

**Dariusz Mucha, Tadeusz Ambroży,  
Justyna Wojtala, Marta Ząbek,  
Andrzej Szczygieł, Juliusz  
Piwowarski, Krzysztof Żaba**

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selected somatic characteristics**

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Security Dimensions. International & National Studies nr 2 (14), 100-106

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2015

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Tekst jest udostępniony do wykorzystania w ramach  
dozwolonego użytku.

## **IDENTIFICATION OF RISKS WITHIN BODY POSTURE BY MEANS OF ANALYSIS OF SELECTED SOMATIC CHARACTERISTICS**

**DARIUSZ MUCHA**

*The Academy of Physical Education in Cracow, the Faculty of Physical Education and Sport, POLAND*

**TADEUSZ AMBROŻY**

*The Academy of Physical Education in Cracow, the Faculty of Physical Education and Sport, POLAND*

**JUSTYNA WOJTAŁA**

*The Academy of Physical Education in Cracow, the Faculty of Motorial Rehabilitation, POLAND*

**MARTA ZĄBEK**

*The Academy of Physical Education in Cracow, the Faculty of Motorial Rehabilitation, POLAND*

**ANDRZEJ SZCZYGIEL**

*The Academy of Physical Education in Cracow, the Faculty of Motorial Rehabilitation, POLAND*

**JULIUSZ PIWOWARSKI**

*University of Public and Individual Security APEIRON in Cracow, POLAND*

**KRZYSZTOF ŻABA**

*The Academy of Physical Education in Cracow, the Faculty of Motorial Rehabilitation, POLAND*

### **ABSTRACT**

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**Introduction:** The aim of the research was to evaluate the relationship between selected body parameters and posture in a group of lower secondary school students. The formulated hypothesis assumed that body mass does not influence the posture of teenagers aged 14–16.

**Materials and methods:** The research included a group of 73 students aged 14–16, including 42 boys and 31 girls. The research was conducted by means of a modern body posture computer analysis system – Zebris APGMS Pointer. Static indicators of body posture, as well as mobility and shape of the spine were analyzed as well.

**Results:** The analysis of body built indicators has proven that there is not any statistical relationship between the distribution of body mass and the value of spinal curvature. What is more, it has turned out that there is a relationship between physical activity and the content of fatty tissue.

**Conclusion:** Non-invasive monitoring of body posture as well as the parameters of body posture enables an early detection and correction of posture defects which influence human physical development and the quality of their life in the future.

### **ARTICLE INFO**

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*Article history*

Received: 01.06.2015 Accepted 28.06.2015

*Keywords*

posture, body built, Zebris APGMS Pointer system

## INTRODUCTION

At present posture defects are common occurrences which constitute a serious social problem. They occur not only in children and teenagers, but also in adults. Correct posture is not only of esthetical, but above all health-oriented significance. By choosing a modern, non-invasive method used to examine patients, such as Zebris APGMS Pointer system, it is possible to check if a person has any deviations from correct posture and to what degree, as well as to investigate how selected indicators of correct posture influence the development of posture in teenagers aged 14–16 attending lower secondary schools in Cracow<sup>1</sup>. Children and teenagers are more and more at risk of presence of posture defects as well as bad movement habits because of among others limited physical activity and a sedentary lifestyle, which exerts negative influence on their physical development. Unfortunately, school environment does not have a positive influence on the prevention of development of posture defects. This is caused by, among others, school desks which are not suitable for children's height and sitting for long periods. However, there are also positive solutions, which support physical fitness: sport classes, the possibility to use the gym by teenagers during the school break. The research was conducted in such school, that is one in which there are sport classes as well as extracurricular sport classes<sup>2</sup>.

The aim of the research was to analyze the relationship between selected body param-

eters and posture evaluated by Zebris APGMS Pointer System, as well as to run a preliminary diagnosis of possible posture defects in the selected group of teenagers.

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This article inaugurates the series of articles concerning the kinesiological aspects of security culture, which has already been announced in the conference paper at *Medzinarodny Vedecko-Odbrony seminar* in Liptovský Mikuláš, 2012<sup>3</sup>.

The research is based on the Japanese *kara-da de oboeru* concept – learning with the whole body<sup>4</sup>, where not only physical activities but also intellectualization and mental practicing is needed for complex preparation of trainees<sup>5</sup>. This is known as a holistic approach, and is closely connected to security culture concept, linking the first (mental) and the second (organizational) pillars of security culture<sup>6</sup>. As a result of scientific project, we plan to show how effectively people use their physical abilities, as well as the ways to preserve trainees' health and prevent their bodies from overtraining.

and boys in the light of body mass index (BMI), „Sports Medicine”, 2008, 4(6).

1 J. Kołodziej, K. Kołodziej, I. Momola, *Body posture, its defects and correction*, 1st edition, Rzeszów 2004; T. Kasperczyk, *Body posture vs. selected morphological and functional features in children aged 8–15*, Cracow 1988; I. Kowalski, L. Hurlo, *Body posture defects in developmental age*, University of Warmia and Mazury in Olsztyn 2003.

2 A. Jopkiewicz, E. Suliga, *Biomedical bases of development and upbringing*, Radom – Kielce 2005; D. Wojna, J. Anweijer, A. Hawrylak, K. Barczyk, *The evaluation of body posture and physical activity in early school age children*, „Sports Medicine”, 2013, 1(4), p. 27–36; M. Grabara, D. Pstragowska, *The evaluation of body posture in girls*

3 J. Piwowarski, T. Ambroży, *The impact of physical culture on realization of human security need*, [in:] *Medzinarodny Vedecko-Odbrony seminar*, Akademia Ozbroyenych Sil, Liptowski Mikulasz 2012, s. 294–303.

4 J. Piwowarski, *Police Officer's Ethics*, Podhajska/Cracow 2013, p. 191.

5 T. Ambroży, H. Duda, D. Ambroży, J. Piwowarski, E. Dybińska, *Интеллектуализация процесса физического воспитания в контексте формирования отдельных элементов культуры безопасности*, „Теория и практика физической культуры”, 2013, no 11, ISSN 0040-3601.

6 For more about the three pillars of security culture see T. Ambroży, J. Piwowarski, H. Duda, J. Matis, *Rola intelektualizacji w procesie szkolenia grup dyspozycyjnych*, [in:] red. P. Bogdalski, D. Bukowicka, R. Częścik, B. Zdrodowski, *Grupy dyspozycyjne społeczeństwa w świetle potrzeb bezpieczeństwa państwa*, t. 1, Szczytno 2014, p. 87–88 and cited literature.

## THE MATERIAL AND METHODS

The research included a group of 73 participants aged 14–16, 42 boys and 31 girls, who are students of Lower Secondary School no. 34 in Cracow. Only students whose parents gave a written agreement to participate in the research were included in the research group. The research study was conducted at the turn of 2013 and 2014 by means of Zebris APGMS Pointer system, which enables to evaluate body

## THE RESULTS

The hypothesis formulated in this paper concerns the lack of significant relations between the spinal curvature and the distribution of body mass. The hypothesis was verified by running two chi-squared independence tests between a student's body mass and his thoracic kyphosis, and then lumbar lordosis.

Table 1 presents participants' body mass and the value of thoracic kyphosis.

Table 1. The number of students depending on body mass and the value of thoracic kyphosis

Body mass \ Kyphosis Th	10–20	21–30	31–40	41–50	51–60	61–70	TOTAL
30–40	0	0	1	0	1	0	2
41–50	0	2	1	1	2	1	7
51–60	1	3	7	12	4	2	29
61–70	1	1	3	5	6	2	18
71–80	0	1	2	4	2	0	9
81–90	0	0	1	1	0	1	3
91–100	1	0	1	1	0	0	3
TOTAL	3	7	16	24	15	6	71

Source: own work.

posture. This method is not only very precise, but also non-invasive, and thanks to this, it is possible to control the progress of correction of posture defects or to exclude it more often or in a more precise way. This programme enables to obtain results in graphic form. Other measurements which were taken are the measurement of body weights on electronic scales, the measurement of body height using a measuring rod, as well as the measurement of fatty tissue using a fat caliper. Fatty tissue was measured in three places. The localization of measures taken in girls included the following places: above hip, thigh, triceps. In boys fatty tissue was measured on chest, stomach and thigh<sup>7</sup>.

7 A. Jopkiewicz, E. Suliga, *Biomedical bases of development and upbringing*, Radom – Kielce 2005; D. Wojna, J. Anweiler, A. Hawrylak, K. Barczyk, *The evaluation of body posture and physical activity in early school age children*, „Sports Medicine”, 2013, 1(4), p. 27–36; A. Malinowski, J. Strzałko,

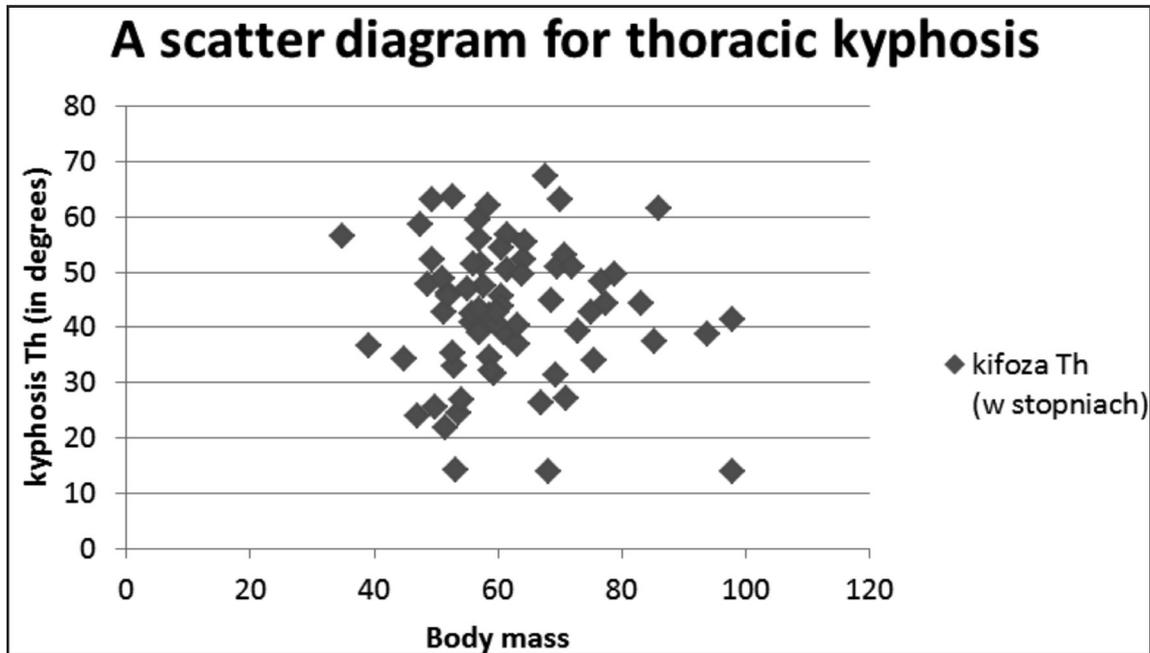
In accordance with the procedure of chi-square independence test the following value of test statistics was arrived at:  $\chi^2 = 22,756$ .

The number of degrees of freedom is  $(r-1)(k-1) = 30$  and the hypotheses were verified at the level of significance  $\alpha = 0,05$ . Using  $\chi^2$  distribution tables the following value  $\chi^2_{\alpha;(r-1)(n-1)} = \chi^2_{0,05;30}$  was read. Therefore,  $\chi^2 \leq \chi^2_{0,05;30}$ , which means that at the level of significance  $\alpha = 0,05$  there was no basis to reject the null hypothesis which assumes the independence of body mass and the value of thoracic kyphosis. The obtained result confirmed the undermentioned scatter diagram for the investigated features and that is why it was difficult to observe any dependency between them<sup>8</sup>.

*Anthropology*, Polish Scientific Publishers PWN Warsaw – Poznań 1985; Zebris Medical GmbH, „WinSpie 2.x for Windows. Manual”, 03/2006 edition.

8 A. S. Jackson, M. L. Pollock, *Generalized equations for predicting body density of men*, „British Journal of Nutri-

Fig. 1. A scatter diagram for thoracic kyphosis



Source: own work

Table 2. The number of students depending on body mass and the value of lumbar lordosis

Body mass \ Lordosis L	0–10	11–20	21–30	31–40	41–50	TOTAL
30–40	0	0	1	1	0	2
41–50	1	3	0	1	1	6
51–60	0	4	9	9	4	26
61–70	0	3	2	4	6	15
71–80	0	2	3	2	1	8
81–90	0	0	2	1	0	3
91–100	0	0	1	1	0	2
TOTAL	1	12	18	19	12	62

Source: own work

Table 2 presents values of body mass and lumbar lordosis in the research group.

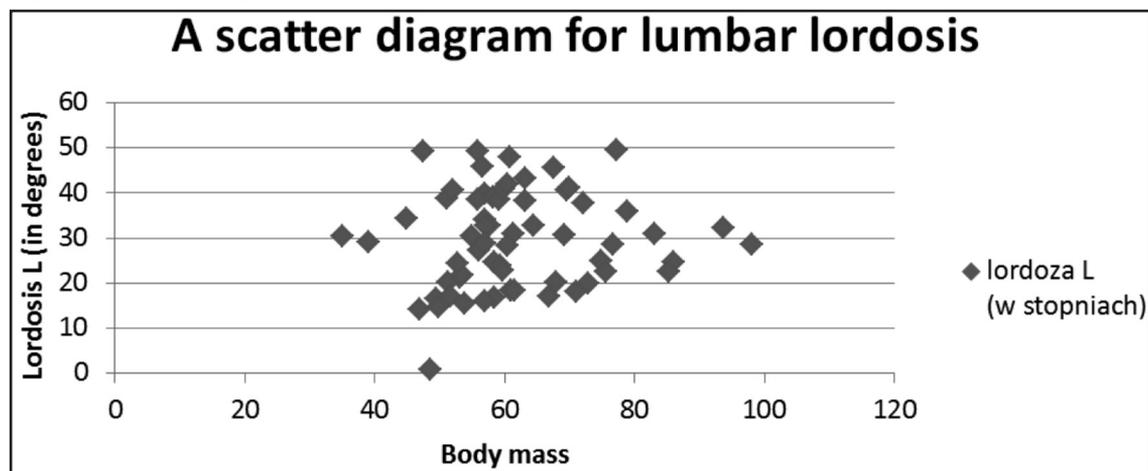
In accordance with the procedure of chi-square independence test the following value of test statistics was arrived at:  $\chi^2 = 25,767$ .

The number of degrees of freedom is  $(r-1)(k-1) = 24$  and the hypotheses were veri-

fied at the level of significance  $\alpha = 0,05$ . Using the  $\chi^2$  distribution tables the following value:  $\chi^2_{\alpha; (r-1)(k-1)} = \chi^2_{0,05; 24} = 36,42$  was read. Therefore,  $\chi^2 \leq \chi^2_{0,05; 24}$ , which means that at the level of significance  $\alpha = 0,05$  there was no basis to reject the null hypothesis, which assumes the independence of body mass and the value of lumbar lordosis. The obtained result (as in the case of previous test) confirms the undermentioned scatter diagram for the investigated features

tion”, 1978, 40, p. 497–504; A. S. Jackson, M. L. Pollock, A. Ward, *Generalized equations for predicting body density of women*, „Medicine and Science in Sports and Exercise”, 1980, 12, p. 175–182; A. Zaliaś, *Statistical methods*, PWE Warsaw 2000; W. Starzyńska, *Practical Statistics*, Polish Scientific Publishers PWN, Warsaw 2005.

Fig. 2. A scatter diagram for lumbar lordosis



Source: own work

and that is why it was difficult to observe any dependency between them<sup>9</sup>.

When analyzing the spinal curvature from the angle of the value of thoracic kyphosis and lumbar lordosis it was assumed that the formulated hypothesis is true. However, a significant dependency between the spinal curvature and the distribution of body mass has not been found in the research group.

## DISCUSSION

Body posture in children and teenagers, both able-bodied and disabled, becomes a challenge of ever increasing proportions, which is confirmed by numerous research studies and scientific publications. An important thing which should be done in case of children and teenagers is monitoring their development and changes which occur in their body built, as well as in the development and forming of body built. Modern methods, such as Zebris APGMS Pointer system, Moiré's photogrammetric method, Posturometr-S method and the Integrated Shape Investigation System (ISIS) method

deserve attention since they enable to obtain objective and accurate results. The growing interest in the evaluation of body posture results from the care for the correct physical development of the young generation<sup>10</sup>.

Sustained and ever-growing development of civilization cause changes in the environment in which children grow. Depending on the effect of environmental factors, children can develop correct or defect posture. The causes of posture defects can be found in the disorders of the axis as well as the position of sections of the motor organ. Body posture is an extremely significant issue, especially when it is seen from the angle of the development of civilization and sedentary lifestyle. Posture defects result from the operation and influence of numerous factors. Correct posture means that the right body parts cooperate in such a way as to ensure the fluidity of movements. If a change occurs in any part of the motor organ, then we should expect a compensation to occur in another part of this organ. A quick diagnosis of posture defect provides grounds to start therapy with a patient

9 A. S. Jackson, M. L. Pollock, *Generalized equations for predicting body density of men*, „British Journal of Nutrition”, 1978, 40, p. 497–504; A. S. Jackson, M. L. Pollock, A. Ward, *Generalized equations for predicting body density of women*, „Medicine and Science in Sports and Exercise”, 1980, 12, p. 175–182; W. Starzyńska, *Practical Statistics*, Polish Scientific Publishers PWN, Warsaw 2005.

10 T. Kasperczyk, *Posture defects – diagnostics and treatment*, Cracow 2004; E. Zeyland-Malawka, *Corrective gymnastics*, the Physical Academy in Gdańsk Publishing House 1995; A. Szczygieł, M. Janusz, A. Marchewka, *The evaluation of selected parameters of body posture in children and teenagers by means of modern diagnostic and measuring techniques in therapeutic aspect*, Med. Sport., 2001, no. 11, p. 420–424.

and avoid in this way problems with the motor organ in the future<sup>11</sup>.

The analysis of indicators of body built in the abovementioned notifications has proven that the distribution of body mass should not be related to the value of the spinal curvature. This has been confirmed in accordance with the hypothesis formulated earlier. What is more, it has turned out there is a significant dependency between physical activity and fatty tissue. People who do sport regularly had on average 5% lower content of fatty tissue than people who were not so physically active<sup>12</sup>.

## CONCLUSION

On the basis of the results of conducted research the following conclusions can be drawn:

1. No significant relations between the value of the spinal curvature (lumbar lordosis and thoracic kyphosis) and the distribution of body mass has been found in the research group.
2. In the research group the content of fatty tissue depends on doing sport. The content of fatty tissue is on average 5% higher in participants who are not very physically active than in those who do sport regularly.
3. Zebris APGMS Pointer System is a useful diagnostic technique and the obtained results enable to detect irregularities early.

11 T. Kasperczyk, *Body posture evaluation methods*, Skryptowe Publishing House no. 65, Cracow 2000; J. C. Eisenmann, R. T. Bartee, M. Q. Wang, *Physical activity, TV viewing, and weight in U.S. youth: 1999 Youth Risk Behavior Survey*, „Obes Res” 2002, 10, p. 379–385; Diet and physical activity: a public health priority. Countryweb site. Geneva, World Health Organization, 2006; A. Wojtyła, P. Biliński, I. Bojar, K. Wojtyła, *Physical activity of lower secondary school students in Poland*, Probl. Hig. Epidemiol., 2011, 92(2), p. 335–342.

12 J. Wilczyński, *Posture vs. somatic characteristics in children aged 12–15 of Świętokrzyskie Voivodeship*, „Medical Studies”, 2011, 24 (4), p. 29–33; W. Rusek, T. Pop, J. Glista, J. Skrzypiec, *The evaluation of posture in students in research conducted by means of ZEBRIS system*, „University of Rzeszow Medical Review”, 2010, 3, p. 277–288.

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