with regard to evaluated deformity types

	N	F	P
MANOVA	4	4.574	.001

Since the established statistically significant difference is $p = .001$, the conclusion is that there is a significant genre difference between the examined children with regard to the evaluated deformities.

Table 10. Mahalanobis distance between the examined genres with regard to evaluated deformity types

	Boys	Girls
Boys	.00	.36
Girls	.36	.00

If we take an integral view of both genre flatfoot deformity patterns, the obtained results presented in Table 10 show that the Mahalanobis distance between the two examined genres, boys and girls, is smaller.

Discussion and conclusion

Table 1 shows that PES TRANSVERSOPLANUS occurred in the great majority of the examined pre-school children (520 deformity cases, 93.02%), whereas only 7% of the examined children of the same age had no foot deformity. The CALCANEO VALGI deformity (Table 2) occurred in the majority of the examined pre-school children, almost 93%. This alarming data also tell us that only 7% of the examined children did not suffer from generalised joint laxity. The first degree collapse of the medial longitudinal arch, PES PLANUS 1 occurred in 14% of children (Table 3). When compared with other flatfoot deformities, PP1 was most infrequent. Table 4 shows the number and percentage of children suffering from the second degree pes planus (PP2). Some 26% of the examined children suffered from this particular deformity. Pes planus 2 is the most frequent medial longitudinal arch collapse deformity. The occurrence of the collapsed longitudinal arch of third degree is almost the same as the collapsed longitudinal arch of second degree, almost 26% (Table 5).

The result indicates that these two deformities are the most common ones in pre-school-aged children because such deformities affected almost 50% of the examined children population. Some 15% of the examined children population (Table 6) suffered from the most severe longitudinal arch collapse known as Pes planus 4. Only 6.98% of the examined children population (Table 7) was without any flatfoot deformity, which is an alarming finding for this specific population. Graph 1 shows the occurrence of the collapsed longitudinal arch deformity classified in the above mentioned four degrees. Using the CDP method, a total of 559 children were examined.

Their feet deformity status was evaluated against 10 possible deformity types, among which 5 were reported as most significant (PP1, PP2, PP3, PP4 and BO) for the establishment of the initial posture status of pre-school children. The obtained results were presented both as tables and graphs. Based on the relevant statistical procedures it may be concluded that in the examined children population 93.02% of children had deformed feet, and only 6.98% had normal feet. When speaking about the degree of pes planus deformity, the most infrequent flatfoot deformity was PP1 (14%) whereas the most frequent flatfoot deformity was PP2 (26%).

Based on the obtained results, it is possible to outline some gender characteristics in terms of prevailing deformity types: the boys had insignificant prevalence of PP2, PP3 and PP4; the girls had insignificant prevalence of *without deformity*, PP1 and BO. Since $p = .003$ χ^2 – of the test, and $\chi = .175$ with the confidence interval (.099; .252) that does not contain a zero, it may be concluded that gender and deformity type are not tightly related. If we observe the sub-groups created on the gender criterion, it may be concluded that the frequency of PP1 in boys was lower than in girls (8.71%, 18.75%, respectively); however, the frequency of PP4 in boys was higher than in girls (19.16%, 11.77%, respectively). In the *girls* group the frequency of PP1 was higher than in the *boys* group (18.75%, 8.71%, respectively); however, the frequency of PP4 in girls was lower than in boys (11.77%, 19.16%, respectively). Also, it may be concluded that the difference between the examined genres in terms of the evaluated deformities are statistically significant ($p = .001$) and that there is a clearly defined line between the two genres. Hence, it is possible to establish genre characteristics in terms of evaluated deformities.

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UTVRĐIVANJE INICIJALNOG STANJA SVODA STOPALA KOD DJECE PREDŠKOLSKOG UZRASTA

Sažetak

Jedan od primarnih faktora tj. razloga nezadovoljavajućeg posturalnog statusa predškolske djece je deformitet stopala. Veliki postotak deformiteta predškolske i školske populacije je činjenica sa kojom se roditelji i pedagoški radnici susreću svakodnevno. Djeca se u najvećoj mjeri odmaraju pasivno uz mikropokrete vezane uglavnom za tehničke aparate tipa video igara i kompjutera. Posturalni status djece u ovom uzrasnom periodu izložen je velikom riziku. U ovom istraživanju utvrđen je deformitet stopala predškolske populacije dječaka i djevojčica uzrasta od 4-6 godina metodom KDP tj. kompjuterizovane digitalizovane podografije. Cilj je bio da se izvrši konstrukcija i funkcionisanje inicijalnog modela posturalnog statusa – stopala predškolske djece i da dobiveni rezultati budu predstavljeni odgovarajućim relevantnim institucijama kako bi se pružila neophodna preventivno-kurativna pomoć. Na osnovu dobijenih rezultata može se zaključiti da veliki broj ispitivane djece posедуju deformitete stopala, čak 93%, dok je bez ikakvog deformiteta svega 7%.

Ključne riječi: inicijalno stanje, deformitet, stopalo, djeca

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Correspondence to:

Assoc.Prof. Ilona Mihajlović, PhD.

University of Novi Sad

Faculty of Sport and Physical Education

Lovćenska 16, 21000 Novi Sad, Serbia

Phone: +381(0)21 450 188

E-mail: fsfv@uns.ns.ac.yu