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The differences in anthropometric variables and in the body composition between 7 and 8-year-olds with scoliotic changes

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Summary

The aim of the study was to determine the differences between the anthropometric variables and body composition between 7 and 8-year-olds with scoliotic changes. The shape of the spine was assessed using optoelectronic Diers formetric III 4D. Body composition was assessed by a bioelectrical impedance. The study was conducted between November 2016 and July 2017 in Posture Laboratory at the Faculty of Medicine and Health Sciences UJK in Kielce. The largest absolute value of variation in 7-year-olds from scoliosis occurred for a variable BMR (kJ) (S = 598.5), the same group of posture in idiopathic scoliosis BMR (kJ) (S = 425) and standard BMR (kJ) (S = 666). In 8-year-olds in the group of scoliosis the differences were also observed in the largest absolute value of the variable BMR (kJ) (S = 639) and in the attitudes scoliotic group (S = 602) and standard (S = 483). The univariate analysis of variance showed significant differences between 7 and 8 year-olds in the group of scoliosis in the measurement of body height (cm), weight (kg), FFM (kg) of muscle mass (kg) TBW (kg), BMR (kJ), BMR (kcal), bone mass (kg) and protein (kg) ($p < 0.05$). In the scoliotic group attitudes significant differences occurred in the body height (cm) weight (kg) BMI, fat mass (kg), FFM (kg) and muscle mass (kg) TBW (kg), BMR (kJ) BMR (kcal), bone weight (kg) and the amount of protein (kg) ($p < 0.05$).

Keywords: Anthropometric variables, body composition of children, scoliosis, idiopathic scoliosis attitude, children of 7 and 8 years old

Introduction

Scoliosis is a systemic disease that causes secondary changes in the organ movement and a circulatory and respiratory systems [1]. Scoliosis is accompanied by biochemical changes, which reflect metabolism of bone, cartilage and nerve tissue [2]. Curvature of the spine and its rotation are secondary, and reducing the thoracic kyphosis is original, leading to the progression of scoliosis [3]. Another issue is the attitude of idiopathic scoliosis, which is the tendency to diverge from the straight axis of the spine. [4] It is rather associated with the wrong posture habit [5]. Each developing spontaneously scoliosis even idiopathic scoliosis is an idiopathic scoliosis attitude at the very beginning, and only then reveals its actual trends [6]. Causes of idiopathic scoliosis have not been clarified yet [7]. There is no commonly accepted theory of aetiopathogenesis of scoliosis [8]. There is an agreement that idiopathic scoliosis is determined by many factors [9]. In the terminology, becoming common to describe phenomena associated with the aetiology, pathogenesis and pathomechanism scoliosis, word scoliogeny is used, which consists of all these processes [10]. An extensive literature describes the irregularities at the level systems, organs, tissues, cells and genes, without prejudice to their primary or secondary nature [11]. A mathematical chaos theory has become very popular recently to explain the phenomenon of scoliosis [12,13]. This theory assumes imperceptible change to the modern researcher of the biological parameters in the body causing a cascade of slow but consistent changes. This is illustrated by generally known, so-called. butterfly effect – a small butterfly's wing movement may result in such an impact that eventually in another area causes a hurricane. Many physiological systems, including postural are partly chaotic systems [14].The aetiopathogenic meaning of scoliosis is only a symptom, external expression of unrecognized pathology that can occur at any spine and age of the child [15-18]. Although, scoliosis is clearly the attitude of distortion, it is at the same time a result of the ability of the compensation body, allowing you to set the behavior of the head and shoulder girdle over the pelvis [19-22]. The final shape of the body is the result of the deforming process and compensation response, so that the body at the expense of a huge own disorders form maintains the general orientation of the body [23]. In the present state of knowledge, it is reasonable to speak about rather etiological factors, not the theory (genetic, metabolic, etc.) of scoliosis formation [24]. Currently, the most supportive concept is a multifactorial including genetic (gene CHD7) determined by the pathology of the central nervous system, causing changes in the postural system [25]. The aim of the study was to determine the differences between the anthropometric variables and body composition between 7 and 8-year-olds with scoliotic changes.

Material and methods

The study involved 251 children, including 113 girls (45.02%) and 138 boys (54.98%). The study included children aged 7 and 8 years, with the świętokrzyskie primary school. Numerous group were children aged 7 years, of which there were 130 (51.79%) of all respondents. Among them there were 63 (48.46%) and 67 girls (51.54%) boys. Eight-year children there were 121 (48.21%) of the total. In this age girls were 50 (41.32%), while 71 boys (58.68%). The selection of respondents was mixed, after having established the criteria to be met by each group. The study was conducted between November 2016 and July 2017 in Posturology Laboratory at the Faculty of Medicine and Health Sciences UJK in Kielce. All test procedures were performed according to the Helsinki declaration in force in 1964 and with the approval of the Bioethics Committee of the University of Jan Kochanowski University in Kielce (Resolution No. 5/2015). Body height tested was determined using a tape centimeter accuracy of 1 cm. Body weight and BMI were calculated using a body composition analyzer TANITA MC 780M. Body composition was assessed by bioelectrical impedance (bioelectrical impedance analysis -BIA), which consists of assessing the resistance of flowing electric current. As a research tool used in body composition analyzer Tanita MC 780 MA. During the study, they were used with three frequency: 5 kHz, 50 kHz and 250 kHz, so that an accurate analysis of the composition of the body [24]. As a result of measurement, the following variables Body composition: Body Mass (kg) Body Mass Index, Fat Mass (%) Fat Mass (kg) Fat Free Mass (kg) Muscle Mass (kg) Total Body Water (kg) , Total Body Water (%). BMR (kJ), BMR (kcal) Bone Mass (kg) Proteins (kg). The shape of the spine was assessed using optoelectronic Diers formetric III 4D. Photogrammetric method allows the video recording back surface using stereographic process raster. On the basis of the data there was created precise, three-dimensional model of the spine. Taking into account the anatomical and biomechanical assumptions of the model, it was possible to calculate the fixed points anatomical curves of the spine and torso forms of spatial parameters. Method Diers formetric III 4D is non-contact and, above all nonradioactive way of body posture measurment. The room, in which the measurement was performed posture was dimmed so that the sun's rays not fall directly on the body. The examined was stripped to the waist and stood back to a device consisting of a digital video camera and projector. The projector emits parallel measurement lines on the back surface, and a digital video camera three-dimensional image conveyed to the computer. The study was conducted in the DiCAM by measuring Average, consisting in the execution sequence of twelve pictures, that by creating the average value of the variances reduced the attitudes and thereby improve the value of clinical research. According to the manufacturer the camera Diers formetric III 4D presence of scoliosis and scoliotic attitudes was observed by considering the values of three parameters: the pelvic skewness (mm) lateral deviation (mm) and a surface of rotation (°). Idiopathic scoliosis attitude occurred when the pelvic skewness was less than 5 mm, lateral deviation was less than 5 mm and a surface of rotation was less than 5 degrees. In contrast, when the scoliosis occurred when the pelvic skewness was greater than 5 mm, lateral deviation was larger than 5 mm, and the rotation surface was greater than 5 degrees. To assess the incidence of idiopathic scoliosis or scoliosis posture all three conditions had to be met. Before starting the analytical process performed Kolmogorov-Smirnov test to determine the normality of distribution. This served to pursue a parametric statistical methods. Differences in anthropometric variables, the composition and posture between 7 and 8-year-olds determined way ANOVA. As the level of statistical significance was $p <0.05$.

Results

The test spine by Diers formetric III 4D showed scoliosis in 103 children (41%). Among the 7-year-olds with scoliosis was 21 (16.15%) girls and 31 (23.85%) boys. Among 8-year-olds with scoliosis was 18 (14.88%) girls and 33 boys (27.27%). Attitude idiopathic scoliosis diagnosed in 141 (56.17%) children. Among the 7-year-olds with an attitude idiopathic scoliosis was 41 (31.54%) and 35 girls (26.92%) boys. Among 8-year-olds with the attitude of idiopathic scoliosis was 29 (23.97%) and 36 girls (29.75%) boys. With the proper attitude was only 7 (3.0%) children. Of 7-year-olds in the proper attitude was 2 (1.54%) children in this 1 (0.77%), a girl, and 1 (0.77%) boy, and of 8-year-olds were 5 (4.13%) children, 3 (2.48%) girls and 2 (1.65%) boys (tab. 1). The values of dispersion and measures the position for the anthropometric variables and body composition variables have different schedules in 7-year-olds, and 8 groups of scoliotic attitudes, scoliosis and normal. The largest absolute value of variation in a 7-year-olds from scoliosis occurred for a variable BMR (kJ) (S = 598.5), the same group of posture in idiopathic scoliosis BMR (kJ) (S = 425) and standard BMR (kJ) (S = 666). In 8-year-olds in the group of scoliosis it was also observed differences in the largest absolute value of the variable BMR (kJ) (S = 639) and in the scoliotic attitudes group (S = 602) and standard (S = 483) (Tab. 2,3,4). The univariate analysis of variance showed significant differences between the 7-year-olds and 8-year-olds in the group of scoliosis in the measurement of body height (cm), weight (kg), FFM (kg) and muscle mass (kg) TBW (kg), BMR (kJ) BMR (kcal), bone mass (kg) and protein (kg) ($p < 0.05$). In the group scoliotic attitudes significant difference occurred in the measurements of variables: body height (cm), weight (kg) BMI, fat mass (kg), FFM (kg) and muscle mass (kg) TBW (kg), BMR (kJ), BMR (kcal), bone mass (kg) and protein (kg) ($p <0.05$). Other anthropometric variables and body composition in groups of scoliosis, scoliotic attitudes standard and did not differ significantly between the 7 and 8-year-olds (Tab. 5).

Discussion

Idiopathic scoliosis are associated with the transmission of genetic metabolic disorders. Gene defect as described CHD7 leads to single-arched or double- arched scoliosis [25]. It is expected that soon will be discovered other genes responsible for the development of scoliosis. CHD7 gene is thought to play a key role in many basic functions in the cell. It was found that the absence or failure occurs in a rare syndrome called Charge. Babies born with this syndrome often die in infancy. Those who survive have, among others, a defect myocardial infarction, developmental delay, problems with genital and urinary and abnormalities of the inner ear [26]. They develop in them also late-onset scoliosis. Mild changes in CHD7 are associated with scoliosis. After analyzing the genetic code in family members suffering from scoliosis, it turned out that they have a defect in the non-coding region of the gene CHD7. This mutation probably alters the binding of a molecule that controls whether a gene is turned on or not. In this case CHD7 gene is turned off more often than it should, which reduces the number of CHD7 protein produced. Changing the amount of protein produced is very small, however, is associated with the onset scoliosis, that progresses gradually [27]. The discovery of the gene responsible for scoliosis, will in the future detect the disease at birth and even in the fetal period. This will make possible early treatment or even prevent the formation of scoliosis.

Conclusions

The largest absolute value of variation in a 7-year-olds from scoliosis occurred for a variable BMR (kJ), the same group of idiopathic scoliosis and standard attitude. In 8-year-olds in the scoliosis group also we observed the most absolute diversity values for the variable BMR (kJ) and group scoliotic attitudes and standard. The univariate analysis of variance showed significant differences between 7 and 8-year-olds in the group of scoliosis in the measurement of body height (cm), weight (kg), FFM (kg) of muscle mass (kg) TBW (kg), BMR (kJ), BMR (kcal), bone mass (kg) and protein (kg). In the group scoliotic attitudes significant differences occurred in the body height (cm) weight (kg) BMI, fat mass (kg), FFM (kg) and muscle mass (kg) TBW (kg), BMR (kJ) BMR (kcal), bone weight (kg) and the amount of protein (kg).

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Table 1. Characteristics of respondents posture

	Children of 7 years old					
	Girls		Boys		Together	
Types of attitude	N	%	N	%	N	%
Correct attitude	1	0.77	1	0.77	2	1.54
The attitude of idiopathic scoliosis	41	31.54	35	26.92	76	58.46
Scoliosis	21	16.15	31	23.85	52	40.00
Together	63	48.46	67	51.54	130	100
	Children of 8 years old					
	Girls		Boys		Together	
Types of attitude	N	%	N	%	N	%
Correct attitude	3	2.48	2	1.65	5	4.13
The attitude of idiopathic scoliosis	29	23.97	36	29.75	65	53.72
Scoliosis	18	14.87	33	27.27	51	42.15
Together	50	41.31	71	58.67	121	100

Table 2. Distribution of anthropometric variables and body composition in children of 7 and 8 years old with scoliosis in age groups

Distribution of anthropometric variables and body composition in 7-year-olds with scoliosis

Variable	Average	Trust -95.00%	Trust 95.00%	Minimum	Maximum	Std. Std.
Body height (cm)	129.87	127.99	131.74	118.00	158,00	6.74
Body mass (kg)	28.38	25.94	30.82	17.50	63.40	8.77
BMI	16.56	15.58	17.54	10.40	26.40	3.52
Fat Mass (%)	20.68	18.92	22.45	10.30	40,20	6.34
Fat Mass (kg)	6.33	5.20	7.47	1.90	20.80	4.07
Fat Free Mass (kg)	21.98	20.63	23.33	15,20	42.70	4.86
Muscle Mass (kg)	20,83	19.52	22,14	14.40	40.50	4.71
Total Body Water (kg)	16.06	15.07	17.05	11.10	31.30	3.55
Total Body Water (%)	58.30	57.05	59.54	43.80	65.70	4.47
BMR (kJ)	4,707.89	4,541.27	4,874.50	3,724.00	7,176.00	598.47
BMR (kcal)	1,125.50	1,084.96	1,166.04	890,00	1,715.00	145.61
Bone Mass (kg)	1.21	1.15	1.28	0.80	2.20	0.24
Proteins (Kg)	4.71	4.41	5.01	3.30	9.20	1.09

Distribution of anthropometric variables and body composition in 8-year-olds with scoliosis

Variable	Average	Trust -95.00%	Trust 95.00%	Minimum	Maximum	Std. Std.
Body height (cm)	137.82	135.53	140.12	122,00	152.00	8.17
Body mass (kg)	32.79	30.16	35.43	20,10	66.10	9.38
BMI	17,10	16.05	18.16	11.20	30.20	3.76
Fat Mass (%)	21.08	19.37	22.78	10.00	42.80	6.06
Fat Mass (kg)	7.32	6.00	8.65	2.00	28.30	4.71
Fat Free Mass (kg)	25,42	23.94	26.90	17.70	41,00	5.26
Muscle Mass (kg)	24,10	22,70	25.51	16.60	38.90	5.01
Total Body Water (kg)	18.58	17.48	19.67	12.60	30.00	3.89
Total Body Water (%)	68.27	46.83	89.70	41.90	601,00	76.23
BMR (kJ)	5,045.71	4,866.09	5,225.33	4,142.00	7,058.00	638.64
BMR (kcal)	1,207.43	1,164.74	1,250.12	990,00	1,687.00	151.79
Bone Mass (kg)	1.38	1.31	1.45	1.00	2.10	0.25
Proteins (Kg)	5.44	5.11	5.77	3.60	8.90	1.17

Table 3. Distribution of anthropometric variables and body composition in children of 7 and 8 years old with the attitude of idiopathic scoliosis in age groups

Distribution of anthropometric variables and body composition in 7-year-olds with an attitude of idiopathic scoliosis

Body composition variables	Average	Trust -95.00%	Trust 95.00%	Minimum	Maximum	Std. Std.
Body height (cm)	129.21	127.71	130.71	112.00	148,00	6.57
Body mass (kg)	26.68	25,40	27.95	17,10	43.20	5.58
BMI	15.81	15,33	16,30	12.00	20.20	2.14
Fat Mass (%)	19,79	18.76	20,83	12.80	30.40	4.52
Fat Mass (kg)	5.45	4.93	5.97	2.40	11.10	2.26
Fat Free Mass (kg)	21.21	20.39	22.03	14.00	33.50	3.58
Muscle Mass (kg)	20.06	19,27	20.85	13.20	31.70	3.44
Total Body Water (kg)	15.63	15,02	16.24	10.20	24.50	2.66
Total Body Water (%)	58.69	57.91	59.47	50.60	63.80	3.41
BMR (kJ)	4,538.95	4,441.86	4,636.04	3,615.00	6,071.00	424.87
BMR (kcal)	1,089.53	1,064.98	1,114.08	864,00	1,451.00	107.43
Bone Mass (kg)	1.16	1.12	1.20	0.80	1.80	0.18
Proteins (Kg)	4.52	4.34	4.71	3.00	7.20	0.80

Distribution of anthropometric variables and body composition in 8-year-olds with the attitude of idiopathic scoliosis

Body composition variables	Average	Trust -95.00%	Trust 95.00%	Minimum	Maximum	Std. Std.
Body height (cm)	136.54	134.64	138.44	118.00	158,00	7.66
Body mass (kg)	32.16	30,24	34,09	19.50	63.40	7.77
BMI	17,10	16.37	17.82	13.10	25,40	2.93
Fat Mass (%)	21.46	20.08	22.83	11.70	38.50	5.55
Fat Mass (kg)	7.20	6.30	8.10	3.10	20,70	3.64
Fat Free Mass (kg)	24.97	23.83	26.11	15.60	42.70	4.60
Muscle Mass (kg)	23.62	22.53	24.70	14.80	40.50	4.38
Total Body Water (kg)	18.20	17.35	19.04	11.40	31.30	3.42
Total Body Water (%)	57.50	56.49	58.50	45,10	64.80	4.06
BMR (kJ)	4,977.71	4,828.62	5,126.80	3,766.00	7,176.00	601.69
BMR (kcal)	1,188.89	1,153.26	1,224.52	900,00	1,715.00	143.79
Bone Mass (kg)	1.35	1.29	1.41	0.80	2.20	0.23
Proteins (Kg)	5.34	5.09	5.59	3.40	9.20	1.00

Table 4. Distribution of anthropometric variables and body composition in children of 7 and 8 years old with the correct attitude in the age groups

Distribution anthropometric variables and body composition in 7-year-olds with correct attitude

Body composition variables	Average	Trust		Minimum	Maximum	Std. Std.
		-95.00%	95.00%			
Body height (cm)	126.50	69.32	183.68	122,00	131,00	6.36
Body mass (kg)	23.25	-15.50	62,00	20.20	26.30	4.31
BMI	14.45	3.65	25.25	13.60	15.30	1.20
Fat Mass (%)	17.90	10,28	25.52	17,30	18.50	0.85
Fat Mass (kg)	4.10	-0.98	9.18	3.70	4.50	0.57
Fat Free Mass (kg)	19.15	-14.52	52.82	16.50	21.80	3.75
Muscle Mass (kg)	18.10	-13.67	49.87	15.60	20.60	3.54
Total Body Water (kg)	14.05	-10.73	38.83	12.10	16.00	2.76
Total Body Water (%)	60.35	54.63	66.07	59.90	60,80	0.64
BMR (kJ)	4,387.00	-1,597.62	10371.62	3,916.00	4,858.00	666.09
BMR (kcal)	1,048.50	-380.95	2,477.95	936,00	1,161.00	159,10
Bone Mass (kg)	1.05	-0.86	2.96	0.90	1.20	0.21
Proteins (Kg)	4.05	-2.94	11.04	3.50	4.60	0.78

Distribution anthropometric variables and body composition in 8-year-olds in the correct attitude

Body composition variables	Average	Trust		Minimum	Maximum	Std. Std.
		-95.00%	95.00%			
Body height (cm)	135.00	126.22	143.78	130.00	145.00	7.07
Body mass (kg)	31.24	25.95	36.53	27.00	36.50	4.26
BMI	17.16	14.71	19.61	15.70	20.50	1.98
Fat Mass (%)	21.28	16:19	26.37	17,10	27.80	4.10
Fat Mass (kg)	6.70	4.42	8.98	4.60	9.60	1.84
Fat Free Mass (kg)	24.54	20,55	28.53	21.40	29.70	3.22
Muscle Mass (kg)	23.22	19.44	27.01	20.30	28,10	3.05
Total Body Water (kg)	17.96	15.07	20.85	15.70	21.70	2.33
Total Body Water (%)	57,62	53.93	61.31	52.90	60.70	2.97
BMR (kJ)	4,853.20	4,253.30	5,453.11	4,393.00	5,648.00	483.15
BMR (kcal)	1,160.00	1,016.59	1,303.41	1050.00	1350.00	115.50
Bone Mass (kg)	1.32	1.10	1.54	1.10	1.60	0.18
Proteins (Kg)	5.26	4.37	6.15	4.60	6.40	0.72

Table 5. ANOVA analysis of differences for the anthropometric variables and body composition between 7 and 8-year-olds

Differences in anthropometric variables and body composition between 7 and 8-year-olds						
Body composition variables	scoliosis		The attitude of idiopathic scoliosis		Standard	
	F	p	F	p	F	p
Body height (cm)	**29,15**	**0.001**	**37.43**	**0.001**	2.15	0.20
Body mass (kg)	**6.10**	**0.02**	**23,65**	**0.001**	5.00	0.08
BMI	0.58	0.45	**8.99**	**0.001**	3.08	0.14
Fat Mass (%)	0.11	0.75	3.86	0.05	1.20	0.32
Fat Mass (kg)	1.31	0.26	**12.10**	**0.001**	3.50	0.12
Fat Free Mass (kg)	**11.91**	**0.001**	**29.70**	**0.001**	3.74	0.11
Muscle Mass (kg)	**11.66**	**0.001**	**29.13**	**0.001**	3.77	0.11
Total Body Water (kg)	**11.75**	**0.001**	**25.07**	**0.001**	3.72	0.11
Total Body Water (%)	0.89	0.35	3.60	0.06	1.49	0.28
BMR (kJ)	**7.68**	**0.01**	**25.54**	**0.001**	1.13	0.34
BMR (kcal)	**7.82**	**0.01**	**21.97**	**0.001**	1.13	0.34
Bone Mass (kg)	**12.29**	**0.001**	**30.16**	**0.001**	3.01	0.14
Proteins (Kg)	**10.76**	**0.001**	**29.09**	**0.001**	3.91	0.11