Assessment of the body posture of children in the school age

Natalia Habik-Tatarowska[1]

1. Faculty of Medicine and Health Sciences, Jan Kochanowski University in Kielce, Poland
Corresponding author: habiknatalia@gmail.com

Abstract

Nowadays, posture defects are a quite significant medical, economic and social problem. They mainly start when the children start school. It is extremely important to diagnose abnormalities in body posture as soon as possible to implement preventive and curative treatment. The main goal of the study was to assess the posture of children in school age.

The research involved a group of 40 children from primary schools in the świętokrzyskie voivodeship. The attitude was assessed using the optoelectronic Diers Formetric III 4D method. It is a photogrammetric video recording via a raster stereography process. The research was carried out in May 2016. The respondents were in the age range 6-13.

In 75% of the subjects, the lateral curvature of the spine was observed and in 25% the scoliotic posture was observed. Due to the location of the curvature, the most of them because up to 50% covered the thoracic segment of the spine. Due to the direction, right-sided curves dominated, giving 90%, and due to the number of bends of the curve, the highest number of scoliosis was 80%. In the sagittal plane, the flat back dominated among children, the number of which was 45%. There was no relationship between age and the angle of scoliosis.

Studies have shown that the dominant defect in the sagittal plane turned out to be lateral curvature of the spine. The scoliotic attitude mainly concerned boys aged 11 and 12. An important problem turned out to be quite flat backs.

Key words. body posture, scoliosis, posture defects, children

INTRODUCTION

There are many ways to define the correct body posture, which in addition to the aesthetic function, in particular has a health significance. It protects the human body against the negative impact of the environment, which is closely related to maintaining health. The correct

posture is characterized by: straight positioning of the head, the spine physiologically bent in the sagittal plane, and straight in the frontal plane, arched chest, which is the foremost part of the body forward, pelvis supported on the heads of the femurs, straight lower limbs and properly arched feet. According to Wolański, the correct posture is one that occurs in a correspondingly high percentage of the healthy children's population, so that it can be considered typical for a particular age [12]. Kasperczyk, on the other hand, determines the correct posture of the body as the one that appears often enough in a specific population to be considered characteristic of a particular population. A faulty posture is a condition in which the deformation of the spine, chest, pelvis or lower limbs has occurred. The faulty posture therefore characterizes both simple and complex defects [1]. According to Nowotny, the wrong attitude is any irregularity in the way of standing up, manifesting itself differently from the normal body system. Pathological attitude is anatomical, usually irreversible, deviations in balancing, positioning and shaping of individual sections or the entire body [5]. Faulty postures are any deviations from the correct posture. These are changes fixed in the bone apparatus that cause various types of dysfunctions. Postural defects are deviations from the generally accepted features of the correct posture, appropriate for a given age group, sex or body structure [2]. The disadvantages of posture are various types of deformities in the motor organs, eg chest defects, back defects or lower limbs. A faulty posture is a state of overloading or the consumption of some of the setting-up structures, which is usually a consequence of unfavorable proportions of the body's development. It may be the result of genetic disorders or specific injuries [3]. Characteristics of a faulty posture are: head extended forward or sideways, chest flat, sunken or distorted, shoulders extended forward, belly convex, extended forward or flabby, sagging, hunched back, rounded, and the pelvis has too much inclination and feet flat [4].

The causes of postural defects include: sitting (sedative) lifestyle; low physical activity; staying too long in one position; mistakes made when carrying a child (only on one hand, keeping a child always for one, the same hand); the uniformity of the sedentary lifestyle combined with signs of fatigue; furniture inadequately matched to the height of the child - too high or too low seats and desks, poor proportion between the height of one and the other; the wrong way to sit at the time of writing - with one hand on the desktop and the other hand lowered; for tight clothing, inappropriate footwear size; poor eyesight (the child slumps or sets his head asymmetrically, especially when seeing one-eyed); weak hearing (hearing loss or vision - especially one-sided - causes the student, by compensating for the defect, tilts his head or projects it forward); weakness after the illness; malnutrition or overfeeding; in girls, the desire to hide growing breasts; too high increase in relation to peers; wearing too heavy and depressed [5,6]. The most common defects of body posture in the sagittal plane include: round back, round - concave, concave and flat. However, the disadvantage of posture, which includes the three-plane position is scoliosis.

The round back (dorsum rotundum) is a defect in posture, which is characterized by excessive bending of the spine towards the rear. The disadvantage is located in the thoracic segment, it is called hyper-diffusion or deep thoracic kyphosis. In the backs of the round weakening and stretching the muscles of the back are undergoing: parallelogram, quadrangular, neck muscles and backbend rectifiers, whose dysfunction causes the torso to tilt forward, spread the shoulders, and protrude the shoulders forward. The concave back is a spinal defect in the lumbar region. In healthy people, characteristic for this segment is the bending of the spine forward, and therefore lordosis. Its size and shape are variable and conditioned by a number of factors, such as age, sex, pelvis position, tension and length of muscles stabilizing the hip joints. On the other hand, in people with a concave back, there is visible deep bending of the spine in this episode, i.e. lumbar hyperlordosis [7]. The round-concave back is a postural defect in which there are both symptoms of the round and concave backs. A characteristic feature of this defect is increased lumbar lordosis and deep thoracic kyphosis. Flat back is a posture which is characterized by the flatness of both physiological curves. This defect may occur in extreme cases both in children who have an asthenic build, are frail, generally weak in muscle, and in heavily muscled children, early and intensely exercising, especially dorsal muscles in elongation

or prolonged positions [8,9]. Scoliosis, on the other hand, are spinal curvatures characterized by the deviation of the anatomical axis (spinous processes) from the mechanical one in three planes: frontal, sagittal, transverse [10]. This deviation occurs in the frontal planes - the spine bends to the side, to the right or to the left, sagittal, which arises as a result of deepening lordotic and kyphotic and transverse bending - vertebrae rotation, which leads to the formation of ribs / lumbar spine [11] .

MATERIAL AND METHODS

The aim of the study was to analyze the postural defects in children aged 6-13. The objectives of the work were formulated in the form of the following research questions: How did the body posture among the examined children in the sagittal plane? What type of defects dominated in the study group in the frontal plane? What dependence exists between age and the angle of scoliosis among the examined group? The research was carried out in May 2016. The photogrammetric method DIERS FORMETRIC III 4D was used for the tests. The development of technology has allowed the use of computers for diagnosis and posture defect therapy. The use of appropriate programs creates the conditions for an appropriate analysis of body posture. This allows you to eliminate time-consuming calculations. The ultimate goal of the equipment is to obtain a body image that will be objective, reliable and documented. Computer methods are non-invasive and very precise. They allow elimination of unnecessary and harmful X-ray examinations. They also give the opportunity to objectively control people who have had postural defects. This device uses the most modern method of optical three-dimensional analysis as well as data processing in a digital way. This allows for extremely fast as well as non-contact evaluation of the back and spine. Data analysis takes place immediately after the test. This is done thanks to extremely fast image transmission to the computer. The whole test is based on the photogrammetry method, which is based on the performance of anthropometric measurements based on the image taken of the surface under examination in accordance with the raster stereography method. The result is an accurate and three-dimensional model of the back area. The determination of anatomical points and curvatures of the spine makes it possible to identify spinal deformities that have been correlated with about 80% of X-ray images. It should be emphasized that the test is very simple to carry out. During the analysis of the posture, the subject is about 2 meters away from the device that will perform the reconstruction of the spine. It is possible to adjust the device to the height of the patient. Then he is asked to freely place the DIERS platform behind the camera and projector. A few seconds after the measurement, the computer shows the analysis of the image. The program accurately determines the shape of the surface of the ridge, pelvis position and the course of the spinal line. Thanks to the automatic detection of anatomical points, the test is absolutely non-invasive. In more than 97% of cases, it does not require the use of markers. Written consent of the children's parents was obtained to participate in the study. The research involved 40 students from primary schools in the Świętokrzyskie Voivodeship, including 22 boys and 18 girls. The respondents were in the age range 6-13. The age of the oldest girl was 13 years and the youngest age was 6. The oldest boy was 12 years old, while the youngest was 6 years old. The average age in the group was 8.8 years. In the group of boys it was 8.9 years and in girls it was 8.2 years. The standard deviation (s) in the research group was 1.96 and the median (Me) 8. The mean increase in the whole group was 137.6 cm in the boys' research group 140.4 cm, while in girls it was 134.5 cm. The average increase in the group of 6-year-olds was 122.2 cm, in 7-year-olds 127.7 cm, in 8-year-olds 136 cm, in 9-year-olds 140.8 cm, in 10-year-olds 143.8 cm, in 11-year-olds aged 144 cm, in the case of 12-year-olds 154.8 cm, while in 13-year-olds 158 cm. The standard deviation (s) in the research group was 11.74, and the median (Me) 138. The average body mass in the study group was 30 kg, among the examined boys 32.1 kg, in girls 27.4 kg. The mean body mass in the examined group of 6-year-olds was 28.6 kg, in 7-year-olds 26.7 kg, in 8-year-olds 26.8 kg, in 9-year-olds 32 kg, in 10-year-olds 34.3 kg, in 11-year-olds 33.3 kg, in 12-year-olds 40.5 kg and in 13-year-olds 45 kg. The standard deviation (s) in the research group was 7.19 and the median (Me) 29. The mean BMI value in the research group was 15.7; among boys 16.2 and girls 15.0.

The average BMI value among the group of 6-year-olds surveyed was 15.9; in 7-year-olds 14.6; 8-year-olds 14.5; in 9-year-olds 16.1; in 10-year-olds 16.6; 11-year-olds 16.1; in 12-year-olds 17, while among 13-year-olds 18.1. The standard deviation (s) in the research group was 2.05 and the median (Me) 15.56.

RESULTS

The results of postural assessment among the examined group of children were presented in the form of tables and percent calculations. Body posture assessments were made on a group of children aged 6 to 13 years. Taking into account the location, direction and number of arches, the following distortions were divided into: - thoracic (Th), - thoracolumbar (Th-L), - lumbar (L), - right-sided (DEX), - left-sided (SIN), - single-piece, - double-arc. In the research group, a higher incidence of lateral spinal curvatures among girls was observed. It amounted to 33.33% (n = 3) in girls aged 7 years and 33.33% (n = 3) in 10-year-old girls. Among 8-year-old boys, the number of lateral spinal curvatures in the Th episode was 50% (n = 3) (tab.1).

Table 1. The structure of occurrence of spinal curvatures in the thoracic segment among the examined children

BOYS		AGE (years)	GIRLS	
N	%		N	%
0	0	6	1	11,11
1	16,66	7	3	33,33
3	50	8	1	11,11
1	16,66	9	1	11,11
1	16,66	10	3	33,33
0	0	11	0	0
0	0	12	0	0
0	0	13	0	0
6	**100**	**TOGETHER**	**9**	**100**

In the study group, a higher percentage of boys with a lateral curvature of the spine in the Th-L segment was observed. It amounted to 28.6% (n = 2) among 8-year-old boys and, respectively, 14.28% (n = 1) in boys aged 6, 7, 9, 10 and 11 years. Among six-year-old girls, the curvature in the Th-L segment was 40% (n = 2), while 20% (n = 1) equally for 7-, 8- and 13-year-old girls (Tab. 2).

Table 2. Structure of the occurrence of spinal curvature in the thoracolumbar segment of the examined children

	BOYS	AGE (years)	GIRLS	
N	%		N	%
1	14,28	6	2	40
1	14,28	7	1	20
2	28,6	8	1	20
1	14,28	9	0	0
1	14,28	10	0	0
0	0	11	0	0

1	14,28	12	0	0
0	0	13	1	20
7	100	TOGETHER	5	100

Among the children's research group, the number of lateral spinal curvatures in the lumbar region was small. It amounted to 50% (n = 1) in an 8-year-old boy and the same in a 9-year-old boy. The curvature of a 10-year-old girl was 100% (n = 1) (Tab. 3).

Table 3. Structure of occurrence of spinal curvatures in the lumbar region among the examined children

BOYS		AGE	GIRLS	
		(years)		
N	%		N	%
0	0	6	0	0
0	0	7	0	0
1	50	8	0	0
1	50	9	0	0
0	0	10	1	100
0	0	11	0	0
0	0	12	0	0
0	0	13	0	0
2	100	T0GETHER	1	100
		42		

Among the examined group, the right-sided curvature turned out to be dominant, which amounted to 90% (n = 23). The left-handed curvature was only 10% (n = 7). In the boys group, the largest percentage of right-sided curvature of 36.4% (n = 4) included 8-year-old boys. Slightly less, 27.2% (n = 3) were boys aged 9 and 18.2% (n = 2) 7- and 10-year-olds. In the group of girls, the right-sided curvature was 33.4% (n = 4) among 7- and 10-year-olds, and 8.3% (n = 1) in the case of 6-, 8-, 9- and 13-year-olds. The left-sided curvature of the examined boys was 50% (n = 2) for 8-year-olds and 25% (n = 1) for 6- and 12-year-old boys. In the case of girls, left-sided curvature was 66.7% (n = 2) for 6-year-olds and 33.3% (n = 1) for 8-year-olds. No child in the 11-year study group had a lateral curvature of the spine (Tab. 4).

Table 4. The structure of occurrence of curvature of the spine due to the direction of the curvature among the examined children

RIGHT-HANDED CURVATURE				AGE	LEFT -HANDED CURVATURE			
				(years)				
Boys		Girls			Boys		Girls	
N	%	N	%		N	%	N	%
0	0	1	8,3	6	1	25	2	66,7
2	18,2	4	33,4	7	0	0	0	0
4	36,4	1	8,3	8	2	50	1	33,3
3	27,2	1	8,3	9	0	0	0	0
2	18,2	4	33,4	10	0	0	0	0
0	0	0	0	11	0	0	0	0
0	0	0	0	12	1	25	0	0

0	0	1	8,3	13	0	0	0	0
11	100	12	100	TOGEHTER	4	100	3	100

In the examined group, in the sagittal plane in 5% (n = 2) children were observed with a round back. Among 18.2% (n = 7) there were postures with concave backs. The same number - 18.2% (n = 7) was the number of children with round back - concave backs. Among the examined children, the flat back was dominant, the number of which was 45% (n = 18). Only 15% (n = 6) attitudes were observed. In the boys group only 4.5% (n = 1) had a round back. The same number of silhouettes were observed with concave backs - 18.2% (n = 4) and round - concave - also 18.2% (n = 4). Flat backs accounted for the most, as much as 45.5% (n = 10). Among boys, only 13.6% (n = 3) attitudes were normal. In the group of girls, 5.5% (n = 1) were round backs. The number of girls with concave backs was the same - 16.7% (n = 3) and round - concave, also 16.7% (n = 3). 44.4% (n = 8) of flat backs were observed. Less than 16.7% (n = 3) were correct attitudes (tab.5).

Table 5. Structure of incidence of posture defects in the sagittal plane in the research group

BOYS			**GIRLS**	
N	**%**		**N**	**%**
1	4,5	round back	1	5,5
4	18,2	back concave	3	16,7
4	18,2	back round-concave	3	16,7
10	45,5	flat back	8	44,4
3	13,6	correct posture	3	16,7
22	**100**	**TOGETHER**	**18**	**100**

In the children's research group, the most scoliosis was observed among 8-year-old boys, which was 40% (n = 6). Slightly less, because 20% (n = 3) scoliosis were in 9-year-old boys. Only 6.7% (n = 1) scoliosis occurred in 6- and 12-year-old boys. Among the examined 7-year-old girls, 26.7% (n = 4) of scoliosis were observed. The same was true for 10-year-old girls - 26.7% (n = 4). Slightly fewer were among 6-year-old girls - 20% (n = 3), 8-year-old 13.2 (n = 2) and the same for 9- and 13-year-olds - 6.7% (n = 1) (Tab. 6).

Table 6. Structure of occurrence of scoliosis in the research group

BOYS		**AGE**	**GIRLS**	
		(years)		
N	**%**		**N**	**%**
1	6,7	6	3	20
2	13,3	7	4	26,7
6	40	8	2	13,2
3	20	9	1	6,7
2	13,3	10	4	26,7
0	0	11	0	0
1	6,7	12	0	0
0	0	13	1	6,7
15	100	**TOGETHER**	15	100

Scoliotic postures were observed mainly in boys. Among 11- and 12-year-olds, they accounted for 28.58% (n = 2). Only after 14.28% (n = 1) they reached 6-, 7- and 9-year-olds. In the girls' research group, scoliotic postures occurred only in 8-, 11- and 12-year-olds, yielding 33.33% (n = 1) (Tab. 7).

Table 7. Structure of occurrence of scoliotic attitudes in the research group

BOYS		AGE	GIRLS	
		(years)		
N	%		N	%
1	14,28	6	0	0
1	14,28	7	0	0
0	0	8	1	33,33
1	14,28	9	0	0
0	0	10	0	0
2	28,58	11	1	33,33
2	28,58	12	1	33,33
0	0	13	0	0
7	100	TOGETHER	3	100

The studies showed that there is no relationship between age and the angle of scoliosis in the study group at the significance level p = 0.05; $\chi2$obl. = 28.36 $<\chi2$ 0.05; 30 = 43.7730 (Tab. 8).

Table 8. Relationship between the occurrence of scoliosis angle and age

SCOLIOSIS ANGLE/AGE	7	9	10	11	12	13	14	15	17	20	22	Together
<6-7>	1	1	1	3	1	0	2	1	0	0	1	**11**
<8-9>	1	1	1	1	2	3	1	2	1	2	0	**15**
<10-11>	1	2	1	1	0	0	3	0	1	0	0	**9**
<12-13>	2	1	1	0	0	0	0	1	0	0	0	**5**
RAZEM	**5**	**5**	**4**	**5**	**3**	**3**	**6**	**4**	**2**	**2**	**1**	**40**

$$\chi^2 = 28,36 \; ; df = 30 \; ; \quad p=0,05$$

53

DISCUSSION

After careful analysis of the studies that concerned the assessment of posture in schoolchildren using the DIERS Formetric III 4D device, it was possible to determine what percentage are correct attitudes, which defects are most common among boys and girls and whose spine segment is related to. In own studies, the most common disadvantage of posture was scoliosis, which concerned 75% of the whole group. The scoliotic attitude concerned a significant minority. For the entire group, it amounted to only 25% and mostly concerned a group of boys - 70%. Among girls, only 30% have a scoliotic posture. Taking into account the location of three-dimensional curvatures of the spine, which were divided into thoracic,

thoracolumbar and lumbar scoliosis, the highest percentage concerned thoracic scoliosis and amounted to 50%, constituting 60% in girls. This may be due to the fact that adolescent girls are ashamed of their maturing body and try to cover them by adopting the wrong attitude. Another factor may be the replacement of schoolbags by bags usually worn on one arm. In the thoracic-lumbar segment scoliosis, 40% of respondents participated, this time in the majority of patients, 58.3%. Only 10% of lumbar scoliosis were observed, which occurred in boys 66.7%. Due to the direction of the sclerosis, right-sided and left-sided scoliosis were distinguished. Among the respondents, the right-sided curvature turned out to be the dominant one, which amounted to 90%. The left-handed curvature was only 10%. The analysis of the number of curves of the curve was dominated by single-body scoliosis, which accounted for 80%. A definite minority were double-bite scoliosis, which amounted to 20%. Children were also evaluated in the sagittal plane. Among the respondents, flat backs dominated, the number of which was 45%. Equally, children had concave backs - 17.5% and round-concave ones - 17.5%. A definite minority was the round back, which for the entire group amounted to 5% and covered equally the group of boys and girls. Worrying is the fact that only 15% of respondents are characterized by a correct posture.

CONCLUSIONS

Studies have shown that the dominant defect of body posture in the sagittal plane among children is the flat back. In the majority of examined children, a lateral curvature of the spine occurred in the frontal plane. A small number of scoliotic attitudes were also observed. There was no correlation between age and the angle of scoliosis. The body supply among children should become the subject of interest and observation by both parents and teachers or physiotherapists. As a result of an increase in the frequency of the development of postural defects, it would be advisable to introduce additional programs and diagnostic tests that will allow a precise assessment of the posture in a quick and non-invasive way. Children should be surrounded with the best care from the first years of life, because it is much easier to prevent postural defects than to treat them later.

REFERENCES

1. Kasperczyk T. Wady postawy ciała diagnostyka i leczenie. Kraków: Wydawnictwo KASPER; 1998.
2. Kowalski IM. Wady postawy i skrzywienia kręgosłupa. W: Latkowski JB, Lukas W. Medycyna rodzinna. Warszawa: Wydawnictwo PZWL; 2009.
3. Kowalski IM, Hurło L. Zaburzenia postawy ciała w wieku rozwojowym. Olsztyn: Wydawnictwo UWM; 2003.
4. Milanowska K. Wady postawy. W: Dega W, Milanowska K. Rehabilitacja medyczna. Warszawa: Wydawnictwo PZWL; 1994.
5. Nowotny J. Reedukacja posturalna w systemie stacyjnym. Bielsko- Biała: Wydawnictwo WSA; 2008.
6. Nowotny J. Podstawowe problemy diagnostyki i terapii wad postawy ciała. W: Nowotny J. Wady postawy ciała u dzieci i młodzieży. Profilaktyka –Diagnostyka –Terapia. Bielsko- Biała: Wydawnictwo WSA; 2009.
7. Śliwa W, Śliwa K. Wady postawy ciała i ich ocena. Legnica: Wydawnictwo Edytor; 2002.
8. Tuzinek S. Postawa ciała, fizjologia, patologia i korekcja. Radom: Politechnika Radomska; 2003.
9. Wilczyński J. Analiza fizjologicznych krzywizn kręgosłupa u dziewcząt z bocznym skrzywieniem kręgosłupa. Studia Medyczne 2012; 28: 27-36.
10. Wilczyński J. Boczne skrzywienia kręgosłupa. Rozpoznanie i korekcja. cz. I. Kielce: Wydawnictwo Uczelniane Wszechnica Świętokrzyska; 2000.
11. Wilczyński J. Korekcja wad postawy człowieka. Starachowice: Anthropos; 2005.
12. Wolański N. Rozwój biologiczny człowieka. Podstawy auksologii, gerontologii i promocji zdrowia. Warszawa: Wydawnictwo PWN; 2012.