

Występowanie wad postawy ciała u dzieci w młodszym wieku szkolnym

The occurrence of the failure body posture of children at primary school

Izabela Wilmańska^{1(A,B,C,D,E,F)}, Anna Paradecka^{2(A,B)}, Jan W. Raczkowski^{1(A)}

¹Uniwersytet Medyczny w Łodzi, Polska/Medical University of Lodz, Poland

²Ośrodek Rehabilitacji dla Dzieci i Młodzieży w Łodzi, Polska/Rehabilitation Center for Children and Youth in Lodz, Poland

Streszczenie:

Cel pracy. Kompleksowa ocena postawy ciała dzieci w młodszym wieku szkolnym oraz określenie częstości występowania w populacji dzieci wad postawy. Oszacowanie wpływu wartości wskaźnika BMI na występowanie wad postawy względem płci oraz odpowiedź na pytanie czy z wiekiem wzrasta ilość wad.

Materiał i metodyka. Badaniem objęto 285 uczniów z klas I-III z łódzkiej szkoły podstawowej. Przedmiotem badań było 135 dziewczynek i 150 chłopców w wieku 6-9 lat. Przeprowadzono badanie metodą oglądową. Oceniano postawę ciała w płaszczyźnie strzałkowej i czołowej. Dokonano oceny dynamicznej chodu. Metodą sylwetkową dokonywano oceny zarysu krzywizn kręgosłupa i wysklepienia klatki piersiowej. Istotną częścią badania była obserwacja kształtu pleców w skłonie tułowia w przód wg testu Bertranda.

Wyniki. W badanej populacji dzieci z klas I-III stwierdzono duży odsetek wad postawy ciała – 30,53% badanej populacji to dziewczęta i 37,54% chłopcy z wadami postawy. Wykazano, że najczęstszym defektem postawy ciała dzieci w młodszym wieku szkolnym jest asymetryczne ustawienie łopatek. Dotyczyło to porównywalnie 37,77% dziewczynek i 31,33% chłopców. Najbardziej obciążoną występowaniem odchyleń od normy była grupa 7-latków. Nie wykazano istotnej zależności między wpływem wskaźnika BMI na wady postawy względem płci. Wykazano, że wartość wskaźnika BMI wpływa na koślawość kolan w badanej populacji.

Wnioski. Badania pokazują jak istotnym problemem są wady postawy u dzieci. Częstość ich występowania powinna zmotywować do wykonywania badań przesiewowych w szkołach. To istotnie wpłynie na jak najszybsze wykrycie odchyleń od normy i zmotywuje rodziców i opiekunów do pójścia na konsultację ortopedyczną czy rehabilitacyjną.

Słowa kluczowe:

wady postawy ciała, młodszy wiek szkolny, BMI, badania przesiewowe, koślawość kolan

Abstract

Goal. Comprehensive evaluation of the body posture in the early school-age children and determining the prevalence of the postural disorders in the population. Estimation of impact of the BMI on the occurrence of the disorders in relation to a child's gender, and answering the question whether the frequency of the disorders increases with age.

Materials and Methods. The study included 285 school children from the grades 1-3, from a primary school located in Lodz. The study population consisted of 135 girls and 150 boys, aged 6-9 years. As the research method, the visual examination has been used. The body posture has been assessed in sagittal and frontal planes. And the dynamic gait assessment has been performed. With the observation-based postural assessment method, the spine curvature and the ribcage curvature have been evaluated. An important part of the research has been the observation of the back in the bent forward position, using the Bertrand's test.

Results. Within the study population of children from the grades 1-3, we have found large percentage of children with the posture disorders, 30.53% in girls and 37.54% in boys. It has been shown, that the most common posture disorder in the early school-age children is the asymmetrical alignment of the shoulder blades. This has been true for, respectively, 37.77% of the girls and 31.33% of the boys. Most at risk for the abnormalities being developed, has been the group of the 7-years-olds. No statistically significant dependency has been found between the impact of the BMI on the posture disorders, in relation to a child's gender. It has been established that, in the study population, the BMI has had an impact on the valgus knees deformity.

Conclusions. The research has shown true importance of the children posture disorders issue. The prevalence rate of these disorders should prompt to organize screening programs in schools. This will definitely help to quickly establish any deviations from the normal status and will motivate parents and guardians to seek an orthopedic advice or join a rehabilitation program.

Key words:

posture disorders, early school age, BMI, screening tests, valgus knees

Introduction

In this study, we wanted to pay particular attention to the constantly growing problem, the posture disorders in children. This is a health problem, but also a social issue [1].

According to Cytowicz-Karpiłowska: "Posture disorders never occur suddenly. There are certain earlier symptoms, which should not be neglected. The sooner we start correction and compensation exercises, the better effect we will accomplish" [2].

We all live surrounded by the amenities of civilization. The sedentary lifestyle helps to create the "generation of the bent-spine computer geeks" [3].

Due to the lack of physical exercise, and the resulting decreased efficiency of the muscles, the active spine stabilization disappears and the body posture deteriorates. When these factors affect young organism, which is prone to acquire all the bad habits, the body posture quickly disintegrates (4).

It does change and is being determined by multiple factors. Body posture is being formed from birth, and lasts until the end of the ossification process [5]. If any disorders shall occur, one may quote Paweł Różański, who said: "It is not true, that the child will outgrow the disorder, but it is true, that the disorder will grow together with the child." [6].

In the school-age children, special attention should be paid to the two critical periods, one around 7 years of age and the other during the pubescence process [7].

The first critical period takes place at the beginning of school, in the age of 6-7 years. This is related to entering the school life and the necessity to adjust to the new situation [8]. In kindergarten a child has the freedom of movement, physical exercise and rest, while the school system imposes sitting down for several hours in a bench, which often is not adjusted for such little children. During this period, care must be taken to ensure that the conditions are proper, and do not allow the posture disorders to develop. [7, 9, 10].

During the puberty period, once more the posture deterioration often takes place. The pubescent leap occurs in girls at the age of 11-13, and in boys at 13-14 [11]. It usually comes together with the postural imbalance phenomenon. A certain "slackening" of the posture becomes noticeable. The body of a child is having a problem to counteract the forces of gravity: jawbone easily falls down, eyelids close, shoulders move forward, front edge of the pelvis moves downward and the feet tend to go flat. During the puberty period occur significant changes in both, body and mind, caused by the hormones. Basic sexual differentiation in the physical appearance takes place [1]. The juvenescence period begins, during which the final posture is being formed [12].

The proper, correct body posture is of great importance to a child's health. If a child has plenty of physical activity, is being raised in a hygienic environment and fed accurately, then the child's posture is being formed and developed properly [4]. Therefore, it is extremely important for the parents to pay attention to the correct posture of their child, since during the kindergarten

and the early-school years the posture may easily become distorted.

In order to properly examine body posture, one must focus on the deviations within the three planes (13, 14). Particularly important it is to assess the symmetry of the body parts in relation to the so-called "long axis." While viewing posture in the frontal plane, looking from the front, we must pay attention to the positioning of the head, torso, the spinal axis and the axis of the lower limbs [12].

Goal

The study goal has been to make a comprehensive assessment of the body posture in children from the grades 1 to 3. The research problem has been: the prevalence of postural disorders, and the determining of types of those disorders, within the population of children in the early school-age. In the study, we have also attempted to answer the question, whether the BMI does have an impact on the occurrence of the disorders in girls and in boys, and whether the number of the disorders increases with age.

Materials and Methods

The study included 285 school children from the grades 1-3, from a primary school located in Lodz. The study population consisted of 135 girls and 150 boys, aged 6-9 years. These were the children whose parents had consented to the study (research proposal had been submitted to parents of all the children).

The research method included the assessment of the orthopedic condition. Examinations took place in the morning, in a school-room designated by the school's headmaster. During the examination the children had been barefoot, dressed in underwear. In the process of the visual examination from the front side, we have paid the attention to the position of the head, shoulders, ribcage, torso, hips, legs and the feet along the longitudinal axis; we have also evaluated the children's gait. Further, we have examined posture from the back, assessing: position of the head, shoulder blades, spinal axis, triangles of the waist, iliac ala, rear upper iliac spines and the lower limbs and feet. From the side view, with the observation-based postural assessment method, we have evaluated the shape of the anterior-posterior spinal curvatures and the chest curvature. Important, and statistically significant, has been the observation of the back in the bent forward position, using the Bertrand's test [11].

The basic anthropometric measurements of the studied population have been taken. The body weight and height have been established. For the weight measurement we have used a medical scale and for the height – anthropometric device. The measurement procedure took place in the school nurse's cabinet. The measurements have been taken to the nearest 0.5 kg and 0.5 cm.

Quantitative variables: body weight, height and BMI, have been analyzed with the Statistica 10 Software, using the basic descriptive statistics measures. We have calculated the arithmetic mean values (\bar{x}) and the standard deviation (SD). To assess the statisti-

cal significance of the dependencies between the groups, and the occurrence of the posture disorders, we have used the Student's t-test for independent samples and the Mann-Whitney U test. To specify interrelationship between the studied variables, on the basis of the data acquired we have calculated the Spearman's rank correlation coefficient. The critical level of statistical significance has been set at $\alpha = 0.05$.

Research Results

Among the 285 children, the posture disorders have been found in 194, which has accounted for 68.07% of the total number (Table 1). The deviations from the correct posture have been found in 87 girls (30.53%) and in 107 boys (37.54%) (Table 2).

Table 1. Number of examined children

Płeć Sex	Ilość Total	%
Girls	135	47.37
Boys	150	52.63
Total	285	100

Table 2. Percentage of children with posture disorders among all examined children

Sex	Children with no disorders		Children with disorders		Total	
	N	%	N	%	N	%
Girls	48	16.84	87	30.53	135	47.37
Boys	43	15.09	107	37.54	150	52.63
Total	91	31.93	194	68.07	285	100

The children participating in the study were 6 to 9 years old. With regard to the age, the comparatively largest group has been the group of children 7 and 8 years old. The smallest has been the group 6 years old children (Tab. 3).

Table 3. Number of children, according to age and gender

Sex	Children with no disorders		Children with disorders		Total	
	N	%	N	%	N	%
Girls	48	16.84	87	30.53	135	47.37
Boys	43	15.09	107	37.54	150	52.63
Total	91	31.93	194	68.07	285	100

Based on the obtained results, it has been established, that in the group of the examined 6-years-olds, more than 11.57% of the children have shown deviations from the correct body posture. In the group of 7-years-olds, we could have observed an even greater number of children with the disorders, which has accounted for 24.21%. Our study results confirm, that the posture disorders are of major concern for the group of 8-years-olds – at 18.24%, and for the group of 9-years-olds, the children with deviations from the normal status accounted for 14.03%. The results we have obtained suggest, that the posture disorders are more frequent in the case of boys – 37.54% (N = 107), than in girls – 30.53% (N = 87) (Table 4).

We have found, that the percentage difference in the incidence rate of the posture disorders between male and female study participants, is not statistically significant $p = 0,21$ (Table 5).

During the study, we have established that there have been numerous cases of disorders of the body posture, such as: asymmetrically positioned shoulder blades, increased thoracic kyphosis, deepened lumbar lordosis, scoliosis and limbs disorders affecting postural stability. On the basis of statistical analysis, we have found the asymmetrical shoulder blades in 34.39% of the study population. The increased thoracic kyphosis – round back have had 16.84% of the participants (Table 6). The deepened lumbar lordosis – concave back, we have noted in 11.23% of the study population. Scoliosis has been found in 28.77% of the children. The analysis has shown, that the flat back disorder has occurred in 10.18% of the participants. The group of children with the concavo-convex back accounted for 4.21% of the study population. Posture errors have been found in 17.54% of the participants (Table 7). Ribcage defects have occurred more frequently in boys – 8.42%, than in girls 4.21 %. The study has shown a small percentage of children with the lower limbs disorders affecting postural stability. Valgus knees related disorders have had 11.93% of the children. Bowleggedness has been found in 5.26% of the study population. 8.42% of the participants have had valgus heels (Table 7).

Table 4. Prevalence of children posture disorders, with regard to age and gender

Correct body posture				Age	Incorrect body posture				Total	
Boys		Girls			Boys		Girls			
N	%	N	%		N	%	N	%	N	%
2	8.33	5	31.25	6	22	91.66	11	68.75	33	82.50
13	28.58	11	27.50	7	40	71.42	29	72.50	69	74.19
18	40.91	21	44.69	8	26	59.09	26	55.31	52	57.14
10	34.49	11	34.38	9	19	65.51	21	65.62	40	65.57
43	28.67	48	37.04	Total	107	71.33	87	62.96	194	68.07

Table 5. Dependency between correlated variables

Correlated variables	Gender	N	Spearman rank correlation R	P
Age & Disorder	0 ₃ +0	135 150	- 0,14	0,0125*
BMI & Disorder	0 ₃ +0	135 150	- 0,03	0,59
Gender & Disorder	0 ₃ +0	135 150	0,073	0,21
Age & Ribcage Defects	0 ₃ +0	135 150	- 0,24	0,000028*
Age & Asymmetry of Shoulder Blades	0 ₃ +0	135 150	- 0,06	0,82
Age & Scoliosis	0 ₃ +0	135 150	- 0,01	0,86
Age & BMI	0 ₃ +0	135 150	0,14	1
BMI & Gender	0 ₃ +0	135 150	0,10	0,084
BMI & Ribcage Defects	0 ₃ +0	135 150	- 0,05	0,37
BMI & Asymmetry of Shoulder Blades	0 ₃ +0	135 150	- 0,000898	0,98
BMI & Scoliosis	0 ₃ +0	135 150	0,01	0,82
BMI & Valgus Knees	0 ₃ +0	135 150	0,20	0,00056*

N- liczebność grup

p* - korelacja istotna statystycznie przy $p < 0,05$

p* – statistically significant correlation at $p < 0,05$

Table 6. Percentage of posture disorders in the study population

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Type of disorder	Girls		Boys		Total	
	N	%	N	%	N	%
Round Back	19	6.67	29	10.18	48	16.84
Concave Back	15	5.26	17	5.96	32	11.23
Flat Back	12	4.21	17	5.96	29	10.18
Concavo-convex Back	9	3.16	3	1.05	12	4.21

Table 7. Percentage of posture disorders in the study population

Type of disorder	Girls		Boys		Total	
	N	%	N	%	N	%
Asymmetrically Positioned Shoulder Blades	51	17.89	47	16.49	98	34.39
Ribcage Defects	12	4.21	24	8.42	36	12.63
Scoliosis	38	13.33	44	15.44	82	28.77
Valgus Knees	23	8.07	11	3.86	34	11.93
Bowleggedness	8	2.81	7	2.46	15	5.26
Valgus Heel	6	2.11	18	6.32	24	8.42
Posture Errors	20	7.02	30	10.53	50	17.54

Evaluation of the anthropometric values is shown in Table 8. It has been determined that the mean values of body weight and height increased with age. The BMI value has not been significantly different in the groups of girls and boys.

Table 8 Examination of the particular bodily features, in the age groups, by gender

Age	Gender	N	Waga		Wzrost		BMI	
			x	SD	x	SD	x	SD
6	♀	16	24.65	±4.74	124.25	±5.89	15.85	±1.86
	♂	24	26.29	±6.23	125.58	±6.19	16.54	±2.79
7	♀	40	25.81	±3.38	126.02	±6.42	16.25	±1.89
	♂	53	27.97	±5.95	128.86	±6.13	16.74	±2.71
8	♀	47	29.9	±5.26	133.59	±5.81	16.68	±2.15
	♂	44	31.63	±5.21	135.81	±6.34	17.09	±2.01
9	♀	32	34.14	±8.20	141.04	±5.49	17.00	±3.22
	♂	29	35.14	±7.29	140.39	±5.47	17.69	±2.68

N – group size
x – arithmetic mean
SD – standard deviation
♀ – girls
♂ – boys

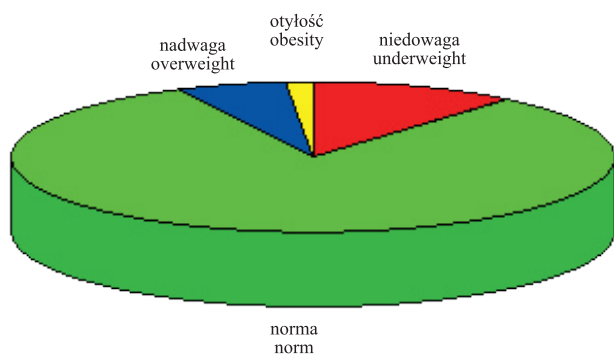


Fig. 1. BMI in the study population of girls

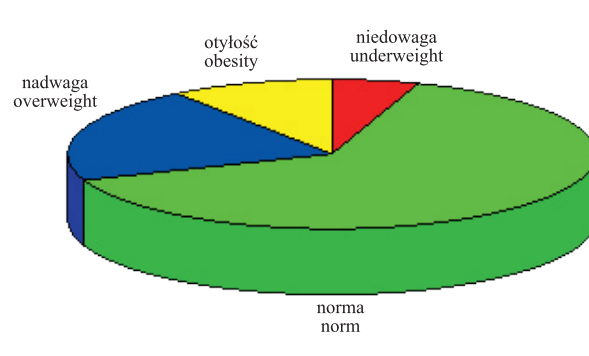


Fig. 2. BMI in the study population of boys

Prevalence of the underweight, normal weight, overweight and obesity in the examined children is shown in Figure 1 and 2. In the study population, the BMI is normal in 81% of girls and 64% of boys. Overweight cases have been more frequent in boys (21%) than in girls (6%). Obesity has been present in 10% of the male population, and only in 1% of the female group. Underweight have been 15 girls, which accounted for 11% of the female population. There have been less underweight boys – 6% (Figure 1, 2).

Discussion

The subject of the posture disorders has been addressed by researches numerous times. One of the major objectives of this discussion has been to prevent the body posture deformations and to forewarn, that the deformations will lead to even worse consequences in future. It seems quite worrying, that despite of so many publications and prevention programs, the posture disorders still pose a growing problem among the children and young generation. The fact is, that the development of computerization, automotive industry and so numerous everyday facilities, make people – from the early childhood on - spend less and less time on physical exercises or on an ordinary walk in a park [9]. The traditional backyard games have been replaced with watching tv; the playing football on the pitch – with computer games. Unfortunately, the young and developing organism, without the proper dose of physical exercises, makes up a fertile ground for the formation of disorders and obesity.

Cited by many authors epidemiology concerning the incidence rate of the posture disorders has been, by and large, confirmed in our study. The research has shown, that in the large percentage, 68.07% of the study population, we have found the posture disorders. In the available subject literature, diversified results for the incidence rate of the posture disorders have been presented. According to Janiszewska – the incidence rate is 93.2% [15]; Maciańczyk-Paprocka presents 18.4% [16]; Pokrywka – 52.6% of girls and 35.8% of boys [17].

Summing up the results of the up-to date analysis of the research

conducted, we have shown that the most common posture disorder is the asymmetrical alignment of shoulder blades. It has been noted in 37.77% of girls and 31.33% of boys (34.38% of the study population). Wojna et al. have reached a comparable result – 30% [18]. Similarly, Rosa in his study says, that the asymmetry of the shoulder blades has been found in 48% of females and 40% of males [19]; Szczepanik et al., a significant misalignment of the shoulder blades have had 54% of girls and 48% of boys [20].

The examination results, available in our study, show the increased thoracic kyphosis in 16.84% of the participants. Rosa et al. have found the round back in 18% of the study population [19]. Deepening of the lumbar lordosis, in our research, have been observed in 11.23% of the examined group.

This result indicates discrepancy if compared to other studies. In the study by Rosa, the concave back have had 4% of the study population [19]; Szczepanik sets the rate at 26.5% of children [20].

Scoliosis, due to its disastrous consequences, is often the subject of research and analyzes [21].

It shall be noted, that in the studies there are differences regarding the prevalence of scoliosis. Maciałczyk-Paprocka has found the scoliotic posture in 10.4 % of boys and in 37.7% of girls. [16]. A similar result has shown Szczepanik, who has indicated the scoliosis disorders in 47% of the examined children [20]. Rosa has estimated the scoliosis incidence for 44% in girls and for 36% in boys [19]. In our study, the lateral bending of spine have shown 28.14% of the female population and 29% of the male population. Walicka-Cupryś has found the scoliosis in 17.33 % of the study participants [22]. The differences in the figures seem to arise from the different research methods applied and the different sizes of the examined groups.

In our study, the most at risk for the development of the posture disorders have been the group of 7-years-olds. Similar results have shown Maciałczyk-Paprocka and the contributing authors [23].

On the basis of the up-to-date research we have sought to determine whether there is a dependency between the BMI and the posture disorder, and the gender of the participating children. Our own observations, as well as the results of Maciałczyk-Paprocka and Mikolajczyk studies, have shown no correlation between the above variables [16], [24]. The statistically significant dependency has been established between the BMI and the valgus knees, and between the age and the incidence rate of posture disorders. This has been confirmed by the research by Chromik. In this research the correlation has been shown, that the incidence rate of the defective postures in children increases with their age (8).

The presented results have shown true importance of the children posture disorders issue. The prevalence rate of these disorders should prompt to organize screening programs in schools. This will definitely help to quickly establish any deviations from the normal status and will motivate parents and guardians to seek an orthopedic advice or join a rehabilitation program. The above shall be aimed to further evaluate and qualify the children for the appropriate corrective exercises in rehabilitation centers, which specialize in the posture disorders treatment.

Conclusions

1. In the studied population of children from the grades 1-3, we have found 68.07% participants with posture disorders.
2. The most common posture disorder, in the early school-age children, is the asymmetrical alignment of the shoulder blades. This has been true for, respectively, 37.77% of the girls and 31.33% of the boys.
3. Most at risk for the abnormalities being developed, has been the group of 6 year old children (82.56). Within this group the defects have occurred more frequently in boys, 91.66%, than in girls, 68.75%.
4. No statistically significant dependency has been found between the impact of the BMI on the posture disorders in relation to a child's gender.
5. It has been established, that in the study population, the BMI has had an impact on the valgus knees deformity.

Adres do korespondencji / Corresponding author



mgr Izabela Wilmańska

Uniwersytecki Szpital Kliniczny im. WAM w Łodzi
Oddział Kliniczny Rehabilitacji Pourazowej
92-115 Łódź, ul. Pieniny 30
izabela.wilmanska@stud.umed.lodz.pl

Piśmiennictwo/ References

1. R. Kopaniarz, „Przyczyny powstawania i korekta wad postawy.,” Lider, pp. 42-43, 2003.
2. W. Cytowicz- Karpłowska, „Wady postawy w płaszczyźnie strzałkowej.,” Wychowanie Fizyczne i Zdrowotne, nr 1, pp. 2-3, 2006.
3. E. Kapuścińska i L. Kapuściński, „Kręgosłup filar naszego organizmu.,” Lider, nr 6, pp. 27-29, 2003.
4. A. Ćwirlej, K. Walicka- Cupryś i H. Gregorowicz-Cieślak, „Aktywność ruchowa dzieci 10-letnich w czasie wolnym.,” Przegląd Medyczny Uniwersytetu Rzeszowskiego, nr 3, pp. 262-266, 2005.
5. J. Nowotny, K. Czupryna, A. Rudzińska i O. Nowotny- Czupryna, „Zmiany postawy ciała w pierwszych sześciu latach nauki szkolnej.,” Fizjoterapia Polska, nr 4, pp. 378- 383.
6. P. Różański, „Następstwa wad postawy u dzieci i młodzieży.,” Wychowanie Fizyczne i Zdrowotne, nr 1, pp. 4-5, 2006.
7. M. Lichota, „Zmiany kształtu przednio-tylnych krzywizn kręgosłupa u dzieci w wieku 6-7 lat.,” Wychowanie Fizyczne i Sport, tom 5, nr 1, pp. 15-16, 2008.
8. K. Chromik, A. Rohan-Fugiel, D. Śliwa i J. Fugiel, „Częstość występowania typów postawy ciała chłopców i dziewcząt w młodszym wieku szkolnym.,” Acta Bio-Opt Inf Med Biomed Eng, tom 4, nr 15, pp. 346-357, 2009.
9. M. Olszewska, K. Żołyński i S. Olszewski, „Wady postawy u siedmiolatków a ich aktywność ruchowa w życiu codziennym.,” Kwartalnik Ortopedyczny, nr 1, pp. 35-43, 2006.
10. M. Kutzner- Kozłowska, Korekcja wad postawy, Warszawa: Akademia Wychowania Fizycznego, 1997.
11. T. Kasperczyk, Wady postawy ciała diagnostyka i leczenie. , Kraków: Kasper, 2004.
12. J. Nowotny, Podstawy fizjoterapii, Kraków: Kasper, 2004.
13. A. Zemba, Kinezyterapia tom 2, Kraków: Kasper, 2002.
14. U. Hoppe, Kryteria biomechaniczne prawidłowej postawy człowieka. , Wrocław: Politechnika Wrocławska, 1994.
15. R. Janiszewska, S. Tuzinek, S. Nowak, A. Ratyńska i T. Binaszewski, „Abnormalities of posture in 6-12 year-old children – pupils of primary schools from Radom – a pilot study.,” Probl Hig Epidemiol, tom 3, nr 90, pp. 342-346, 2009.
16. K. Maciałczyk-Paprocka, „Epidemiologia wad postawy u dzieci i młodzieży.,” Poznań, 2013.
17. J. Pokrywka, J. Fugiel i P. Pośluszny, „Częstość wad postawy ciała u dzieci z Zagłębia Miedziowego.,” Fizjoterapia, tom 4, nr 19, pp. 3-10, 2011.
18. D. Wojna, J. Anwar, A. Hawrylak i K. Barczyk, „Ocena postawy ciała dzieci w młodszym wieku szkolnym.,” Fizjoterapia, tom 4, nr 18, 2010.
19. K. Rosa, R. Muszkieta, W. Zukow, M. Napierała i M. Cieślacka, „Częstość występowania wad postawy u dzieci z klas i-iii szkoły podstawowej.,” Journal of Health Sciences, tom 3, nr 12, pp. 107-136, 2013.
20. M. Szczepanik, J. Walak, E. Stępień, M. Woszczak i M. Woszczak, „Ocena wad postawy jako test przesiewowy dla dzieci zagrożonych skoliozą.,” Studia Medyczne, tom 2, nr 26, pp. 31-37, 2012.
21. E. Zeyland-Malawka i E. Prętkiewicz-Abacjew, „Objawy asymetrii w postawie ciała dzieci i młodzieży – potencjalne zagrożenie pełnosprawności układu ruchu i zdrowia.,” Nowiny Lekarskie, tom 4, nr 75, pp. 394- 398, 2006.
22. K. Walicka- Cupryś, R. Skalska-Izdebska, J. Drzał-Grabiec i A. Sołek, „Związek pomiędzy postawą ciała i stabilnością posturalną u dzieci w wieku wczesnoszkolnym.,” Postępy Rehabilitacji, nr 4, pp. 47-54, 2013.
23. K. Maciałczyk-Paprocka, A. Krzyżaniak, T. Kotwicki, A. Sowińska, B. Stawińska-Witoszyńska, M. Krzywińska-Wiewiórowska i J. Przybylski, „Występowanie błędów w postawie ciała u uczniów poznańskich szkół podstawowych.,” Probl Hig Epidemiol, nr 2, pp. 309-314, 2012.
24. E. Mikołajczyk, A. Jankowicz-Szymańska, W. Wojtanowski i M. Janusz, „Postawa ciała w płaszczyźnie strzałkowej dzieci w wieku przedszkolnym.,” Hygeia Public Health, tom 50, nr 1, pp. 26-30, 2015.