

ASSESSMENT OF BODY POSTURE OF BOYS AGED 7-15 IN RELATION TO THE BODY MASS INDEX -BMI

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SUMMARY

Introduction. The problem of growing incidence of bad posture in children and adolescents is so significant that it has become an important social problem. One of reasons behind higher incidence of abnormal posture may be underweight, overweight or obesity. **Objectives.** Evaluation of incidence of bad posture in boys aged 7-15, including the *Body Mass Index* (BMI). **Material and methods.** The study included 511 boys aged 7-15 from Szczecin. Each age group consisted of approx. 50-70 children. Posture was assessed with the spheromatometric method. Physiological curvature of the spine in the sagittal plane were determined. Next, normative values for anterior-posterior spinal curvatures were used to determine the incidence of bad posture. Based on logistic regression, the parameters of the logit model were assessed, taking into account subjects' age and BMI. **Results.** In the entire population, bad posture was identified in 32.48% of subjects. Age did not differentiate the incidence of bad posture in terms of statistical significance. Boys with incorrect BMI amounted to 28.37% of all subjects. Underweight was observed in 6.96% of subjects. 7.54% of subjects were overweight and 2.03% obese, which gave a total of 9.57% of the researched population. The increase in BMI correlated with higher chances of bad posture by almost 25%, while age was a variable which reduced the risk of bad posture by almost 15%.

Conclusions. Incorrect BMI predisposed subjects to bad posture. High proportion of children with bad posture justify the need to promote preventive and corrective measures. The increasing proportion of overweight and obese children should serve as a motivator to shape healthy behaviors of students and parents, as well as schools and the medical environment.

Key words: body posture, bad posture, BMI, children and adolescents

INTRODUCTION

Epidemiological data on incidence of bad posture in children and adolescents are very diverse and range from a few to several dozen percent of the population [1, 2, 3, 4, 5, 6]. Consequently, it is difficult to reliably answer the question: What proportion of children and adolescents suffer from bad posture? Discrepancies arise from – among others – various test methods [7, 8] and usage of non-uniform eligibility criteria to evaluate body posture and its components. Despite these discrepancies in the data on bad posture incidence, the scale of the problem is so significant that it has become a social problem, as correct body posture has not only an aesthetic value, but it does affect health of an individual [10, 11, 12].

Body posture depends on age, gender, somatic type, race, somatic structure of the bone, joint and muscle system, mental state, lifestyle, sports, and professional occupation [4]. Sedentary lifestyle and increasing number of hours spent in front of TV and computer may lead not only to hypokinesia, but also to an increased proportion of overweight and obese pupils. This, in turn, may intensify the incidence of bad posture.

The aim of the study was to evaluate the incidence of bad posture in boys aged 7-15, considering their Body Mass Index (BMI).

MATERIALS AND METHODS

The study included 511 boys aged 7-15 from Szczecin. Random selection of subjects was used, where the sampling frame were schools in different districts. Each age group consisted of approx. 50-70 children (Tab. I). Posture was assessed with the spheromatometric method. Physiological curvature of the spine in the sagittal plane were determined. Next, normative values for anterior-posterior spinal curvatures (developed for children and adolescents from Szczecin [12]) were used to determine the incidence of bad posture. The term ‘bad posture’ in this study refers to abnormal anterior-posterior spinal curvatures.

Measurements of height and weight were made according to the principles of anthropometry; BMI (*Body Mass Index*) was used to calculate the degree of underweight,

overweight and obesity (BMI = body weight in kg / height² in cm). Cut-off points for underweight, norm, overweight and obesity were adopted from Woynarowska's criteria [13].

Statistical analysis was performed with Statistica 10.0. Characteristics of the distribution and significance of differences were determined on the basis of the chi-square test. Statistically significant indicators had to meet the condition of $p < 0,05$. Based on logistic regression in the logit model, model parameters were assessed, taking into account subjects' age and BMI.

RESULTS

Mean values (M), standard deviation (SD), standard error (SE) and the scope of the analyzed variables (minimum-maximum) of the boys' BMI is presented in Table I.

Table I. Characteristics of boys' BMI (N=511)

Age [years]	Number of subjects N=511	BMI M [kg/m ²]	BMI SD	BMI SE	BMI Min.	BMI Max.
7	54	16,61	2,63	0,35	12,91	24,01
8	55	16,75	2,27	0,30	13,46	22,91
9	49	15,74	2,62	0,37	11,03	22,38
10	53	18,01	3,44	0,47	13,54	26,33
11	60	18,19	3,08	0,39	13,85	28,44
12	59	17,25	2,33	0,30	12,32	25,00
13	72	21,03	4,30	0,50	13,01	32,19
14	56	19,82	4,21	0,56	12,36	36,93
15	53	20,75	2,96	0,40	15,69	29,91

M - mean value, SD - standard deviation, SE - standard error, Min. - Minimum Max. - Maximum.

The incidence of bad posture in various age groups is presented in Table II. Bad posture was identified in 166 boys, which accounted for 32.48% of the total population. The highest proportion of pupils with bad posture was observed in boys aged 13 (37.5%), 9 (36.73%) and 7 (35.18%). The least frequent (28.3%) bad posture was identified among 12- and 15-year-olds.

Based on the data presented in Table III, it may be said that age did not differentiate significantly the incidence of defective body posture of the surveyed boys.

Table II. Incidence of good and bad posture in boys (N=511)

Body posture		Age	Age	Age	Age	Age	Age	Age	Age	Age	Total
		[years] 7	[years] 8	[years] 9	[years] 10	[years] 11	[years] 12	[years] 13	[years] 14	[years] 15	
Bad	N	19	18	18	16	17	17	27	19	15	166
	%	35,18%	32,72%	36,73%	30,18%	28,33%	28,81%	37,50%	33,93%	28,30%	32,48%
Good	N	35	37	31	37	43	42	45	37	38	345
	%	64,82%	67,28%	63,27%	69,82%	71,77%	71,19%	62,50%	66,07%	71,70%	67,52
N		54	55	49	53	60	59	72	56	53	511

Table III. Descriptive statistics related to differences in incidence of bad posture, based on the subjects' age

	Chi-kwadrat	df	p
Chi² Pearsona	2,847733	df=8	p=,94355
Chi² NW	2,847999	df=8	p=,94353

df - degrees of freedom, p - statistical significance.

BMI varies between population with good and bad posture (Tab. IV). Boys with body posture defects had higher BMI – (19.46 kg/m²) compared to students with good posture (17.81 kg/m²). The observed differences were statistically significant (Tab. V).

Table IV. Descriptive statistics related to body posture (N=511), based on the BMI (dependent variables do not contain BD)

Body posture	BMI M [kg/m ²]	N	BMI SD	BMI Min.	BMI Max.
Bad	19,46	166	4,60	11,03	36,93
Good	17,81	345	2,99	12,29	31,98
Total	18,35	511	3,67	11,03	36,93

M - mean value, SD - standard deviation, SE - standard error, Min. - Minimum
Max. - Maximum.

Table V. Analysis of variance of body posture and BMI

	SS Efekt	df Efekt	MS Efekt	SS Error	df Error	MS Error	Statistical value F	p
BMI	304,6672	1	304,6672	6573,480	509	12,91450	23,59110	0,000002

SS - sum of squares, df - degrees of freedom, MS - mean squares, p - statistical significance. Selected results are significant with $p < 0.05000$.

The incidence of bad posture in boys, based on BMI is presented in Table VI. Boys with incorrect BMI amounted to 28.37% of all subjects. Underweight was observed in 6.96% of subjects. 7.54% of subjects were overweight and 2.03% obese, which gave a total of 9.57% of the researched population. Out of 166 students with bad posture, 20 individuals (12.05%) were underweight, 48 (28.92%) were overweight, while 20 (12.05%) were obese. Incorrect BMI of subjects predisposed them to bad posture. Pupils with incorrect BMI suffered from bad posture significantly more often ($p < 0.05$), compared to subjects with correct body weight. The observed differences were statistically significant (Tab. VII).

Table VI. Observed incidence of bad posture, based on BMI

Body posture		BMI underweight	BMI correct	BMI overweight	BMI obesity	Total
Bad	N	20	78	48	20	166
	%	12,05%	46,99%	28,92%	12,05%	
Good	N	24	288	26	7	345
	%	6,96%	83,48%	7,54%	2,03%	
Total		44	366	74	27	511

Table VII. Descriptive statistics related to bad body posture versus correct and incorrect BMI

	Chi-kwadr.	df	p
Chi² Pearsona	80,87672	df=3	p=0,0000
Chi² NW	77,64706	df=3	p=,00000
Fi	,3978335		
Contingency coefficient	,3696546		
V Craméra	,3978335		

df - degrees of freedom, p - statistical significance.

To analyze the impact of age and BMI on the likelihood of bad posture, logistic regression in a logit model was used. The parameters of the model, taking into account subjects' age and BMI, are presented in Table VIII. The increase in BMI correlated with higher risk of bad

posture by almost 25%, while age was a variable which reduced the risk of bad posture by almost 15%.

Table VIII. The logit model of logistic regression for impact of age and BMI on the incidence of bad posture

	B0	BMI	Age
Assessment	-3,679077	0,2189262	-0,1527064
Standard deviation	0,04510567	0,002504503	0,003512047
t(103E3)	-81,56574	87,41302	-43,48072
p	0	0	0
-95%CL	-3,767642	0,2140086	-0,1596022
+95%CL	-3,590513	0,2238438	-0,1458105
Chi-kwadrat Walda	6652,971	7641,037	1890,573
p	0	0	0
Odds ratio	0,02524625	1,244739	0,8583817
-95%CL	0,02310648	1,238633	0,8524828
+95%CL	0,02758418	1,250876	0,8643215
Odds ratio		290,2899	0,2947432
-95%CL		255,5708	0,2789235
+95%CL		329,7256	0,3114602

DISCUSSION

Results of author's own study showed that 32.48% of boys aged 7-15 from Szczecin suffered from bad posture. These results, compared with the results of studies on posture of school-age children and adolescents in various regions of Poland, indicate a much lower proportion of bad posture. Similar values were obtained in studies on girls aged 7-15 from Szczecin, where bad posture was identified in 32.4% of subjects [2]. In many publications, the incidence of bad posture reaches 40-80% of children's population [3, 4, 5, 14, 15]. There are also results which indicate as many as over 90% of children and adolescents aged 7-15 with bad posture [6, 16]. According to Kotwicki [17], Polish publications which report a 50% incidence of bad posture among children, should be approached critically. The results of the research on bad posture in school-age children (N=3520) from the Czech Republic show that only 38.3% of pupils aged 7-15 were diagnosed with bad posture [18]. This result is similar to the results obtained in this study.

According to author's own study, the largest proportion of children who require general development exercises, was aged 7, 9 and 13 (when children face an accelerated growth rate). According to Proszkowiec et al. [19], adverse changes in body posture usually

become apparent in the most critical periods for posturogenesis, that is at the age of 6-7, and during the first phase of puberty.

Nowadays, we face many factors that trigger acquired body posture defects. Usually, these are associated with the development of civilization and modern lifestyle. Among them are: poor nutrition [20], reduced – or in extreme cases almost a total lack of – physical activity [10, 20, 21, 22, 23], increased risk of overweight and obesity [2, 20, 24, 25], increased time spent in front of TV/computer [20], long and incorrect sitting position at school and while doing homework [20], too heavy backpack [20], wearing uncomfortable shoes [20], muscle imbalance [26], and functional disorders of the musculoskeletal system [9, 21].

Findings of author's own study presented in this paper showed that incorrect BMI of subjects predisposed them to bad posture. It was found that an increase in BMI correlated with higher risk of bad posture by almost 25%. Polish literature does not see overweight and obesity as a major factor which negatively affects body posture. Research by Kazmierczak et al. [27] showed no correlation between the degree of spinal curvature in certain sections and BMI of children and adolescents. On the other hand, Grabara and Pstrągowska [24] stated on the basis of research on overweight and obese children that increased body weight is accompanied by flattened thoracic kyphosis and increased lumbar lordosis. Górnjak et al. [25] showed that a deficit of fatty tissue was related with greater lability of posture and a higher incidence of asymmetry, while excess of body fat triggered increased physiological curvatures of the spine and incidence of flat feet. Barczyk et al. [28] also found that both underweight and overweight/obesity predispose individuals to adverse changes in the spine curvature. International studies show that there is a significant correlation between obesity and incidence of bad posture in children and adolescents [29]. Authors suggest that obesity increases the risk of incorrect spinal curvatures in children. According to Wszyńska et al. [30], the content of muscle tissue, fat tissue and level of physical activity determine parameters of a body posture. It may be concluded that early diagnosis and early treatment of both deficiency and excess of body weight reduces the risk of bad posture. Early diagnosis of incorrect body posture helps take timely and appropriate steps to correct the curvature or increase the level of physical activity, which is the key to children and adolescents' health [10, 22].

CONCLUSIONS

1. Incorrect BMI predisposed subjects to bad posture.
2. High proportion of children with bad posture justifies the need to promote preventive and corrective measures.

3. Increasing proportion of overweight and obese children and adolescents should serve as a motivator to shape healthy behaviors of students and parents, as well as schools and the medical environment.

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