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A COMPARISON OF BODY BALANCE OF BLIND CHILDREN AGED 7-16 YEARS IN SEX AND AGE CATEGORIES

Key words: blind, body balance, postural stability.

ABSTRACT

The aim of the work was to compare body balance in a standing position of the blind (6-17 years of age) in sex and age categories as well as to evaluate the relations between the somatic development of the subjects and their balance in a standing position. Sixty students from the Primary School and Lower Secondary School of the Education Centre in Laski took part in the tests. Tests consisted of standing on a stabilographic platform for 30 seconds in natural both legs standing. Drawing on the comparative analysis, no statistically significant differences between posturographic parameters measured in girls and boys from the younger and older groups of subjects were found. Together with the biological development (increase in body height and mass), the stability of a body posture in a standing position in children aged 6-11 is improving.

INTRODUCTION

A vertical positioning of the body axis in relation to a supporting plane, characteristic of a body posture, often causes the loss of balance [1, 3]. To maintain a firm upright posture, necessary to perform many motor and sensory activities, an effective system of body posture control has been developed known as the sense of balance. Kuczyński [4] presents balance as a particular motor activity conditioned by an accurate cooperation of all body segments that takes place unconsciously as a result of dynamic processes. The movement apparatus forms a morphological basis of regulation, whereas the nervous system has a steering function. There have been many works concerning the process of maintaining body balance in healthy people with full visual control as well as without it. Research results showed, inter alia, that with eyes closed the deflection ranges of the stabilogram curve are bigger [3, 9, 10]. In practice it means a deterioration in body stability. It was also stated that a logarithmic deterioration in visual acuity leads to a linear increase in posture instability [9, 10]. The lack of visual control of a movement during the development of motor abilities causes an improper formation of motor coordination [3, 10]. Visual impairment leads to the development of compensation mechanisms by other non-visual sensory systems (senses), especially somatosensory but also the vestibular one, or even the hearing system – sound perceptions [6, 10].

The process of maintaining balance in a standing position by a child has not been sufficiently examined yet. According to some authors, a synergic organisation of a posture as well as vestibular processes reach adult levels in children aged 7, and this period has to be acknow-

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ledged as a critical age in posture development [2]. Research into balance development proved that the ability to control a standing position is already fully developed in 12-year-old children [2]. According to Ljach [5], static and dynamic balance reaches its peak development in 17-year-old girls and in 15-year-old boys. Raczek et al. [8] maintain that on average this ability is better formed in women. This phenomenon is explained by the fact that in the case of women the gravity centre is positioned at a lower level. However, it was also noticed that a supporting surface, i.e. the size of feet, is proportionally smaller. In their study, Ribadi and Rider [9] observed the lack of characteristic differences in a standing position between girls and boys.

In literature there are many observations concerning balance development in ontogenesis, as well as dimorphic differences in the sphere of maintaining body balance in a standing position. Those works mainly deal with the disabled. Taking into consideration the fact that maintaining body balance plays a key role in the development of motor abilities, physical fitness and spatial orientation in the blind, it seems relevant to continue scientific research in this field. Apart from comparisons of the level and dynamics of the development of maintaining a stable position in the sighted and in the blind, it is necessary to look for relations characteristic only of this group by comparing people with visual dysfunction mainly with one another. The aim of the work was to compare body balance in a standing position of the blind (6-17 years of age) in sex and age categories as well as to evaluate the relations between the somatic development of the subjects and their balance in a standing position.

METHODS

Sixty students from the Primary School and Lower Secondary School of the Education Centre in Laski took part in the tests. The subjects were totally blind and the eyesight loss occurred before the age of 5.

The tests consisted of natural standing on a stabilographic platform for 30 seconds in natural both legs standing. The evaluation of basic anthropometric characteristics of blind children was based on the school records, which included measurements of body height (BH), body mass (BM). The ponderal index (PI) was calculated. Also, the measurements concerning the amount of adipose tissue were made with the aid of the apparatus used to define body composition – FUTREX 5100. Analysis of variance was carried out as well as the significance of differences between the groups of blind boys was evaluated with the help of the t-Student test. Owing to the fact that in some cases small deviations from a regular set occurred, the distribution of sets was verified by means of non-parameter rank signs tests of Wilcoxon and Kruskal-Wallis. To analyse the correlations between selected morphological parameters and posturographic tests, Pearson's simple correlation coefficients as well as partial correlation coefficients were used.

RESULTS

In the analysis of particular posturographic parameters no statistically significant differences between the group of blind girls and boys were found in most cases (Tab. 2). The only exception

Table 1. The characteristics of the examined groups in relation to the number, age and basic morphological parameters

	Girls [n=36]	Boys [n=24]	Children 6-11 aged [n=27]	Young 12-17 aged [n=33]
Age	11.4 ± 3.3	12.1 ± 3.1	8.7 ±1.3	14.2 ± 1.9
Body height [cm]	144 ± 13	152 ± 18	134 ± 9	159 ± 9
Body mass [kg]	39.2 ± 11.6	45.1 ± 16.0	31.2 ± 7.3	50.0 ± 11.8
FAT [%]	24 ± 6	22 ± 6	21 ± 4	24 ± 7
Ponderal Index	43 ± 2	43 ± 3	43 ± 2	43 ± 2

was the speed of the gravity centre movements in a coronal plane. This value was significantly lower in girls than in boys. Drawing on the comparative analysis, no statistically significant differences between posturographic parameters measured in the younger and the older groups of subjects were found (Tab. 2).

The correlation analysis of basic parameters of body build and age as well as posturographic parameters in particular groups of the blind (boys, girls, younger and older children) revealed correlations only in the group of younger children aged 6-11. Age, height and body mass were correlated with most posturographic parameters in this group (Tab. 3). The older, taller and heavier the children were, the lower the values of particular parameters. This means that the stability of the body posture in the examined was better.

Table 2. The comparison of posturographic parameters in blind children in sex and age categories

Compared group / posturographic parameters	Girls [n=36]	Boys [n=24]	p	Children 6-11 aged [n=27]	Young 12-17 aged [n=33]	p
Average of deflection radius [mm]	2.6 ± 1.2	2.7 ± 0.8	ns	2.7 ± 1.1	2.6 ± 1.0	ns
Developed area [mm^2]	259 ± 154	279 ± 144	ns	273 ± 139	261 ± 159	ns
Overall length of statokinesiogram [mm]	300 ± 62	320 ± 75	ns	314 ± 48	303 ± 81	ns
Average of deflection speed [mm/s]	9.4 ± 2.0	10.0 ± 2.3	ns	9.8 ± 1.5	9.5 ± 2.6	ns
Length of deflection-frontal plane [mm]	168 ± 35	189 ± 48	ns	178 ± 29	175 ± 50	ns
Average of deflection speed-frontal plane [mm/s]	5.2 ± 1.1	5.9 ± 1.4	<0.05	5.6 ± 0.9	5.4 ± 1.5	ns
Numbers of deflection-frontal plane [n]	18.0 ± 9.5	21.4 ± 7.9	ns	17.9 ± 6.8	20.6 ± 10.3	ns
Length of deflection-sagittal plane [mm]	207 ± 48	212 ± 53	ns	215 ± 36	205 ± 59	ns
Average of deflection-sagittal plane [mm/s]	6.5 ± 1.5	6.7 ± 1.6	ns	6.8 ± 1.1	6.4 ± 1.9	ns
Numbers of deflection-sagittal plane [n]	23.9 ± 8.4	23.0 ± 7.1	ns	23.4 ± 7.4	22.6 ± 8.3	ns

Table 3. The correlation analysis of basic parameters of body build and age as well as posturographic parameters of younger blind children aged 6-11

Compared group / posturographic parameters	Age	Body height	Body mass	FAT	Ponderal Index
Average of deflection radius [mm]	–0.05	0.02	–0.01	–0.11	–0.02
Developed area [mm^2]	–0.19	–0.09	–0.13	–0.12	0.00
Overall length of statokinesiogram [mm]	**–0.58 p<0.002**	**–0.53 p<0.005**	**–0.54 p<0.005**	–0.23	0.09
Average of deflection speed [mm/s]	**–0.58 p<0.002**	**–0.56 p<0.005**	**–0.55 p<0.005**	–0.25	0.05
Length of deflection-frontal plane [mm]	**–0.48 p<0.02**	**–0.48 <0.02**	**–0.57 <0.002**	–0.30	0.20
Average of deflection speed-frontal plane [mm/s]	**–0.39 p<0.05**	**–0.39 p<0.05**	**–0.48 p<0.01**	–0.24	0.17
Numbers of deflection-frontal plane [n]	**–0.40 p<0.05**	–0.29	–0.22	–0.10	–0.10
Length of deflection- sagittal plane [mm]	**–0.61 p<0.001**	**–0.51 p<0.01**	**–0.47 p<0.05**	–0.16	0.00
Average of deflection speed-sagittal plane [mm/s]	**–0.61 p<0.001**	**–0.47 p<0.05**	**–0.40 p<0.05**	–0.10	–0.07
Numbers of deflection-sagittal plane [n]	**–0.40 p<0.05**	–0.22	–0.15	–0.05	0.08

DISCUSSION

The dynamic character of the balance process consists in its constant loss and regaining. The process itself is most often associated with the posture stability in a standing position [1, 3, 4]. As far as the able-bodied athletes are concerned, this issue has been thoroughly discussed in literature. In the case of the body balance of the blind, however, little research is available. What is more, observations and conclusions present in literature are quite divergent.

Dimorphic differences concerning physical education in both the sighted and the blind have been relatively well examined. Yet, the existence of dimorphic differences in an ontogenetic development of balance which is a component of coordination motor abilities is not described in literature. In this study no characteristic differences concerning the maintenance of body balance in a standing position in the blind boys and girls were found. Similar observations of people with visual dysfunction were made by Ribadi and Rider [9], however Raczek et al. [8], who studied the sighted subjects, stated that on average women have a better body balance, which may be explained by the fact that their gravity centre is situated at a lower level. Perhaps being blind is the factor which is the most essential also in the development of body balance regardless of sex of the examined. For that reason the results in both groups were similar.

The research results of this study also indicate that no significant differences concerning body balance in a standing position between younger and older blind children were observed. Perhaps the examined people aged 6-11 have a better developed system of controlling a standing position, which is similar to adults. Research results of some authors may confirm this, as they stated that the locomotive model and postures stabilise

and acquire features of an adult already at the age of 5-7 [2, 6]. According to Ljach [5], coordination motor abilities displayed in various forms of motor activities are not connected with the indices of somatic development. The research results of this work partially confirm Ljach's conclusions [5]. The only thing is that in the group of younger children aged 6-11 relations between their age, body height and mass as well as most posturographic parameters were noted. The older, taller and heavier the children were, the lower the values of particular parameters. This means that the stability of the body posture in the subjects was better. A possible explanation for this phenomenon may be that there is a period sensitive to the body balance development. This period lasts until the age of 12, when children reach full maturity connected with the maintenance of a standing position [3]. The increase in both height and body mass in children before and during an early stage of puberty shows that there occurs biological development during which a systematic balance development takes place.

The results obtained on the basis of research into the balance of the blind children in a standing position, carried out with the use of stabilographic method, provide an essential picture of the development of a discussed ability and describe its tendencies. Nevertheless, you have to be careful while formulating explicit conclusions. First of all, there have been too few scientific studies in this field. Moreover, the number of the subjects was not large enough. However, it seems that it is necessary to continue research in this field as body balance plays a key role in the development of motor abilities, physical fitness and spatial orientation in the blind. The interpretation of research results may be useful especially for those who work on improving physical abilities of blind children and youth, i.e. PE teachers, rehabilitation experts and spatial orientation instructors.

The results of this study lead to the following conclusions:

1. There are no significant differences concerning body balance in a standing position between blind girls and boys aged 6-17.
2. Body balance in a standing position in blind younger children (6-11 years of age) and older (12-17) is similar.
3. Alongside biological development (increase in body height and mass), the stability of a body posture in a standing position in children aged 6-11 is improving.

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