LITERATURE

1. *DemczukE./1993/FizykoterapiaTlNo2.*
2. *Demczuk-WtodarczykE./1998/FizykoterapiaT6Nol-2.*

CONSTITUTION FOOT OF SWIMMER

КОНСТИТУЦІЯ СТОПИ У ПЛАВЦІВ

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Proper anatomic structure of the foot is a prerequisite for foot's correct functioning. During ontogenesis, various egzogamic factors exert their effect on foot architecture. Understanding the mechanisms of this effect makes H also possible to influence foot's development in a beneficial way, as well as prevent any malformations. There is a prevalent opinion that a long-lasting static work of feet constitutes the cause for their dysmorphia. While, in fact, the examinations of feet conducted on people training swimming proved that intensive dynamic work, in conditions of strain put on feet, also leads to alterations in particular segments of feet architecture. The aim of this study is to analyse the parameters of features of the morphological structure of child swimmers feet, taking into consideration the" length of training period. The analysis will make it possible to evaluate the mechanism of alterations in foot's architecture; mechanisms of alterations being related to the character of work and the length of training.

Research material

The study involved a group of 125 girls and boys aged between 12 and 15. All of them were swimmers in Wroclaw's sport club called "Juwenia", systematically training swimming. The collected research material was classified according to age of people under examination, length of training period, and the training load.

Tab. 1. The characteristics of research material

Group	Age	Number	Length of training period	Weekly training load
1	12	29	Second year	12 hours
2	13	33	3 years	15 hours
3	14	33	4 years	17 hours
4	15	30	5 years	21hours

Podometric method / Demczuk-Wlodarczyk 1998/ was applied to evaluation morphological structure of feet. From the total parameters of foot, its length, width and circumference was analysed. Longitudinal arch *was* evaluated by analysing the course of five longitudinal plantar arches of the foot over the base and according to Demczuk /1993/ [illegible] Transverse arch was evaluated on the basis of distribution of pressing force on heads of metatarsus bones' heads. Anterior carrying zone was assessed on the basis of

an analysis of intensity with which toes adhere to the ground, as well as a measurement of hallux' valgity angle and varus deformity of the fifth digit / Kutzner- Kozinska [illegible] norms were accepted as physiologic norms for angle values. Foot architecture was evaluated in conditions of relief from the burden ofbodyweight as well as with the burden ofbodyweight.

The study's findings.

Presented in table 2 general characteristics of the mean values of analysed [illegible] features indicate that in all examined groups and in different static-dynamic conditions with and without load/ foot's architecture is properly shaped. The comparison of analysed features' values /table 3/ revealed that statistically significant differences occur solely as far as the shape of feet with load and without load is concerned. There is a noticeable statistically important, lowering of height of foot's longitudinal plantar arches, varied in different feet and dependent on the length of training period / tab. In case of children with a five- year-long training period, none of the arches changes its values, in a statistically important way, as a result of putting a strain on the feet. Other features' values do not change in a statistically important way. The exception is the length of right foot.

On the basis of individual evaluation of foot's morphological structure a characteristic of functional condition of particular segments of feet of children who train swimming was presented, according to the length of training period/ figures 1,2,3 and 4.

The evaluation of condition of foot's longitudinal arch /fig. I/ revealed that the frequency with which functional platypodia occurs decreases with each year of training. No occurrence of malformation was recorded in case of children training for 4 years. In the second group under research, the frequency with which correctly arched feet occurred dramatically decreased, while there was a rise in the number of hollowed feet. In successive years, an increase in correctly arched feet and a decrease of hollowed feet can be observed.

The evaluation of the state of foot's transverse arch was conducted on the basis of distribution of pressure force on the level of metatarsal bones' heads. The analysis revealed that the frequency of transversal platypodia occurrence increases with the length of training period / fig. 2.

The assessment of the state of foot's anterior carrying zone revealed that the frequency, ofhallux valgus occurrence decreases, while defects of other toes intensify /fig.3.4/. The intensity of second toe's adherence to the ground decreases. It most often occurs in the forth group, with strain.

Discussion of findings

Motor apparatus in human beings undergoes constant changes during individual life. Their direction is dependent on a number of factors, among which motor activity plays an essential role. Training sport in the period of human being's progressive development has a considerable effect on the state of motor apparatus. The research was carried out on children training swimming on intensive basis, and at the age of puberty, the age of various changes that take place in different parts of the body. The general characteristics of the features of feet's morphological structure /tab. *11* depicts changes that took place in its form during a four-year-long period. All parameters undergo changes depending on the conditions of examination and child's age. These changes do not matter in statistical terms /tab. *31.* The exception is the value of heights of longitudinal plantar arches. In the first group of swimmers with a 2 -year-long training period, external and medial plantar arches become fallen (in a statistically relevant way

as a result of putting a strain on them. In case of children swimming for 3 years, the whole longitudinal architecture undergoes a statistically relevant process of lowering, and in case of children with a 4-year-long training period, four medial arches in the right foot undergo process of statistically significant falling. Whereas, in case of children swimming for 5 years, the values of longitudinal arch do not change significantly.

From the biomechanical point of view, important are the changes in height of longitudinal arch's roof /arch II and III/. The conducted analysis gives grounds for presumption that swimming initially leads to relaxation of tightness of roofs vault, and subsequently it leads to vault's strengthening. The effect of relaxation of muscle-sinew-ligament structures occurred in the third year of training swimming. Lack of variations in children swimming for 5 years indicates the structure's stability. Taking into consideration the developmental age of examined children, it is difficult to univocally determine the precise circumstances under which swimming as a sport exerts its effect on the state of longitudinal arch of the foot. It should be underscored that certain flaccidity of ligament-muscle apparatus is typical for individuals at this stage of life. Therefore, it is not possible to say for certain whether the relaxation of tightness of longitudinal arch is a result of training or constitutes certain regularity typical for this age.

An evaluation conducted to investigate the individual state of particular segments of foot depicts certain tendency in the changes of its form. The state of longitudinal arch improves as the training progresses. The frequency of functional platypodia occurrences decreases, while the number of hollowed and properly arched feet increases. In case of children training for 3 years, a considerable decrease of correctly arched feet and increase of hollowed feet can be observed. In the successive years, the number of correctly arched feet gradually increases and hollowed feet decreases. Finding out the existence of hollowed feet in these children does not necessarily mean that they have malformation. It should be rather understood as a transitory better arch of the foot. None of the children complained about pain in the area of feet. Furthermore, this state of feet was transitory. In the fifth year of intense swimming activities, the percentage of hollowed feet decreased slightly.

As the training period progresses, the state of transverse arch along with the anterior supporting zone of a foot /fig. 4/ deteriorates. This suggests a detrimental effect of training swimming on the anterior segments of the foot. After four years of training, in over 30% examined cases the pressure force is directed on the medial heads of metatarsal bones. Though increasing with the training period, percentage of disorders of the way feet are placed suggests that these are secondary alterations resulting from transverse platypodia. It can be assumed, then, that in a couple of years time this diagnosed strain pressure will result in development of the whole range of alterations typical for transverse platypodia. Intensive swimming along with predisposition to malformations at stage of puberty instigate development of various disorders involving anterior segment of the foot. Therefore, preventive measures should be taken in case of this children to avert malformations, and in case of younger swimmers, prevent occurrence of malformations. The improvement of longitudinal plantar arch's state seems to indicate that swimming has a beneficial effect on the state of feet's long muscles. Therefore, while taking preventive measures against transversal platypodia, special attention should he devoted to strengthening of feet's short muscles- especially ascaris muscles and flexor

muscles of short toes and a large toe. It will improve tightness of metatarsus' bones and ensure proper range of motion of flexion in metatarsal-phalangeal joints.

Conclusions:

1. Swimming has a beneficial effect on longitudinal plantar arch of the foot, at the same time it disturbs anterior segment of the foot and anterior carrying zone.

Tab. 2. The importance of differences betweem particular groups as far as features offeets morphological structure are concerned /a/with relief from load /b/withlood

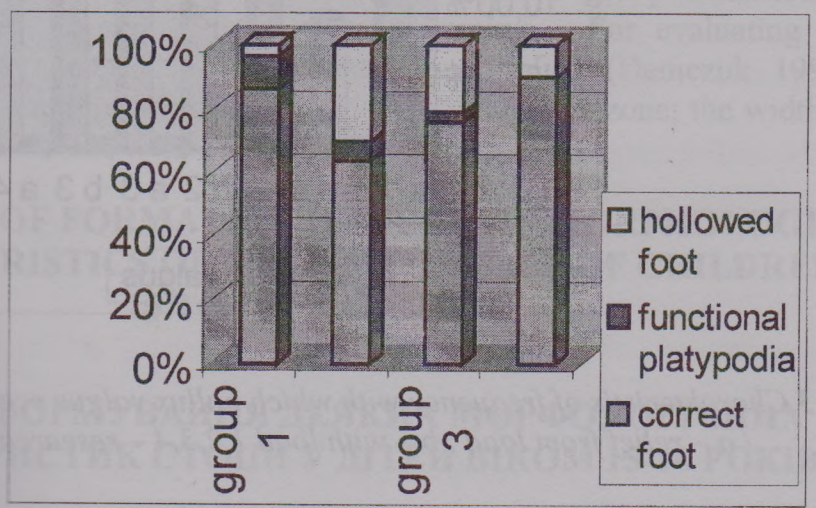
Feature		1a-1b	2a-2b	3a-3b	4a-4b	1a-2a	2a-3a	3a-4a	1b-2b	2b-3b	3b-4b	1a-4a	1b-4b	2a-4a
Right foot	I	* 5.76	* 3,62	* 2,44	0,00	0,34	0,39	0,07	0,13	0,33	0,08	0,04	0,03	0,09
	II	0,00	* 1,25	* 8,53	0,01	0.29	0,32	0,01	0,06	0,45	0,12	0,00	0,01	0,02
	III	0,00	* 1,47	* 2,03	0,03	0,25	0,23	0,02	0,07	0,47	0,21	0,01	0,04	0,02
	IV	* 2,41	* 9,53	* 4,43	0,00	0,50	0,45	0,01	0,3	0,32	0,1	0,01	0,15	0,01
	V	* 7,76	* 4,18	0,00	0,00	0,25	0,24	0,09	0,31	0,28	0,05	0,09	0,24	0,03
Left foot	I	* 4,21	* 7,60	0,00	0,01	0,34	0,17	0,03	0,11	0,43	0,05	0,00	0,00	0,02
	II	0.00	* 2,11	0,00	0,01	0,45	0,16	0,02	0,23	0,38	0,05	0,01	0,00	0,02
	III	* 7,68	*• 2,73	0,00	0,02	0,33	0,09	0,03	0,33	0,39	0,13	0,00	0,04	0,01
	IV	* 9,12	* 1.98	0,04	0,04	0.41	0,3	0.00	0,21	0,35	0,34	0,00	0,47	0,00
	V	0,00	* 1,07	0,01	0,01	0,15	0.3	0.02	0,33	0,15	0,21	0,09	0,32	0,00
Right foot	Width	0,00	0,00	0,00	0.02	0.20	0,01	6,02	0,04	0,01	0,08	0,00	0,00	0,00
	lengt h	0,00	* 2,43	0,00	* 2,96	0,27	0,03	0,05	0,24	0,01	0,1	0.00	0,00	0,00
	Alfa	0,00	0,00	0,00	0,4	0,4	0,3	0,4	0,2	0,00	0,00	0,3	0,1	0,2
	Beta	0,13	0,2	0,22	0,01	0,07	0,28	0,07	0,44	0,24	0,19	0,24	0,09	0,19
Left foot	Width	0,00	0,05	0,00	0,01	0,3	0,00	0,1	0,1	0,00	0.00	0.00	0,00	0,00
	lengt	0,05	0,09	0,05	0,00	0,37	0,02	0,04	0,27	0,03	0,11	0,00	0,00	0,00
	Alfa	0,3	0,00	0,00	0,1	0,4	0,4	0,2	0,3	0,1	0,3	0,5	0,2	0,3
	Beta	0,09	0,31	0,07	0,3	0,38	0,02	0,41	0,15	0,42	0,34	0,04	0,07	0.06

*p=0,01

Artykut 2

Tab. 1 .Characteristics of morphological structure of the feet im the case of children training swimming ,in four research groups / x - mean vaire, s -standard deviation /

Feature	Grupa 1				Grupa2				Grupa 3				Grupa 4			
	Relief from load		load		Relief from load		load		Relief from load		Load		Relief from load		load	
	X	S	X	S	X	S	X	S	X	S	X	S	X	S	X	S j
I	14,6	4,9	11,3	3,6	16,4	4	12,9	4,4	16,8	6	12,3	5,3	17,4	5,4	13,9	5,1 1
II	10,3	3,4	8,3	3,4	12.5	3,4	9,6	3.9	13	5,1	9,4	4,2	13,7	4,2	11,2	3,9
III	7,9	3,1	6,1	3,7	9,4	2,6	6,8	2,5	10	3,8	6,8	3,1	10,7	4.1	8,1	3,4
IV	4,24	2,5	2,3	1,9	6,1	2,7	3,1	2,5	6,2	3	3,4	2.3	6,2	2,6	3	2,8
V	1,4	1,5	0,1	0,4	2,1	1,9	0,6	1,2	2,4	2.2	0,4	1	2,1	1,6	0,3	0,9
I	13,6	4,8	10,5	3,7	15.9	3,7	12,6	4,9	17	6,3	12,9	5,2	17,7	4,3	14,5	4,5
II	10.1	3,9	7,7	3,2	12,2	3,3	9,5	3.9	13,4	6,3	9.8	4,1	13,3	4,3	10,5	3,2
III	7.2	3,4	5,6	2.9	8,8	2,9	6,6	3,1	10,1	4,8	6,9	3.4	10.7	4,2	7,3	2,7
IV	3,8	2,2	2.7	2,8	5,8	2,4	3,01	2.8	6,1	3,4	3,2	1,9	5.9	2,6	2,9	2,3
V	16,2	1,53	0,8	1,6	2,8	2,4	1,21	1,84	3,1	2	0,8	1,4	2,5	2,4	0,6	1,3
Width	81,7	8,5	83,7	7,6	84,1	6,3	86,6	6,9	88,1	7,8	90,4	6,7	89,8	7,2	93,8	7
Length	224	14.7	229	16,5	231	15,5	235	15,4	237	12,3	241	12	239	11,5	244	12,3
Hallu	3,6	6.9	4	6,1	4	6,8	0,2	7,1	4,9	6,3	2,8	5,2	4,5	7	6,8	1,5
Instep	17	4,4	14	7,5	14,5	6,7	15.5	5,3	15,5	7	16,4	5,9	18,3	6,7	16,7	5,3
Width	84	6,9	86	7,5	87	7,9	90	7,6	94	7,3	95	9.1	95	8,4	98	8
Length	224	14,5	228	17,1	231	13,9	234	14,5	237	11,9	239	12,8	239	11,8	241	10,6
Hallu	4,5	5,9	2,6	6,7	5,9	6,2	1,8	5,7	5,3	8,2	3,3	7	4,6	6	4,2	6,4
Instep	14,1	4,3	14,7	6,2	13,8	4,3	15.5	5,7	16,2	5,1	15,7	6	16,7	4,9	1.7,3	4,6



Characteristics of frequency with which types of longitudinal arch occur, in percentage

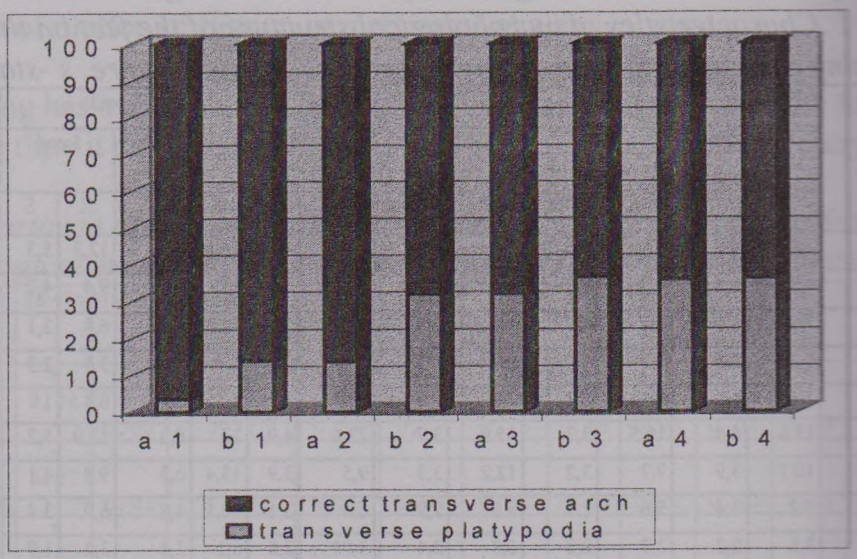


Fig.2. Charakteristics of freqvency with which transverse platypodia occurs, in percentage / a – relief from load , b – with load 1,2,3,4 – research groups

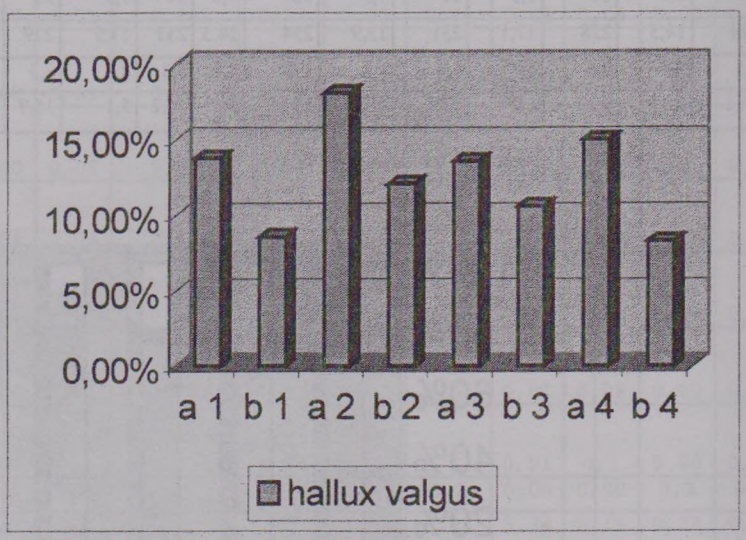


Fig.3.Charakteristis of frequency with which hallux valgus occurs , in percentage / a – relief from load , b – with load 1,2,3,4 – research groups /.

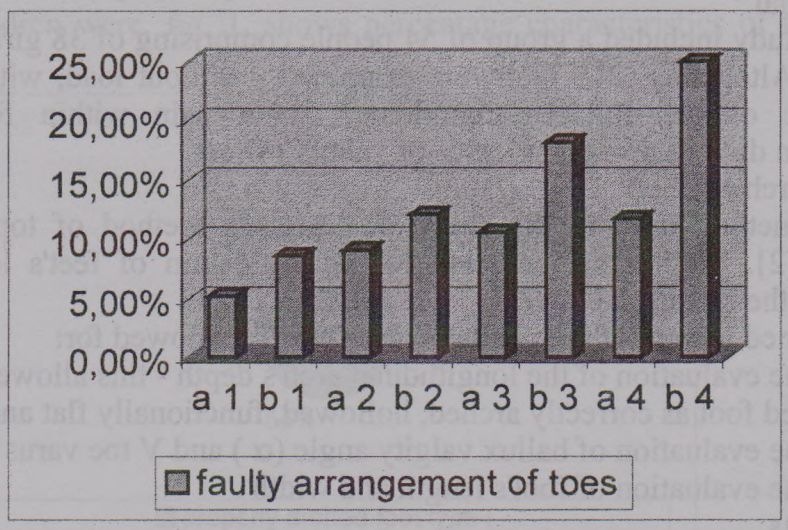


Fig.4. Characteristics of freqvency with which defects within anterior carrying zone occur , in percentage / a – relief from load , b – with load 1,2,3,4 – research groups /.

LITERATURE:

3. *DemczukE./1993/Physiotherapy Tl №2*
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SUMMARY:

The aim of the research has been to observe the changes in the shape of all the foot segments which result from swimming. The experimental group consisted of 125 children aged between 12 and 15 who train swimming. . For evaluating the foot architecture the biostereometrical method has been applied (Demczuk 1998). The longitudinal foot arch, the transversal foot arch, the front carrier zone; the width, length, and the size of the sole surface were evaluated.

THE PROCESS OF FORMATION OF CERTAIN MORPHOLOGICAL CHARACTERISTICS OF FEET IN THE CASE OF CHILDREN 15 TO 16 YEARS OLD

ПРОЦЕС ФОРМУВАННЯ ДЕЯКИХ МОРФОЛОГІЧНИХ ХАРАКТЕРИСТИК СТОПИ У ДІТЕЙ ВІКОМ 15-16 РОКІВ

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In the following study, a bio-stereo-metric method based on Moire's effect was employed. The method enables to record three - dimensional shape of plantar side of the foot. This makes it possible to determine depth of the longitudinal plantar arches and classify the foot as hollowed, correctly arched and flat. Furthermore, this method gives an