COMPARATIVE ANALYSIS OF FOOT SUPPORT-SPRING INDICATORS OF PRIMARY SCHOOL AGE CHILDREN WITH WEAK EYESIGHT IN PHYSICAL EDUCATION PROCESS
Juha Habіb, Yurchenko A.A., Sergіenko K.N.
National University of Physical Education and Sport of Ukraine

Abstract. **Purpose:** to fulfill comparative analysis of foot support-spring indicators of schoolchildren with weak eyesight. **Material:** in the research 7-10 years’ age children (n=76) with weak eyesight participated. The children learn in specialized boarding school. **Results:** we found statistically confident differences between some foot support-spring indicators of primary school children with weak eyesight and their practically healthy children. It was registered that primary school children had weaker muscles and ligaments of lower limbs. The reason can be insufficient motor functioning and muscles’ stiffening in moving in space as well as the absence of exercises for prophylaxis of foot functional disorders. **Conclusions:** we determined that there is demand in working out and implementation of practical recommendations in physical education process of schoolchildren with weak eyesight. Physical education process shall be oriented on educational aims, on application of health related correcting and compensatory-prophylaxis physical exercises. Such approach will positively influence on correction of foot support-spring disorders. **Key words:** primary school pupil, eyesight, weakened, foot.

**Introduction**
Muscular skeletal apparatus has a lot of functions, the most important of which are ensuring of support, protection and movements of human body. Every of these functions provide different biological and morphological structures. In this connection many skeleton and muscles’ system morphological formations participate in realization of the whole complex of morphological functional organs and systems [2, 7, 11, 12, 26, and 27].

Such motor abilities as standing and locomotion are of special importance for assessment of human biological condition. They are indicators of his (her) adaptation mechanisms to environmental conditions. It is important both: in phylogeny and ontogeny aspects [3, 8, 9, 13, 21-25]. In conditions of natural locomotion foot serves as support and ensures organization of spring interactions of human body with surface. It means that in foot motor mechanisms great potentials of spring-ductile properties of the whole lower limb are embedded [1, 5, 11, 12, 28-31].

Study of foot adaptation potentials in sports and physical culture practicing is rather important for assessment of foot’s functional-morphological characteristics. Under influence of physical exercises, foot can significantly deform. Often it results in undesirable after effects in dynamic of ordinary walk and in progressing of foot pathologies. That is why, detail and profound study of foot motor potentials in different conditions of its motor function’s organization acquires high methodological importance. It requires organization of specialized control over foot morphological functional state in period of active sports or physical culture practicing [5, 8, 11, and 12].

Analysis of special scientific-methodic literature showed that practically all specialists point that children with visual analyzer problems have secondary disorders of health, as well as related deviations of morphological-functional systems in work of muscular-skeletal apparatus. Among functional disorders of muscular-skeletal apparatus, primary school pupils with weak eyesight had disorders of carriage and support-spring properties of foot [6, 14, 17, 19, and 20]. Among many researches we can mention the works of K.N. Sergiyenko [11, 12]. The author determined interconnection of lower limbs geometry and bio-mechanical properties of skeleton muscles, ensuring foot functional resistance of primary school age children. A.A. Dyachenko [5], in the process of her researches found that primary school age children with weak eyesight lag behind their practically healthy peers by somatic metrical characteristics (p<0.05). It was found that the most expressed lagging of primary school children with weak eyesight had by characteristics of foot support-spring properties: height of foot arch, forefoot and heel angles. N.L. Nosova [9] determined the height of foot arch in practically healthy primary school pupils. Analysis of the researches showed that all data were presented fragmentary and did not reflect the whole depth of the problem. In our researches, in the process of stating experiment we studied the whole number of quantitative data. These data completely characterize foot support-spring properties of primary school age pupils with weak eyesight. Among them the main are: foot length

doi:10.15561/18189172.2016.0209
and height, length of foot supporting part, expressiveness of arch, height of ankle, foot rise, angles of support and spring foot arches, Freedland’s index.

**Purpose, tasks of the work, material and methods**

*The purpose of the work* is to fulfill comparative analysis of foot support-spring indicators of schoolchildren with weak eyesight and find statistically most significant differences.

*The tasks of the work:*
1. To analyze special scientific-methodic literature and determine importance of the problem of foot support-spring functional disorders in 7-10 years’ age children with weak eyesight.
2. To fulfill comparative analysis of some foot support-spring indicators of primary school pupils with weak eyesight and their practically healthy peers.
3. To determine the most significant statistically confident distinctions in indicators of foot support-spring properties of primary school age children with weak eyesight by the data of different authors.

*Material and methods of the research:* analysis of special scientific-methodic literature, pedagogic observation, pedagogic experiment with the help of methodic «BIG FOOT» and «FOOT SPRINT», methods of mathematical statistic.

**Results of the research**

In our research we found angle characteristics, which play important role in formation of body vertical stability and human locomotion function: forefoot angle (angle between supporting part line and straight line, connecting the head of first forefoot bone with point of arch maximal height); heel angle (angle between supporting part line and straight line, connecting supporting calcaneal tuberosity with point of arch maximal height). Results were received in the process of digitization of feet images in program «BIGFOOT» [11, 12]. For comparative analysis of angle characteristics of foot support-spring properties we found and studied analogous indicators of other researches (see table 1).

| Table 1. Angle characteristics’ indicators of foot support-spring properties of primary school age children |
|---------------------------------|------|------|------|------|------|------|------|------|------|------|
| Age, years | Indicators | Angle $^\circ$ | Angle $^\circ$ |
|------|------|------|------|------|------|------|------|------|------|------|
| 7 | 8 | 9 | 10 | 7 | 8 | 9 | 10 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Adel Ben Zheddu Ben Larbi [1] | $\bar{x}$ | 22.85 | 23.20 | 24.77 | 24.67 | 27.13 | 27.57 | 27.80 | 28.27 | |
| $\bar{s}$ | 2.51 | 2.76 | 3.24 | 3.08 | 3.35 | 3.84 | 4.61 | 3.96 | |
| A.A. Dyachenko [2] | $\bar{x}$ | 21.96 | 23.27 | 23.29 | 24.0 | 24.9 | 26.23 | 28.52 | 27.75 | |
| $\bar{s}$ | 1.92 | 1.15 | 1.10 | 1.83 | 5.15 | 2.39 | 4.89 | 3.65 | |
| Results of our researches | $\bar{x}$ | 15.04 | 20.70 | 13.54 | 12.86 | 23.0 | 20.89 | 20.85 | 18.97 | |
| $\bar{s}$ | 3.19 | 2.96 | 3.53 | 3.53 | 5.90 | 5.91 | 5.10 | 5.71 | |

The data of table 1 point that results of our researches of 7-10 years’ age children with weak eyesight significantly lag behind by indicators of angle $^\circ$ and angle $^\circ$ from practically healthy children [1, 4, and 5]. It should be also pointed that we studied angle characteristics of foot support-spring properties both: right and left feet. The data of other authors are presented only ion right foot. That is why we fulfilled comparative analysis only by indicators of right lower limb.

Thus, it is obvious that it is necessary to work out and implement experimental program of prophylaxis of foot support-spring disorders in primary school age children with weak eyesight.
During phylogeny development human foot has significantly changed due to its adaptation to vertical movement. Owing to relative lengthening of tarsus and shortening of forefoot foot turned into organ of support. It was facilitated by development of longitudinal and lateral arches, strengthened by powerful ligaments and kept by tonus of foot muscles. Foot arches ensure characteristic springiness, which significantly soften pushes of foot on ground in walk, run or jumps [2, 3, 8, and 15]. That is why foot arch-type construction is the most important specificity of human foot as well as height of arches. Comparison of received by us values of foot arches of children with weak eyesight with practically healthy children’s indicators is shown in table 2.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Right foot</th>
<th>Left foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>L.N. Nosova [4]; practically healthy children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>29.0</td>
<td>31.0</td>
</tr>
<tr>
<td>$S$</td>
<td>2.2</td>
<td>3.3</td>
</tr>
<tr>
<td>A.A. Dyachenko [3]; primary school pupils with weak eyesight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>26.39</td>
<td>27.54</td>
</tr>
<tr>
<td>$S$</td>
<td>1.06</td>
<td>1.75</td>
</tr>
<tr>
<td>Results of our own researches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>20.72</td>
<td>20.35</td>
</tr>
<tr>
<td>$S$</td>
<td>4.80</td>
<td>5.13</td>
</tr>
</tbody>
</table>

In this aspect it is interesting to compare the heights of foot arches. Spring oscillations of foot arch protect organism from rough pushes and shaking during walking. Disorders of foot spring properties are caused by overloads and over-fatigue of muscles.

Comparative analysis of foot arches characteristics of primary school age children with visual analyzer pathologies and practically healthy peers showed that they have statistically confident differences. It witnesses that in this indicator pupils with weak eyesight demonstrate the lowest results. Such tendency exists in every age period. For example, 7 years’ age children with weak eyesight, by our data, have foot arch of right leg by 9 mm less than practically healthy children [4, 5, and 9]. In left leg mean statistic difference reaches 10 mm, comparing with children with weak eyesight and 12 mm, comparing with practically healthy children.

In children of 8 years’ age we observed statistically confident difference ($p<0.05$) between data of right and left feet. Difference is 7 mm between peers with weak eyesight and 11 mm, comparing with healthy children. The highest difference between indicators of foot arch of children with weak eyesight and indicators of practically healthy children was observed in 10 years’ age on left foot – 13 mm. Such significant difference between indicators justifies implementation of correcting prophylaxis means with application of technical equipment in physical education practice. Application of such equipment is oriented on improvement of foot support-spring properties of schoolchildren with weak eyesight. Regular medical examinations shall assess effectiveness of such physical exercises’ prophylaxis complexes. The purpose of these examinations – determination of tendencies to improvement of foot arch characteristics and reduction of flat foot risk.

Analysis of special scientific-methodic literature [6, 15, 16, 17, and 20] witnesses that at present time little attention is paid to rising generation’s physical condition. In opinion of leading specialists in physical culture [10, 13, 14], physical education means are very powerful factor of disorders correction and prophylaxis of morphological functional deviations in child’s health. Sports and physical culture practicing facilitate development of child’s motor abilities and skills and improve muscular skeletal apparatus morphological and functional indicators. Among them the main are: improvement of muscular tonus, respiratory and cardio-vascular systems. Keeping of vertical posture in
static and dynamic exercises facilitate correct carriage, mobility of ligament-muscular apparatus, strengthening of foot support-spring properties.

**Discussion**

Study of foot support-spring properties of school age children with weak eyesight is caused by urgency of such researches. Analysis of scientific literature points at principle importance of foot support-spring properties’ development in schoolchildren with weak eyesight [2, 4, 5, and 7]. The authors think that “foot is pedestal of body”. That is why any disorders influence negatively on effectiveness of the whole muscular-skeletal apparatus work.

In our research we found the whole number of statistically confident distinctions, comparing with practically healthy children. It witnesses that children with weak eyesight have weaker muscles and ligaments of lower limbs. The reason of it can be insufficient motor functioning, muscles’ stiffening in movements as well as absence of prophylaxis exercises, which would prevent from foot functional disorders. It of common knowledge, that children with visual analyzer’s pathologies have secondary disorders and deviations from normal functioning of muscular skeletal system. Among them we can name: disorders of carriage, flat foot, joints’ limited mobility. Thus, physical education process for such contingent shall be directed to educational activity, application of correcting-health related means, compensatory-prophylaxis physical exercises.

**Conclusions:**

Analysis of special scientific-methodic literature showed that normal functioning of foot is the main precondition of muscular-skeletal apparatus effective work.

Different authors stated that primary school age children with weak eyesight lag behind in indicators of physical condition, physical fitness and functional disorders of muscular skeletal apparatus. It also relates to foot support-spring properties.

Comparative analysis of quantitative data, received by different authors, confirms the results of our experiment. The experimental data witness that children with visual analyzer’s problems lag behind from their healthy peers in indicators of foot support-spring properties.

**Acknowledgements**

The work has been fulfilled in compliance with combined plan in sphere of physical culture and sports for 2010-2015 of Ministry of education and science, youth and sports of Ukraine by topic 3.7 “Perfection of biomechanical technologies in physical education, rehabilitation and sports, considering individual features of human motor system” (state registration number 0111U001734).

**References**


2. Bondar’ EM. Korrektsiiia funktsional'nykh narushenij oporno-dvigatel'nogo apparata detej 5-6 let s uchetom prostranstvennoj organizacii ikh tela. Cand. Diss. [Correction of muscular-skeletal apparatus functional disorders in 5-6 years’ age children, considering space organization of their bodies. Cand. Diss.], Kiev; 2009. (in Russian)


6. Evseev SP. Teoriia i organizaciia adaptivnoj fizicheskoj kul'tury [Theory and organization of adaptive physical culture], Moscow; 2007. (in Russian)


17. Shapkova LV. Chastnye metodiki adaptivnogo fizicheskogo kul'tury [Special methodic of adaptive physical culture], Moscow: Soviet sport; 2007. (in Russian)


20. Iurchenko OA. Korekciia porushe'n statodinamichnochii postavi ditej molodshogo shkil'nogo viku z poslablennim zorom u procesi fizichnogo vikhovaniia [Correction of static-dynamic carriage disorders of primary school age children with weak eyesight in process of physical education], Pedagogics, psychology, medical-biological problems of physical training and sports, 2012;10:80–83.


Information about the authors:

Juha Habib; http://orcid.org/0000-0002-4537-1724; kinesiology@ukr.net; National University of Physical Education and Sport of Ukraine; Fizkultury str. 1, Kiev, 03680, Ukraine.

Yurchenko O.A.; http://orcid.org/0000-0003-0167-259X; sashajurchenko@mail.ru; National University of Physical Education and Sport of Ukraine; Fizkultury str. 1, Kiev, 03680, Ukraine.

Sergienko K.N.; http://orcid.org/0000-0001-9199-6007; miytrener@gmail.com; National University of Physical Education and Sport of Ukraine; Fizkultury str. 1, Kiev, 03680, Ukraine.

Cite this article as: Juha Habib, Yurchenko A.A., Sergienko K.N. Comparative analysis of foot support-spring indicators of primary school age children with weak eyesight in physical education process. Pedagogics, psychology, medical-biological problems of physical training and sports, 2016;2:59–65. doi:10.15561/18189172.2016.0209

The electronic version of this article is the complete one and can be found online at: http://www.sportpedagogy.org.ua/html/archive-e.html

This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (http://creativecommons.org/licenses/by/4.0/deed.en).

Received: 18.01.2016
Accepted: 22.02.2016; Published: 28.02.2016