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Characteristics of Body Posture in Children and Youth with Hearing Disorders

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1. Introduction

Beginning at birth, and until the moment of death, changes in the shape of one's spine are conditioned by the processes of posturogenesis. Posturogenesis (postural development) is a process of the form a body posture during the development. It is very intensive process, especially during the children life (Wolański 2005, Angelakopoulos et al., 2008) . The specificity of the construction of the spine, which has anterior-posterior spinal curvatures, is connected with its function, as well as with the fact that humans adopted an upright position (Iwanowski, 1982; Kiwerski, 2009; Lewandowski, 2006;).

Body posture constitutes a motor habit that is typical for an individual (Kutzner-Kozińska et al. 2001). For that reason, it is difficult to specify only one pattern of body posture, especially if it is change through ontogeny (Wolański 2005, Lewandowski 2006). Researchers are still looking for a pattern of correct body posture, and the first typologies were introduced at the end of the 19th century (Babakhani 2011, behind Staffel 1889). At present, the size of physiological spinal curvatures, as well as abnormalities along the cephalocaudal axis, can be assessed by means of visual inspection. This includes a point-based method and an orthopaedic check-up, as well as with measuring apparatuses such as Moire's method, an S-posture meter, and a electrogoniometer Penny & Giles with modification of Boocock. S-posture meter is a polish devices to measures physiological curves (ryc.1). [Boocock, et al., 1994; Iwanowski, 1982; Kasperczyk, 2004; Kasperczyk & Waleszek, 2009; Śliwa, 1993; Wilczyński, 1999).

The most important element of assessing the course of posturogenesis is diagnosing children and adolescents, with special attention given to detecting postural defects.

Postural defects are not conditioned by climatic or geographical factors. They affect children and youth from various countries and social environments to the same degree (Goldberg et al., 1995; Karachalios et al., 1999). Scoliosis is one of the most dangerous abnormalities in body posture. According to the Scoliosis Research Society (www.srs.org), scoliosis is considered a systemic disease. Many authors in their studies have shown that a scoliotic curves , which is of the spine is accompanied by an asymmetric construction of the brain stem, sensory and balance disorders, as well as blood and collagen function disorders

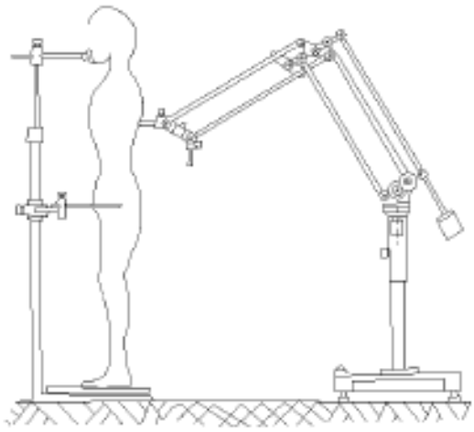


Fig. 1. S-posture meter – the polish devise to measures body posture.

(Cailliet 1975, Romano et al., 2008). Most cases of scoliosis have an idiopathic character, which makes it difficult to define both the progression of the spinal curve as well as the chances for posture correction. There is a conviction that the only efficient methods of treating progressive, sideways curvature of the spine are by wearing corsets or by conducting surgery. In the case of children with scoliosis, kinisiotherapy can only contribute to the increase of the physical fitness and functioning of youth and children (Maruyama et al., 2008; Negrini et al., 2008; Romano et al., 2008; Weiss & Goodall, 2008).

Treating scoliosis is incredibly difficult, and physiotherapeutic treatment can be inconclusive as well as sometimes inefficient. Thus, the early diagnosis of children and youth, with special attention given to abnormalities along the cephalocaudal axis of the spine, allows for preventive action to be taken in the period when abnormalities are not permanent. It can be assumed that, beginning in early childhood, influencing the development of the habits of good posture can have a positive influence on the physical and motor development of the young organism. It is accepted that body posture is an indication of physical and mental state as well as an indication of neuromuscular balance and coordination (Dega, 1996; Kutzner-Kozińska, et al., 2001; Nowotny et al., 2008; Szczygieł et al., 1999;).

Epidemiological studies have shown that bad posture also occurs, or is even more common, in disabled children and youth. Many authors suggest that visual and hearing impairment, mental disabilities, neurological disorders, or any other abnormalities, both congenital and acquired, can cause changes in the processes of posturogenesis (Kasperczyk, 1988; Szczygieł et al., 1999; Śliwa et al., 1999; Zwierzchowska & Gawlik, 2006).

Hearing impairment is one of the sensory defects that cause abnormalities in the physical, motor, and psychosocial development of children and youth. There are many criteria pertaining to the degree of hearing loss.

The International Bureau for Audiophonology established a line at 90 decibels of average value that delineates the difference between serious hearing impairment and deafness. Complete and partial deafness were distinguished:

- mild hearing impairment – 20-40 decibels;

- moderate hearing impairment – 40-70 decibels;
- severe hearing impairment – 70-90 decibels;
- profound hearing impairment – above 90 decibels (Szczepankowski, 1999).

Another criteria, commonly applied in the relevant literature, are the division according to human speech reception. Flower's classification, combined with Van Uden's categorization, distinguishes the following:

- mild hearing impairment – inaudible whisper (0-20dB);
- moderate hearing impairment – troubles with hearing colloquial language;
- not very severe hearing impairment – moderately laud speech in most cases inaudible (40-60 dB);
- severe hearing impairment – loud speech inaudible (60-80 dB);
- extremely severe hearing impairment – scream inaudible (above 80 dB);
- complete deafness – very loud scream inaudible (hearing loss) (Skarżyńska et al., 1997).

Hearing impairment is a factor that negatively influences the processes connected with shaping physiological spinal curvature. Maintaining correct body posture in an upright position requires cooperation between the middle ear, sight, proprioception, and the central nervous system (Błaszczyk, 2004; Dudek & Szczygieł, 1999; Woods et al., 1995). The central nervous system receives limited information from peripheral centres due to hearing impairment, and this leads to the disturbance of dynamic processes connected with maintaining balance (Sipko, 1999; Sipko & Skolimowski, 1997, 1998). The loss or impairment of hearing can damage an individual's motor functions and cause disturbances in balance, plasticity, and speed of movements. The pace of physical and motor development in deaf children is slower. Many authors explain that this results not only from hearing impairment but from social and living conditions as well (Maszczak, 1977; Shephard & Berg, 1986; Umsławska & Staniszewska, 2006; Zwierzchowska et al,. 2008).

Abnormalities in the physical and motor development of children and youth are reflected in body posture, which is contingent upon morphological, functional, and environmental conditions (Kutzner-Kozińska et al., 2001).

Relevant literature reports the presence of numerous abnormalities in the body posture of children and youth with developmental defects. That is why the authors decided to conduct research on body posture of children and youth with hearing impairment.

The purpose of the present paper is to assess the body posture of children and youth with hearing impairment, with an emphasis on the frequency of the occurrence of abnormalities. Subjects were students at the Institute for the Deaf in Warsaw. Defining the percentage of abnormalities in the body posture of the examined group allows for corrective work to be planned.

2. Material and testing methods

Tests were conducted at the Institute for the Deaf in Warsaw in 2005. Children and youth who participated in the study were hearing impaired and were aged between 7 to 18 years. Altogether, 88 persons were examined. All subjects had severe or profound hearing impairment. This information was procured from the child's health card in the institute.

Moreover, the subjects took part in speech corrective classes; most of them had difficulties communicating verbally, whereas all of them had a command of sign language.

Table 1 presents the number of subjects.

girls	N	%	boys	N	%
	41	100.0		47	100.0
prepubertal period	11	26.8	prepubertal period	11	23.4
the puberty period	23	56.1	the puberty period	30	63.8
the postpubertal period	7	17.1	the postpubertal period	6	12.8

Table 1. The number of deaf subjects in the studied group with view to gender and developmental periods.

The number of students in individual age classes was diverse, causing the results to be presented in three developmental brackets: before puberty, at puberty, and after puberty. The classical division, acknowledged by both anthropologists and psychologists, was accepted (Wolański 2006; Birch & Malim, 2007). The age of puberty was determined in girls between 10.51 and 10.50 years; in boys, between 11.51 and 15.50 years.

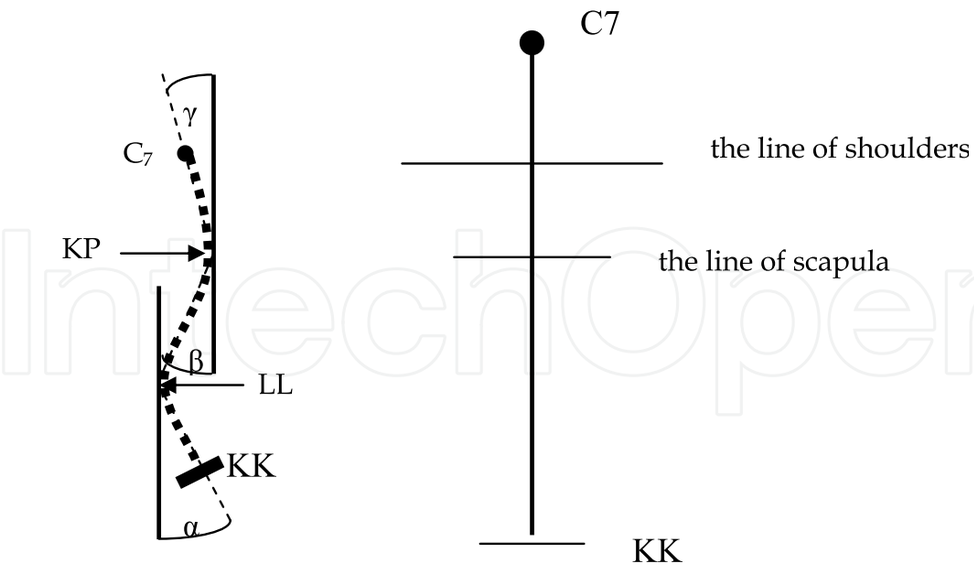
The majority of children and youth in the Institute for the Deaf in Warsaw live in the Mazowieckie Voivodship and come from both the urban (65%) and rural (35%) environments. Some subjects (63%) stay at the boarding house during the week, the rest stay at home and come to classes at the Institute for the Deaf in Warsaw.

The socioeconomic status is diverse due to the specificity of the examined group. Research participants came from both the city and the country. The education level of the parents of the children and youth can be determined as low, taking into account the fact that 36% of the subjects live in Warsaw. Among the parents, 54% of the fathers and 51% of the mothers received a vocational education. The lowest educational status was observed in 27% of the parents. Only one mother had higher education. The material status of the families was described on the basis of an assessment by the parents. They usually defined the material status of the family as average (42.5%). This meant that a family could afford to cover the basic living needs. Roughly one-third (36.8%) of the parents determined their living conditions to be good, i.e., after fulfilling their basic living needs, the family could afford to send their children on summer holiday.

Moire's photogrammetric technique was applied to assess body posture (Nowotny et al., 1992). This technique uses the refraction of the source of light on a given object. All accepted parameters that assess body posture were presented as a function of body height.

The following parameters were used to assess the body posture of the deaf children:

- the angles of individual segments of the spine in relation to perpendicular (α, β, and γ) (Fig. 2a);
- the angle of chest kyphosis (KP);
- the angle of loin lordosis (LL);
- the asymmetries of shoulder and scapula placement (Fig. 2b);
- the angle of the pelvis turn;
- the angle, localization, and direction of scoliosis.



a. The sagittal plan b. The coronal plane

Fig. 2. The angles of individual segments of the spine in relation to perpendicular. (C7 – seventh cervical vertebra, KK – the beginning of sacrum).

The age of children was accurate to 0.01 years and calculated on the basis of the difference between the date of birth and the date of the test. The gathered results were statistically analysed, and the following parameters were calculated:

- the average formed values of the angles of individual parts of the spine in relation to perpendicular (the value of the angles α, β, γ of each subject were brought to the arithmetic mean and the standard deviation of the examination of the children from Gdansk, with emphasis put on their age and sex);
- the percentage distribution of the selected features of body posture;
- the correlation factor between the angles of individual parts of the spine in relation to perpendicular and the angle of the torso in relation to the cephalocaudal axis;
- the percentage distribution of the frequency of defective posture occurrence.

3. Results

3.1 The body posture of the subjects in the sagittal plane

The physiological curvatures of the spine have an indisputable influence on one's existence, yet it is difficult to clearly determine their size on the sagittal plane They support an individual, and help to maintain an individual's balance and steadiness in various situations (Adams et al., 2002; Hof, 2003).

The angles, as well as the length of chest kyphosis and loin lordosis, depend on numerous factors: the stage of biological development, the body height, the pelvis position, and the pectoral girdle, among other things. It needs to be mentioned that physiological curvatures do not constitute a sector, which causes another problem when defining their proper size. However, the fact that defects can occur in the body posture of children and youth brings about the need to define at least the general criteria that would allow body posture to be

assessed. In the present paper such criteria was also applied; they served as a basis for assessing the body posture in children and youth with hearing impairment.

The characteristics of the body posture in the sagittal plane of deaf children was predicated on the analysis of the angles of individual spinal segments in relation to perpendicular as well as the size of the angles of chest kyphosis and loin lordosis (Fig. 2). The torso angle in relation to the cephalocaudal axis was determined as well. Maintaining silhouette in the body axis allows the mechanical balance to be maintained. The inclination of the torso to the front or to the back can disturb the upright position as well as contribute to the occurrence of abnormalities in physiological spinal curves. The description of this parameter, especially in deaf children, can have a crucial significance from the perspective of introducing corrective and compensating exercises, which contribute to maintaining the optimal physical fitness of children with hearing impairment.

The analysis of the position of the silhouette in the body axis showed the inclination of the torso to the front in over 50% of the subjects, a little more often in the boys than the girls. Taking into consideration periods of development, it has been noticed that the inclination of the torso to the front was more common in the subjects who had reached puberty 68.4% (over 14.5 years in the girls and over 15.5 years in the boys). Such a silhouette also characterises 53.8% of the children before puberty. The inclination of the torso to the back from the main axis pertained to only 8% of the subjects (Table 2).

The position of the torso in the vertical axis.	girls		boys	
	N	%	N	%
the position of the spine in the vertical axis.	16	39.0	17	36.2
the inclination of the spine to the back	4	9.8	3	6.4
the inclination of the spine to the front	21	51.2	27	57.4

Table 2. The position of the torso in the vertical axis.

A correlation rate was calculated in order to characterise a connection between the inclination of the torso in relation to the cephalocaudal axis and the angle parameters of the physiological spinal curves (the angles α, β, γ and the angles KP and LL). Table 3 presents the values of the correlation rate.

A negative correlation was observed in case of the angle β (the inclination of the section conjoining the apex of chest kyphosis with the apex of loin lordosis). It can be assumed that the torso of the subjects moves closer to perpendicular with the increase of the β angle. The correlations showed a positive direction of change in cases of the inclination of the torso and the angles α and γ. The axis of the spine diverges from the cephalocaudal axis with the increase of the angle of the outermost segments of the spine (especially the one conjoining C7, the seventh cervical vertebra, with the apex of chest kyphosis). Its significant inclination may have an influence on the maintenance of the mechanical balance as well as the deterioration of the body posture of the subjects (Table 3).

	α angle	β angle	γ angle	KP angle	LL angle
The angle of inclination of the torso	- 0.11	0.81*	-0.42*	-0.39*	-0.42*

* - p≤0,05; KP angle – the angle of kyphosis, LL angle – the angle of lordosis

Table 3. The correlation rate.

The inclination of individual segments of the spine in relation to perpendicular (Fig. 2) determines the size of the physiological spinal curve and might be applied to assess the frequency of defective posture occurrence in the sagittal plane.

Due to the differentiation of the number of the examined children in individual age classes, the value of the angles α, β, and γ of each subject were brought to the arithmetic mean and the standard deviation of the examination of the children from Gdansk (Zeyland-Malawka, 2003).

The analysis of data showed that in a group of deaf boys, the values of the discussed angles are on average a little higher in comparison with hearing boys (fig. 3). The differences amount to 0.26 SD, 0.57 SD, and 0.22 SD, respectively. In the size of the β angle, the differences are significant statistically. Higher values of the discussed angles may signify that there is an enlarged physiological spinal curve in a subject.

Taking into consideration developmental periods, it was observed that the size of angles α, β, and γ in the boys with hearing impairment, aged between 11.5-15.15 years, are closest to the average values of hearing children.

The γ angle that influences the size of chest kyphosis had similar values in all the mentioned groups. A difference of 1.97 SD was observed in the sizes of the α angle between the boys aged 7-11 and those aged 16-18 years. The deaf boys aged between 16 and 18 are characterised by smaller values of the α angle in comparison with the boys aged between 7 and 11, as well as their healthy peers (Fig. 3). This result may suggest that there is a tendency to the reduction of the loin lordosis in the boys between the ages of 16 and 18 years with hearing impairment. Nevertheless, the small number of the examined boys in this age group does not allow conclusions to be generalised.

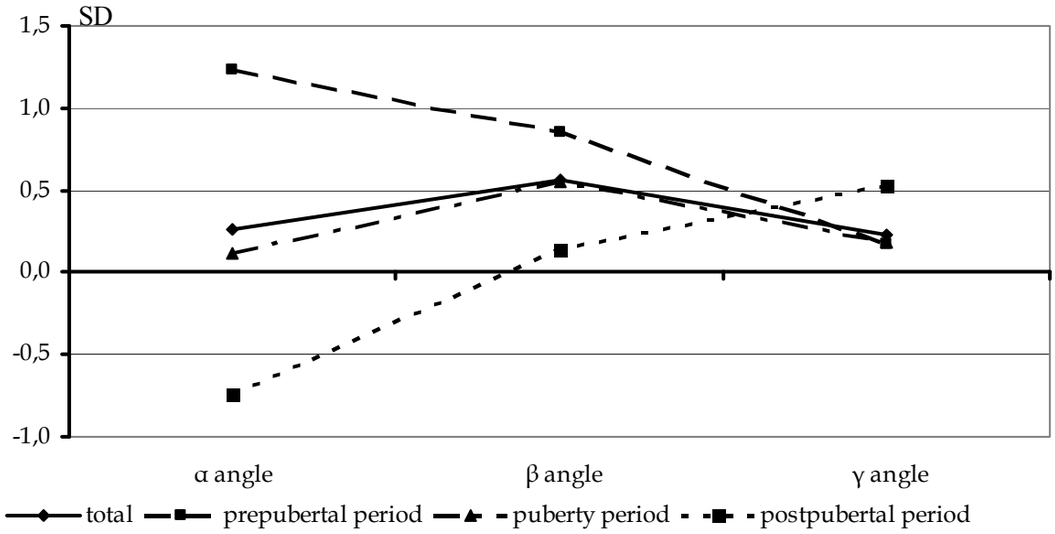


Fig. 3. The normalized values of the angles α, β, and γ of the tested boys.

The sizes of the angles of chest kyphosis and loin lordosis were also applied to assess the frequency of abnormalities of the spine on the sagittal plane. The abnormal size of the physiological spinal curvatures only occurs in around 40% of the tested hearing-impaired boys; the most common defects comprise concave back or roundly-concave back. The

frequency of the excessive physiological spinal curves decreased with the age of the subjects. Body posture defects on the sagittal plane occurred in about 20% of the subjects, in the boys aged between 16 and 18. At this stage of development only excessively enlarged chest kyphosis was observed (Fig. 4).

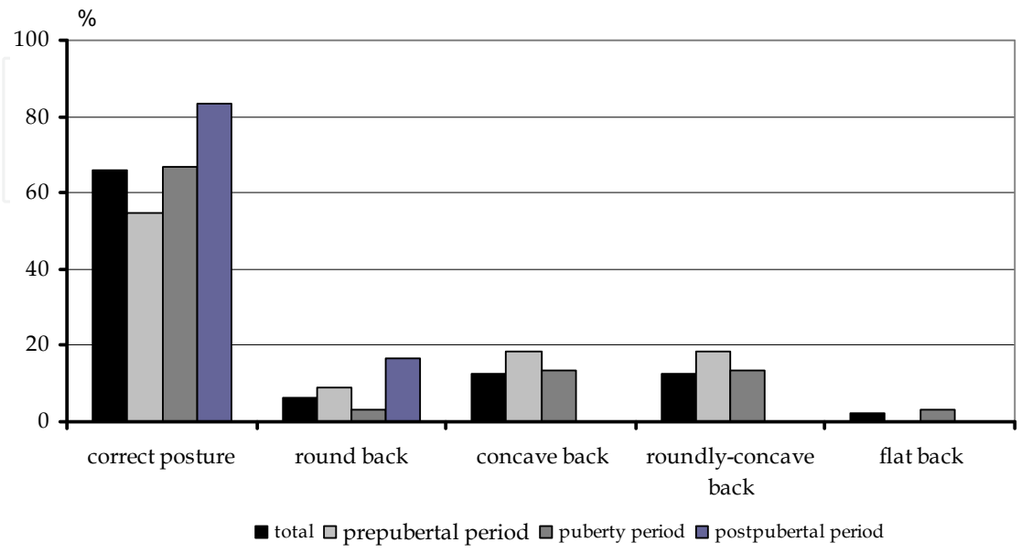


Fig. 4. The frequency of defective posture occurrence on the sagittal plane in a male group.

In the group of hearing-impaired girls, the assessment of the angles of individual spinal segments in relation to perpendicular, showed that they have bigger values of the angles α, β, and γ compared to the hearing girls. Changes in the size of these angles are presented in Figure 5. Despite the fact that the values of the discussed angles are varied in the given age groups, no statistically significant differences were observed.

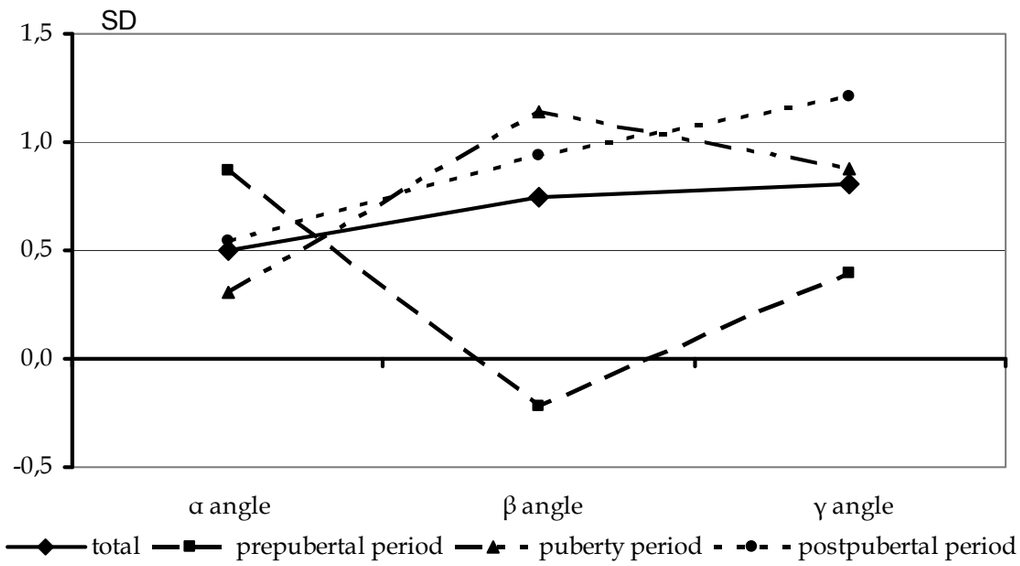


Fig. 5. The normalized values of the angles α, β, and γ of the tested girls.

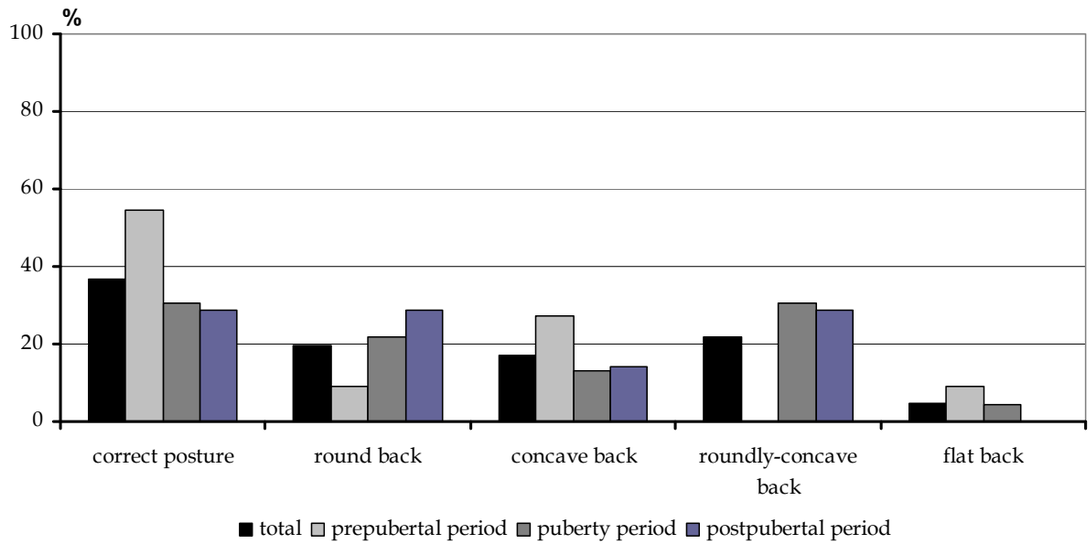


Fig. 6. The frequency of defective posture occurrence in the sagittal plane in the female group.

A disturbance of physiological spinal curve in the hearing-impaired girls was observed in the case of 62% of the subjects. The most common defects were round back, concave back, and round-concave back. Taking into consideration developmental periods it was observed that abnormalities in the size of the curvature of the spine were most common in the girls aged between 12 and 18 years. The frequency of defective posture occurrence increased with age. Round and round-concave back was observed in about 60% of the girls aged between 14.5 and 18.5 years (Fig. 6).

Additionally, a comparative analysis was conducted of the features of the body posture on the sagittal plane of the subjects with hearing impairments, with emphasis put on the sex of the students. No significant changes in the size of the angles β and γ were observed; whereas the differences in the angles α and loin lordosis were on the border of statistical significance, which can indicate a more frequent occurrence of body posture defects in hearing-impaired girls rather than boys. A small number of subjects in individual developmental periods could lead to the lack of significant differences in the discussed parameters, but the percentage values indicated that the enlargement of curvature was more common in the group of girls rather than boys at every developmental stage.

3.2 The body posture on the coronal plane

The assessment of the body posture on the coronal plane allows the asymmetric position of the individual segments to be identified, which then determines the course of the cephalocaudal axis. Disorders of the spine and other posture segments on the coronal plane can cause scoliosis. The sideways curve of the spine is considered a systemic abnormality because it can cause not only hearing disorders but disorders of other systems as well, for example, respiratory or cardiovascular ones. According to the definition by the Scoliosis Research Society, scoliosis is understood as a structural curvature of the spine where a rotation took place, and with the Cobb angle greater than 10 degrees. However, when

analysing a child's body posture during a developmental period, it is worth considering the problem of the liability of body posture, which sometimes is typical of children with a limp and asthenic build. Disorders of the tension of the postural muscles can cause abnormalities in body posture to occur. These abnormalities, as well as a child's intensive development and growth, can contribute to scoliosis. For that reason, the present research comprises subjects with scoliotic posture. Such an abnormality was characterised by a slight curvature of the spine (4-9 degrees in a photogrammetric picture) and lack of rotation. The curvature bore no signs of consolidation, and in most cases could be actively corrected.

Body posture defects and scoliosis often occur together with some other disorders, such as visual or hearing impairment, as well as mental disorders. There is the need for an early diagnosis of children and youth with various developmental defects, as well as in terms of postural defects and scoliosis (Woods et al., 1995).

In the present paper, the body posture research in terms of scoliosis had a screening character. The applied method of assessment did not allow a thorough diagnosis of the sideways curve of the spine, which is possible when using an X-ray machine, for instance. That is why the subjects whose photogrammetric picture showed a significant sideways curve of the spine were referred for a more specialised diagnosis.

The present study provides an analysis not only of the course of the cephalocaudal axis but also of the symmetric position of shoulders, scapulas, and pelvis. Moreover, the turn of the pelvis in the transverse plane was assessed.

The results of the hearing-impaired boys showed that asymmetry of the shoulders occurred in about 53% of the subjects; whereas the asymmetry of the scapulas pertained to 43% of the boys. The abnormalities in most cases pertained to the left side. The turn of the pelvis characterised around 33% of the students with hearing organ dysfunction (Fig. 7).

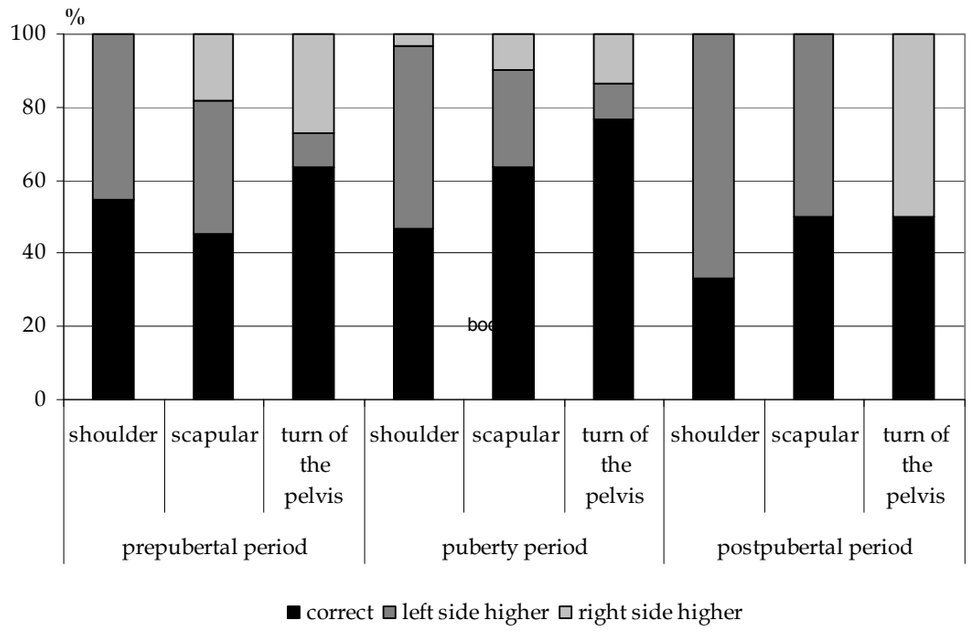


Fig. 7. The occurrence of shoulder and scapular asymmetry as well as the turn of the pelvis in the hearing-impaired boys, according to their developmental periods.

Taking into consideration the subjects' developmental periods, it was determined that the most frequent asymmetry of the discussed segments occurred in the boys aged between 15.5-17.5 years (Fig. 7).

When the course of the cephalocaudal axis was being analysed, it was accepted in the testing methodology, that children with the angle of curve over 10 degrees would qualify for the groups of scoliosis. The subjects with the angle between 5 and 10 degrees and the asymmetric position of shoulders, scapulas, or pelvis were qualified for the group with scoliotic posture.

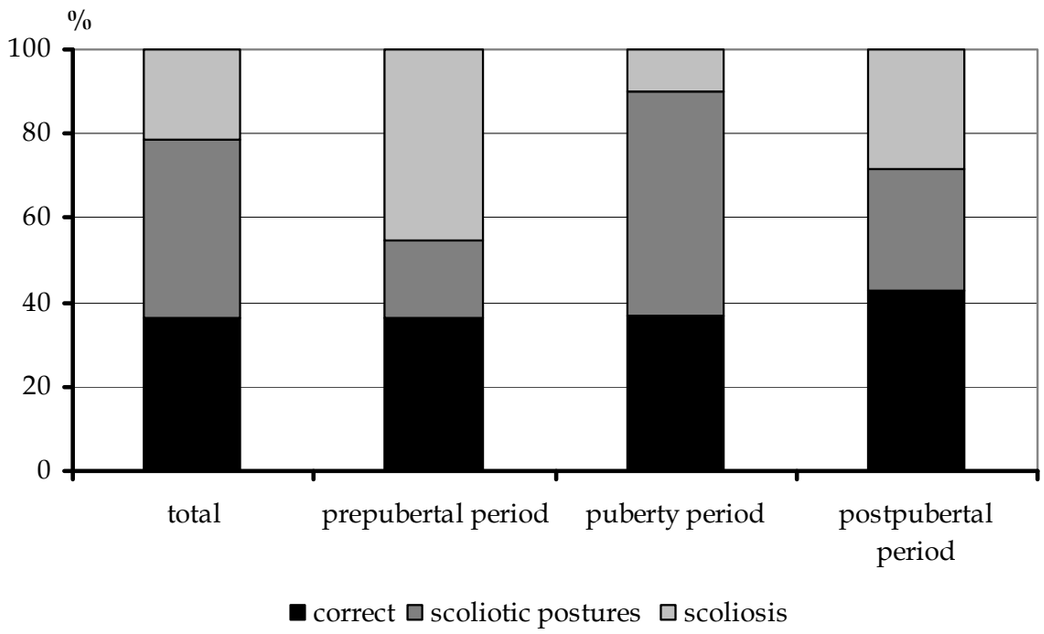


Fig. 8. The occurrence of the sideways curves of the spine in the group of boys.

Scoliotic postures and scoliosis occurred in around 63% of the subjects. The degree of the advancement of changes was in most cases small, these abnormalities could be determined as trace scoliosis. Altogether, it was diagnosed in around 27% of the hearing-impaired boys. A consolidated sideways curve of the spine, with asymmetric outline of the back, was diagnosed in 4.3% of the boys Taking into consideration their developmental periods, no consolidated scoliosis was detected in the group of the oldest boys. The highest percentage of the most advanced sideways curve of the spine was observed in a group of the youngest boys (Fig. 8).

The results of the tests in the group of girls showed that the asymmetry of shoulder position was typical for 51% of the subjects. The left shoulder was positioned higher than the right one much more frequently. An abnormal position of scapulas in the girls was less common than an abnormal position of shoulders. It pertained to around 22% of the subjects. The turn of the pelvis was observed in around 46% of the hearing-impaired girls. The pelvis was more often turned to the right, i.e., left anterior superior iliac spine was more moved to the front compared to the right one. Similar concurrences were observed when the discussed segments were being analysed, with emphasis put on the developmental period.

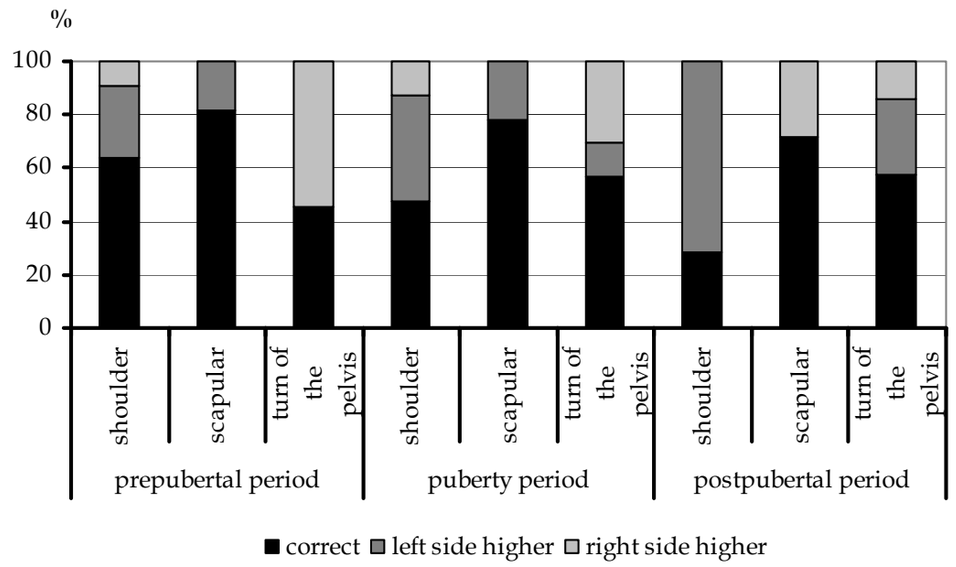


Fig. 9. The occurrence of shoulder and scapular asymmetry as well as the turn of the pelvis in the hearing-impaired girls, with a focus on developmental stages.

The percentage of shoulder and scapular asymmetry in the examined girls increased with their age. Also, the number of the subjects with a turn of the pelvis was on the increase (Fig. 9).

Abnormalities of the course of the cephalocaudal axis on the coronal plane were observed in around 64% of the examined hearing-impaired girls. Scoliotic posture was typical for around 30% of the deaf; whereas scoliosis occurred in around 37% of the subjects. This was, most frequently, scoliosis of a lower degree, with no asymmetry of the back outline. Consolidated scoliosis, with spine rotation (positive results in the Adam's Forward Bend Test) was observed in only 4% of the girls (Fig. 10).

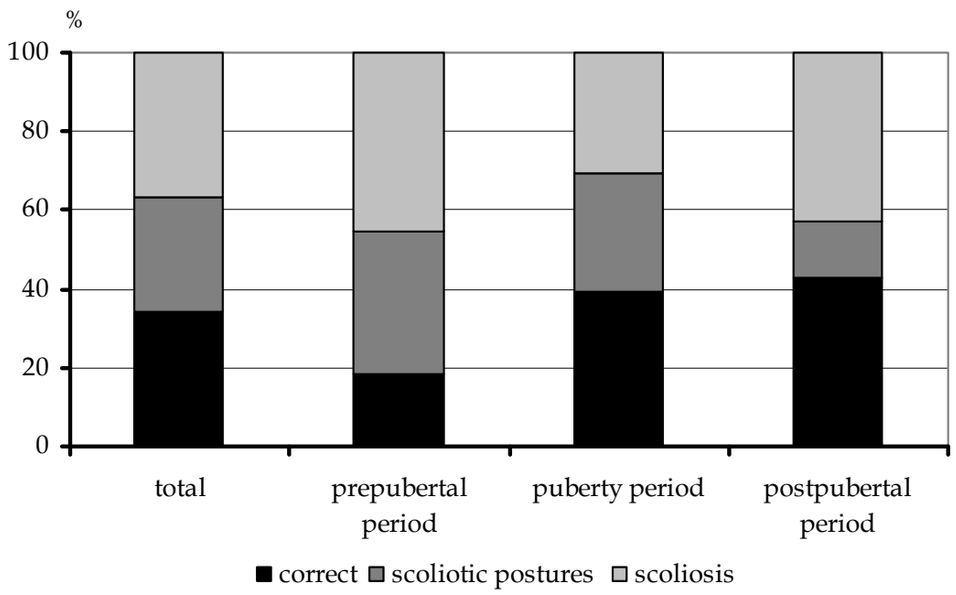


Fig. 10. The frequency of occurrence of the sideways curve of the spine in the group of girls.

The number of abnormal postures declined with age, but simultaneously, the percentage of more advanced scoliosis, with a tendency for asymmetric back outline, increased.

4. Discussion

Human body posture depends on many factors: morphological, functional, as well as environmental (Kasperczyk, 2004; Kutzner-Kozińska et al., 2001). There are numerous studies where the authors emphasise that various developmental disorders of children and youth influence, most often negatively, the process of posturogenesis. Among such abnormalities we may list: mental disorders, visual and hearing impairment, as well as short height. In Poland, the assessment of body posture with developmental dysfunctions was studied by Szczygieł, Śliwa, Kasperczyk, Grabara, Zwierzchowska, and Gawlik (Kasperczyk, 1988; Szczygieł et al., 1999; Śliwa et al., 1999, Zwierzchowska & Gawlik, 2006; Grabara, 2006). The analysis of posturographic parameters was primarily subjected to the assessment of sideways curves of the spine as well as the asymmetry of the position of individual segments of the body.

Wilińska and Kasperczyk (1990) claimed that abnormal body posture occurred in around 40% of hearing-impaired children. A much bigger percentage of defects in a group of deaf-mute and hard of hearing were observed by Szczygiel (Szczygieł et al., 1999). The frequency of disorders in the discussed tests was present in around 80% of the boys and girls. These abnormalities in majority pertained to the coronal plane and had a small degree of advancement (the angle of the sideways curve reached up to 10 degrees. Body posture disorders were also quite frequent in the examination of the children from Wroclaw aged between 7 and 15 years. In most cases, this was trace scoliosis. Consolidated sideways curve of the spine occurred in 35% of the hearing-impaired subjects (Śliwa et al., 1999). According to Zwierzchowska and Gawlik, 44% of children and youth with hearing impairment had sideways curve of the spine, girls more frequently than boys. Apart from the changes in the course of the cephalocaudal axis, the authors observed an asymmetric position of shoulders, scapulas, and pelvis (Zwierzchowska & Gawlik, 2006, 2007; Grabara, 2006). Moreover, the present study showed an abnormal position of such segments of the body as shoulders and scapulas, as well as a turn of the pelvis. The percentages of abnormalities among the subjects are bigger in comparison with hearing children (Olszewska & Trzcińska, 2005; Olszewska & Trzcińska, 2007). The discussed asymmetries accompany sideways curves of the spine. Scoliosis was observed in a considerable number of subjects with hearing impairment, with similar frequency among the boys and girls. It needs to be emphasised, though, that in the group of girls a percentage of the most advanced abnormalities along the course of the cephalocaudal axis occurred in the oldest group. There was no such correlation in the group of boys. In the discussed test, the percentage of scoliotic postures in the developmental stages did not change significantly. Hearing impairment can have a negative influence on the processes of posturogenesis, especially due to the connection between deafness and maintaining balance. According to the tests, the mechanism for maintaining balance is impaired in deaf and hard-of-hearing persons. The results of the Fleming's test conducted in a group of hearing and hearing-impaired showed that the time that balance can be maintained is considerably shorter in a group with hearing impairment. Many authors showed a correlation between the correct body posture and maintaining balance. Some tests show a smaller percentage of scoliosis among hearing-impaired children in comparison with hearing children. According to the authors, this results from the fact that hearing-impaired are "protected" from scoliosis by neurological disorders that accompany deafness. For that

reason, a need exists to undertake actions to prevent postural defects as well as incorrect movement habits.

5. Conclusions

The results of the present research allow the following conclusions to be drawn:

1. Body posture defects among children and youth with hearing impairments are rather common. The frequency of occurrence of abnormalities increased with the subject's age, which should alarm people who look after children with hearing impairment.
2. There is a need to undertake actions that will shape correct movement habits, including those pertaining to body posture, as well as to correct the existing abnormalities in body posture in children and youth with hearing impairments. Creating programmes of preventive and corrective actions in postural defects should be the responsibility of the teachers working in facilities for hearing-impaired children and youth, as well as of doctors and education authorities.

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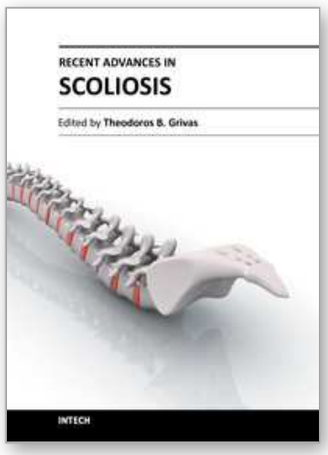

Recent Advances in Scoliosis

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This book contains information on recent advances in aetiology and pathogenesis of idiopathic scoliosis, for the assessment of this condition before treatment and during the follow-up, making a note of emerging technology and analytical techniques like virtual anatomy by 3-D MRI/CT, quantitative MRI and Moire Topography. Some new trends in conservative treatment and the long term outcome and complications of surgical treatment are described. Issues like health related quality of life, psychological aspects of scoliosis treatment and the very important "patient's perspective" are also discussed. Finally two chapters tapping the untreated early onset scoliosis and the congenital kyphoscoliosis due to hemivertebra are included. It must be emphasized that knowledgeable authors with their contributions share their experience and enthusiasm with peers interested in scoliosis.

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