

Kashuba Vitaliy, Afanasiev Dmitriy. Dynamics indicators of supporting - spring properties of a foot in the children of primary school age with derivation of hearing during process of adaptive physical education under influence of author's technology on prevention of violations the biomechanical properties of foot. *Pedagogy and Psychology of Sport*. 2020;6(4):56-63. eISSN 2450-6605. DOI <http://dx.doi.org/10.12775/PPS.2020.06.04.006>
<https://apcz.umk.pl/czasopisma/index.php/PPS/article/view/PPS.2020.06.04.006>
<https://zenodo.org/record/4276300>

The journal has had 5 points in Ministry of Science and Higher Education parametric evaluation. § 8. 2) and § 12. 1. 2) 22.02.2019.

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 01.11.2020. Revised: 16.11.2020. Accepted: 16.11.2020.

DYNAMICS INDICATORS OF SUPPORTING - SPRING PROPERTIES OF A FOOT IN THE CHILDREN OF PRIMARY SCHOOL AGE WITH DERIVATION OF HEARING DURING PROCESS OF ADAPTIVE PHYSICAL EDUCATION UNDER INFLUENCE OF AUTHOR'S TECHNOLOGY ON PREVENTION OF VIOLATIONS THE BIOMECHANICAL PROPERTIES OF FOOT

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Abstract

The global trend of increasing number of people with special needs encourages the scientific community to search effective pedagogical methods and techniques aimed at mobilizing all compensatory opportunities that will contribute to the successful socialization of students with hearing impairments at the present stage. **Objective.** In general, number of respondents involved in the sequential conversion phase of the experiment reflected on the children of 7 years old (n=37). **Methods.** In the given research uses: analysis of professional

scientific and methodological literature, pedagogical observation; anthropometry, photometry. In the determining somatotype by W.H. Sheldon (digestive, muscular, thoracic, asthenoid) main attention was focused on the development and ratio of such features as a shape of back, chest, abdomen, legs, the amount of development a bone, muscle and adipose tissue. Tables of M.O. Friedland were used to estimate height of the foot arch by the methods of mathematical statistics. **Results of the study.** Technology of prevention violations of biomechanical properties of foot in the children of primary school age with deprivation of sensory systems in the process of physical education is based on the following structural components: organizational, diagnostic, methodological, control and correctional, informational and effective. Technology includes the following stages: preparatory, basic, supporting. The study dynamics of support-spring properties of foot in children of 7 years old with hearing deprivation under the influence of author's technology showed that in the boys rate of increase of a foot length exceeded rate of increase of a foot length in the girls. Generally, average rate in the boys increased on 3.02% (from (178.97; 4.37) to (184.38; 4.07) mm), and in the girls a median value increased on 2.81% (from (178.28; 175.66; 193.88) to (183.28; 180.66; 198.88) mm). **Conclusions.** Results of a sequential conversion experiment confirmed effectiveness of a developed technology. Regardless the type of physique in children of both sexes there was an improvement of the support-spring properties of a foot, i.e. after implementation of a proposed author's technology had a positive effect on the children with hearing deprivation in all types of body structure. Distribution of children with hearing deprivation by the size of foot arch according to the stage of research showed that after the experiment a share of boys with normal feet by the angle of arch increased on 40.9 and the girls – on 53.3%. Regarding the distribution of children with hearing deprivation by value of a Friedland podometric index, at the end of experiment, percentage of boys with normal feet increased on 40.9, and the girls – on 46.7%.

Key words: children of primary school age, support-spring properties of foot, deprivation, hearing, technology.

Problem formulation. Human musculoskeletal system, from a point of view of biomechanics, is the system of biokinematic chains, all parts of which are united in the biokinematic pairs and have interconnections that determine their external freedom of movement [4, 5, 6].

The most important structural segments of a human musculoskeletal system include the foot, in the architecture of which phylogenetically provides a certain reliability of structural units that provide a stato-locomotor function and reflects a holistic morpho-functional object – determinant of a motor function [4, 5, 6, 13].

Diseases and injuries of the support organs, in a wide range of which quantitatively and qualitatively outlines changes in the biomechanical properties of a foot [3, 4, 5, 6, 8, 15].

The problem of assessing geometry of a bone and joint components of the human foot belongs to the field of a fruitful scientific research for theorists and practitioners in the given field for many decades [4, 5, 6, 12, 16].

Analysis of recent research and publications. The global trend of increasing number of people with special needs encourages the scientific community to search for effective pedagogical methods and techniques aimed at mobilizing all compensatory opportunities that will contribute to the successful socialization of students with hearing impairments at the present stage [1, 2, 11].

According to the scientific research [2, 11, 14] it is determined that the basic task in working with children with special needs is to prevent and overcome negative trends that cause childhood disability, providing necessary prerequisites for their full physical, intellectual, spiritual, moral development and social adaptation, which will contribute to the implementation of both constitutional norms and Ukraine's international obligations to the world community.

Increased attention of researchers to diseases and disorders of the supporting organs is due to a high frequency of functional changes in the human musculoskeletal system, decreased strength and muscle tone, loss of ability to move normally, and thus – escalation of risks for a permanent disability [4, 7].

Research was performed in accordance with thematic research plan in the Dnipropetrovsk State Institute of Physical Culture and Sports during 2016-2020 years "Scientific and theoretical principles of improving process of physical education in the different groups" (state registration number 0116U003010).

Objective. In general, number of respondents involved in the sequential conversion phase of the experiment reflected on the children of 7 years old (n=37).

Methods and organization of the study. Theoretical methods included analysis and generalization of scientific and methodological literature, Internet data, documentary materials; instrumental: using a footmeter measured length of the foot (distance between the heel and end points), width of a foot (distance between the metatarsal points), when determining somatotype – by W.H. Sheldon [5]: digestive, muscular, thoracic, asthenoid). The main attention focused on the development and ratio of such features as a shape of back, chest, abdomen, legs, amount of development a bone, muscle and adipose tissue. The method of photometry "BIG FOOT" [7, 8] is used to determine the linear (length of the foot, maximum height of the foot arch, height of the foot) and angular (angle α – metatarsal angle, angle β – heel angle, angle γ – angle, which characterizes the support-spring properties of a foot in general) parameters of the foot. Tables of M.O. Friedland used to estimate height of the foot arch.

Representation average indicators of the support-spring properties of a foot was performed by using a median Me and the interquartile range, i.e. interval from 25 to 75 percentiles.

Taking into account a form of distribution in order to compare changes that occurred in the indicators during the experiment, we chose a parametric Student's t-test for dependent samples or non-parametric paired Wilcoxon T-test. The statistical significance of last one was determined by comparing z-value with 1.96.

All these calculations were performed with using Microsoft Excel XP 2010 application package, as well as using a software package for statistical analysis Statistica 7.0, developed by StatSoft, USA.

The research conducted during 2018-2019 years in the Department of Theory and Methods of Sports Training of Dnipropetrovsk State Institute of Physical Culture and Sports, and in the municipal educational institution "Multidisciplinary educational and rehabilitation resource-methodical center of correctional work and inclusive education".

During planning of the conversion experiment for a choice of the research contingent, state of the support-spring properties of a foot in the children of 6 – 8 years with hearing derivation, depending on the age and gender studied. The study showed that in both groups among boys and girls in this category the most alarmed were children of 7 years old. Indeed, in the general sample of children with hearing derivation, the largest share of children with disorders in the foot arch, according to the pedometric index by Friedland is concentrated among 7-year-old children. Technology of prevention violations the biomechanical properties of a foot in the children of primary school age with deprivation of sensory systems in the

process of physical education is based on the following structural components: organizational, diagnostic, methodological, control and correctional, informational and effective. The technology includes the following stages: preparatory, basic, supporting.

Results. The study dynamics of the support-spring properties of a foot in the children of 7 years old with hearing derivation under influence of the author's technology showed that in the boys rate of increase a foot length exceeded rate of increase a foot length in the girls. Primary, average rate in the boys increased on 3.02% (from (178.97; 4.37) to (184.38; 4.07) mm) and in the girls a median value increased on 2.81% (from (178.28; 175.66; 193.88) to (183.28; 180.66; 198.88) mm). Moreover, in the future, an average data are presented in the form $(\bar{x}; S)$, if they undegone to a normal law of distribution and such values (Me; 25; 75) otherwise. Similarly, taking into account a form of distribution in order to compare changes that occurred in the indicators during experiment, we chose the parametric Student's t-test for dependent samples or non-parametric paired Wilcoxon T-test. Statistical significance of the last criteria was determined by comparing z-value with number 1.96. Thus, for both boys ($t = -34.559$) and the girls ($T=0; z=3.408$) was proved a statistically significant ($p < 0.05$) increase in a foot length.

Evaluation dynamics of a height in the upper edge of navicular bone above the support of the given subjects allowed obtaining the following results:

- in the boys, median value increased on 8.91% (from (50.5; 49.0; 52.0) to (55.0; 53.0; 57.0) mm) and this increasing was statistically significant ($p < 0.05; T = 0; z = 4.107$);
- in the girls average value increased on 9.07% (from (50.53; 4.03) to (55.07; 4.22) mm) and it was statistically significant ($p < 0.05; t = -19.179$).

The observed dynamics of mold angle in the alpha participants of the experiment was as follows:

- in the boys, average rate was statistically significant ($p < 0.05; t = -17.095$) increased on 22.64% (from (20.27; 2.25) to (24.86; 2.14) degrees);
- in the girls, average value of indicator increased on 26.32% (from (19.0; 2.24) to (24.0; 2.80) degrees) and this increasing was statistically significant ($p < 0.05; t = -20.917$).

The study was able to trace the following changes in a beta heel angle at the boys: median value is statistically significant ($p < 0.05; T=0; z=4.107$) increased on 11.11% (from 27.0; 22.0; 29.0) to (30.0; 27.0; 32.0) mm).

In the girls average value of this indicator increased on 18.40% (from (26.80; 3.75) to (31.73; 3.77) degrees) and it was statistically significant ($p < 0.05; t = -32.187$).

The positive dynamics was shown at the support-spring properties of a foot in the children of 7 years old with hearing derivation, which led to the positive changes in the angle of foot arch gamma. In particular, in the boys the median value of this angle decreased on 7.09% from (134.0; 130.0; 139.0) to (124.5; 122.0; 130.0) degrees. The statistical significance ($p < 0.05$; $T = 0$; $z = 4.107$) of the changes that occurred was proved. However, in the girls average statistically significant ($p < 0.05$; $t = -17.095$) decreased on 7.4% (from (134.20; 4.62) to (124.27; 4.89) %).

Under influence of the author's technology after experiment, there was shown an improvement state of a feet in the children with hearing derivation according to the Friedland index:

- in the boys, an average rate was statistically significant ($p < 0.05$; $t = -12.032$) increased on 5.72% (from (28.15; 1.63) to (29.76; 1.73)%);
- in the girls, median value of the indicator was statistically significant ($p < 0.05$; $T = 0$; $z = 3.408$) increased on 5.84% (from (27.89; 27.34; 28.61) to 29.52; 28.57, 30.55)%.

Moreover, median values by Friedland index in the girls of different body types increased approximately equally, and in the boys with asthenoid and muscular types a faster rate than in the boys with thoracic and digestive body types.

Conclusions. Thus, regardless a type of body structure in the children of both genders there is shown improvement of the support-spring properties of a foot, i.e. means of the proposed author's technology had a positive effect on the children with hearing deprivation in all types of body.

Distribution of children with hearing derivation by the size of foot arch according to the stage of study showed that after experiment a share of boys with normal feet by the angle of arch increased on 40.9 and the girls – on 53.3%.

Regarding the distribution of children with hearing derivation by value of Friedland podometric index, at the end of experiment, percentage of boys with normal feet increased on 40.9, and the girls – on 46.7%.

The obtained results testify the effectiveness of a proposed author's technology and recommending it for prevention and correction the numerous disorders of the support-spring properties of a foot in the junior schoolchildren with hearing derivation.

References

1. Afanasieva, O.S. Physical rehabilitation of hearing-impaired middle school children with posture disorders [dissertation]. Kyiv, Ukraine; National University of Physical Education and Sport of Ukraine; 2014. 20 p.

2. Burdaiev, K.V. Biological preconditions for the development of technology for the formation of statodynamic posture of children of primary school age with hearing impairments in the process of adaptive physical education. *Naukovyi chasopys: zb. naukovykh prats.* 2018; 11(105):21-26.
3. Valkevych, A.V., Bychuk, A.Y. Influence of the program of prophylaxis of violations of vaults of foot on the sagittal profile of foot for the children of midchildhood. *Pedagogy, psychology and medical and biological problems of physical education and sports.* 2012; 6:36-41.
4. Vypasniak, I., Samoiliuk, O. Bimechanical properties of the foot of young athletes as a prerequisite for the development of physical rehabilitation technology. *Youth Scientific Bulletin of the Lesia Ukrainka East European National University. Physical education and sports.* 2019:20-8.
5. Yedynak, H.A., Zubal, M.V., Mysiv, V.M. Somatotypes and development of physical qualities of children. 2011. *Omiom, Kam'yanets-Podilskiy*: 80 p.
6. Kashuba, V.A., Sergienko, K.N. Technologies for biomechanical monitoring of the state of the support-spring function of the human foot. *Materials of the I International Scientific and Practical Conference "Biomechanics of the Human Foot; Grodno, 2008.* p. 32-4.
7. Kashuba, V. & Popadiukha, Yu. (2018). *Biomechanics of human body spatial organization: modern methods and means of diagnostics and infringement renovation: monograph.* K. Centre of Educational Literature. 768 p.
8. Sergienko, K.N. (2003). *Control and prevention of violations of the support-spring properties of the foot of schoolchildren in the process of physical education [dissertation].* Kyiv, National University of Physical Education and Sport of Ukraine; 2003. 205 p.
9. Kashuba V., Lopatskyi S. The control of a state of the static and dynamical posture of a person doing physical exercises. *Journal of Education, Health and Sport.* 2017; 7(4): 963-74.
10. Kashuba V., Lopatskyi S., Vatamanyuk S. The control of a state of the static and dynamical posture of a person doing physical exercises. *Journal of Education, Health and Sport.* 2017 ;7(5):1075-85.
11. Kashuba V., Savlyuk S. Structure and content of the technology of prevention and correction of disturbances of spatial organization of the body of children 6-10 years old with sensory systems deprivation. *Journal of Education, Health and Sport.* 2017;7(8):1387-407.

12. Kashuba V.O., Lopatskyi S.V. Theoretical and practical aspects of monitoring human posture spatial organization. Ivano-Frankivsk: Editor Kushnir G.M., 2018. 232 p.
13. Kashuba V., Andrieieva O., Goncharova N., Kyrychenko V., Karp I., Lopatskyi S., Kolos M. Physical activity for prevention and correction of postural abnormalities in young women. *Journal of Physical Education and Sport*® (JPES), Vol 19 Art 73, 2019, pp 500-506.
14. Formela, M., Skalski, D., Grygus, I., Nesterchuk, N., Lizakowski, P. Bezpieczeństwo społeczności lokalnych w kontekście roli rodziny i szkoły w organizacji czasu wolnego dzieci i młodzieży [Safety of the local communities in the context of the role of the family and the school in the organization of the leisure time of children and teenagers]. *Medycyna i społeczeństwo*. 2018; 113-125. (in Polish).
15. Mykhaylova N., Grygus I., Prusik K., Prusik Ka. Enhancement of Functional State of Children with Congenital Clubfoot via Physical Rehabilitation. *Theory and Practice of Physical Culture*. 2014. № 3. P. 30-32.
16. Nesterchuk N, Grygus I, Prusik K, Zukow W. The technique of physical rehabilitation in clubfoot. *Physiotherapy Quarterly*. 2019, 27(1), 25–34. <https://doi.org/10.5114/pq.2019.83058>