Observational Study

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Body mass index and waist-to-height ratio among schoolchildren with visual impairment

A cross-sectional study

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Abstract

Children and adolescents with visual impairments may be predisposed to excessive body mass due to restrictions in everyday functioning and the ability to take part in physical activity. This study aimed to estimate the prevalence of obesity, overweight, and abdominal obesity (AO) among blind and partially sighted schoolchildren and to determine whether sociodemographic factors and participation in physical education classes (PEC) are associated with excessive body weight or AO in this group.

A cross-sectional sample of 141 partially sighted or blind schoolchildren aged 7 to 18.9 years were included in this study. Anthropometric measurements were performed, and sociodemographic variables and ability to attend PEC were recorded. Overweight and obesity were noted among 21.3% and 14.9% of students, respectively. Although more males than females had excessive body weight (39.2% vs 32.3%), the difference was not significant (chi square test [ch^2] = 3.197; probability value [*P*] = 0.362). There was a significant association between mean body mass index standard deviation score and age (results of ANOVA analysis [*F*] = 5.620; *P* = 0.0045). A waist-to-height ratio (WHtR) ≥0.50 was observed among 27.7% of pupils. The prevalence of AO in boys and girls was 32.9% and 21.0%, respectively; this difference was not significant (ch^2 = 2.48; *P* = 0.12). There was a significant relationship between mean WHtR and age (7–9 years: 0.477 ± 0.050; 10–13 years: 0.484 ± 0.065; ≥14 years: 0.454 ± 0.061; results of Kruskal–Wallis test [*H*] = 8.729; *P* = 0.023, respectively).

Multivariate logistic regression analysis showed that none of the sociodemographic variables examined (except "having siblings") were significantly associated with the occurrence of overweight, obesity, and AO. Subjects with no siblings were 4 times more likely to have WHtR ≥ 0.5 (odds ratio [OR] = 4.22; 95% confidence interval [CI] = 1.33–17.8; *P* = 0.01).

Overweight and obesity were almost 4 times more frequent (OR = 3.74; 95% CI 0.81–17.4) and AO 3 times more frequent (OR = 3.18, 95% CI 0.71–14.2) among students not participating in PEC. Excessive body mass and AO represent an urgent health problem among schoolchildren with visual impairments. Health education concerning healthy eating habits and physical activity should be provided to this group to reduce potential future health costs.

Abbreviations: Φ = phi, Φ_c = Cramér phi, BMI = body mass index, BMI *z*-score = BMI standard deviation score, ch^2 = chi square test, CI = confidence interval, *F* = results of ANOVA analysis, GP = general practitioner, *H* = results of Kruskal–Wallis test, N = number of participants, OR = odds ratio, *P* = probability value, PA = physical activity, PEC = physical education classes, *t* = results of Student *t* test, WC = waist circumference, WHO = World Health Organization, WHtR = waist-to-height ratio, *z* = result of Mann–Whitney *U* test.

Keywords: obesity, schoolchildren, visual impairment, waist-to-height ratio

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1. Introduction

Overweight and obesity among children and adolescents represent an urgent public health problem.[1,2] Preventing excessive body mass index (BMI) among schoolchildren is important to reduce cardiovascular mortality risk in adulthood.[3] Studies suggest that youngsters with disabilities are at increased risk of obesity compared to peers without chronic conditions, and difficulty performing regular exercise is known to be the main obstacle these children face in maintaining normal body weight.[4,5]

In Poland, special schools for blind and partially sighted pupils represent an ideal setting where children and adolescents can not only be educated but also rehabilitated or prepared for working life. The number of children with visual impairment worldwide is estimated to be 19 million, about 7% of whom are registered as blind.[6] In Poland, over 6000 pupils are blind or partially sighted; about half attend special schools.[7]

Although BMI has been used for many years to assess overweight and obesity among children and adolescents, it does not provide an insight into the distribution of body fat. Evidence suggests that abdominal obesity (AO) is a better predictor of cardiometabolic disorders than BMI or waist circumference.[8,9] Currently, the waist-to-height ratio (WHtR) is recommended as a screening tool in detecting central fat distribution, and an elevated WHtR is recognized as part of the cardiometabolic risk profile among children and adolescents.[10–12] A WHtR ≥ 0.50 is recognized as a useful tool in pediatric practice because it does not require conversion to *z*-scores or percentiles and represents a universal value regardless of sex or ethnicity.[12]

Information concerning overweight and central obesity among youngsters with disabilities, including visual impairment, is scarce. A small number of global reports indicate that between 18.4% and 63% of young people with visual impairment are overweight or obese.[4,13,14]

Assuming that children and adolescents with visual impairment are more likely to experience obesity and overweight than their sighted peers as a result of potential restrictions in everyday functioning or ability to take part in common forms of physical activity,[14–18] the central aim of this study was to estimate the prevalence of obesity, overweight, and AO among blind and partially sighted schoolchildren. In addition, it attempts to determine whether sociodemographic factors and participation in physical education classes (PEC) are associated with the prevalence of obesity, overweight, or AO in the study group.

2. Methods

The study was approved by the Bioethics Committee of the Medical University of Lodz (no. RNN/291/14/KB) and was conducted between June 2014 and December 2014. Students from 4 National Polish Special Schools for the Blind and Partially Sighted (Cities: Dąbrowa Górnicza, Kraków, Łódź, and Wrocław) participated in the study. Exclusion criteria were the presence of other mental or physical disabilities, being absent on the day of examination, or a lack of interest in participation. All children had been diagnosed with visual impairment according to International Classification of Diseases (ICD)-10[19] before the age of 5. A cross-sectional sample of 141 schoolchildren with visual impairment was included in the study. One hundred twenty-two subjects were partially sighted, and the rest were blind. The mean age of the study group was 14.20 ± 3.54 years (range, 7–18.9). The exclusion criteria comprised the presence of any diagnosed intellectual disability, any physical disability other than a visual one, and being absent at the time of data collection. Only students who were capable of unassisted movement were included in the study, and those who needed a wheelchair were excluded. Formal consent was obtained from all subjects. It was also taken from the parents or guardians of children who were under 18. Students over 18 wrote the consents themselves.

2.1. Sociodemographic variables

A standardized protocol was used to collect sociodemographic data. It included the following points: whether subjects live in a boarding school (Yes/No), place of residence (rural areas: residence with <50k population; semiurban areas: residence with 50–500k population; and urban areas: residence with ≥500k population), family situation (living with both parents, living only with mother or father, or other situation), whether the subjects have siblings (Yes/No), and the number of children in the family. All sociodemographic data were obtained from medical records, or declared by the subjects and confirmed by the school teachers (Table 1).

Table 1

Sample group characteristics.

	Number of participants	%
Gender		
Male	79	56.03
Female	62	43.97
Type of visual impairment		
Blind	19	13.47
Partially sighted	122	86.53
Age		
Min	7.0	
Max	18.9	
Mean	14.20	
SD	3.54	
Living in boarding school*		
Yes	60	42.86
No	80	57.14
Place of residence		
Residence with <50k population	37	26.24
Residence with 50–500k population	17	12.06
Residence with ≥500k population	87	61.70
Family situation†		
Living with 2 parents	83	60.15
Living only with mother or father	40	28.98
Other family situation	15	10.87
Number of siblings		
0	25	17.73
1	64	45.39
2 or more	52	36.88
Type of participation in PEC‡		
Participation in PEC without any restriction	28	20.74
Restricted participation in PEC depending on health condition	89	65.93
Unable to attend PEC because of health condition	18	13.33
Height in centimeters		
Min	123.2	
Max	194.95	
Mean	156.71	
SD	17.65	
Body weight in kilograms		
Min	22.5	
Max	129.3	
Mean	53.16	
SD	18.54	
WC in centimeters		
Min	50.0	
Max	126.0	
Mean	72.83	
SD	11.56	
WHtR		
Min	0.35	
Max	0.77	
Mean	0.47	
SD	0.06	
BMI *z*-score		
Min	−3.30	
Max	5.14	
Mean	0.48	
SD	1.39	

BMI = body mass index, PEC = physical education classes, SD = standard deviation, WC = waist circumference, WHtR = waist-to-height ratio.
* Missing data for 1 subject.
† Missing data for 3 subjects.
‡ Missing data for 6 subjects.

2.2. Participation in physical education classes

Participation in PEC was found to be the most basic form of physical activity among schoolchildren; however, lack of participation in PEC is prevalent throughout Europe, as a child can be excused on the basis of medical opinion or parental request.[20] According to Polish law, only the school director may waive or limit participation in PEC on the basis of a valid medical opinion. The recommendation regarding the level of participation in physical activity at school is made by a pediatrician or general practitioner and should be documented in the medical records at the school.[21] A physician may give an opinion that a student can participate in all physical activities during classes or that a student may participate in PEC with some restrictions. If restricted physical activity is recommended, the physical education teachers are obliged to adjust the exercise program to the individual needs of these students. Finally, a physician may decide that a student is unfit to attend PEC, but may participate in rehabilitation programs.

2.3. Anthropometric measurements

All students were measured without shoes and in light clothing. A stadiometer was used to measure height; the height of each student was measured twice, and if the difference between the measurements was 5 mm or more, a third measurement was taken. Weight measurements were taken using a digital physician scale with an accuracy of 50 g. Again, the measurements were taken twice, with a third measurement taken if the difference between the measurements was 300 g or more. Two waist circumference measurements were taken at the midpoint between the lowest border of the rib and the upper border of the iliac crest; a third measurement was taken if the first and second measurements differed by 3 cm or more.[22]

The BMI (kg/m^2) criteria for overweight and obesity was based on WHO criteria.[23] Overweight was identified if BMI > +1 SD, obesity >+2 Standard Deviation (SD), underweight <−2 SD, and severely underweight <−3 SD from the WHO growth standard median. Central body fat distribution was assessed via WHtR, which was obtained by dividing the waist circumference by height (both in centimeters); a cutoff point of ≥0.50 was selected for defining AO.[24,25]

2.4. Statistics

The partially sighted and blind groups were further subdivided according to gender and age. Age groups were as follows: 7 to 9 years (children), 10 to 13 years (early adolescence), and ≥14 years (late adolescence). Data were incomplete for a few cases. Information about living in a boarding school was missing in 1 subject, while 3 subjects did not give information about their family situation. We were unable to find documentation regarding the recommended level of participation in PEC for 6 of the subjects.

All statistical analyses were performed using Statistica v 10 PL software (Statsoft Polska, Kraków, Poland). Nonparametric chi-square test was used to evaluate differences in WHtR and BMI standard deviation score (BMI *z*-score) distributions among gender, type of visual impairment (blind/partially sighted students), and age group. Phi and Cramér phi were used to analyze the effect size. BMI *z*-score distribution did not differ significantly from normal; therefore, Student *t* test was used to compare mean values based on gender. In order to compare BMI *z*-score mean values between particular age groups, ANOVA analysis of variance was used, while Tukey honest significance test was used as a post hoc test to compare groups in pairs. WHtR distribution was significantly different from normal; therefore, nonparametric Mann–Whitney *U* test was used to compare the mean WHtR values of 2 age groups and independent gender groups, and a nonparametric Kruskal–Wallis test was used to make a comparison among 3 age groups. Effect size was measured with Cohen *d* parameter.

Multivariate logistic regression was used to evaluate the association between sociodemographic variables and participation in PEC and prevalence of WHtR ≥ 0.50 or excess weight. All confidence intervals (CIs) are presented as 95% CI.

There was no significant relationship between the distribution of BMI *z*-score in blind and partially sighted groups (chi square test [ch^2] = 2.21; P = 0.53) and WHtR ≥ 0.50 (ch^2 = 0.17; P = 0.68); this was the basis for combining these groups in the statistical analysis. For all analyses, a P value less than 0.05 was considered to be significant.

3. Results

3.1. Statistical analysis of obesity and overweight

Overweight was noted among 21.3% (number of participants [N] = 30) of students, and obesity was observed in 14.9% (N = 21). Although more males than females had excessive body weight (39.2% [N = 31] vs 32.3% [N = 20]), the difference was not significant (ch^2 = 3.19; P = 0.36). The distribution of the BMI *z*-scores was found to have a significant relationship with age group (ch^2 = 18.56; P = 0.005; Cramér phi = 0.26), with the following prevalence of excessive body weight found: 7 to 9 years: 45% (N = 9); 10 to 13 years: 57.2% (N = 24); ≥14 years: 22.8% (N = 18).

The mean BMI *z*-score was 0.48 ± 1.39, and the difference between genders was not statistically significant (mean BMI *z*-score for boys was 0.54 ± 1.50 and for girls was 0.400 ± 1.24; results of Student *t* test [t] = 0.58; P = 0.56). There was also a significant relationship between mean BMI *z*-score and age (F = 5.62; P = 0.005). The highest BMI *z*-score was observed in the 10 to 13 years age group (7–9 years: 0.80 ± 1.08; 10–13 years: 0.95 ± 1.39; ≥14 years: 0.14 ± 1.39). Statistically significant differences between the mean BMI *z*-score values were observed between the 10 to 13 years and ≥14 years age groups (P = 0.02); the effect size was medium (Cohen d = 0.58). Moreover, the age groups showed a significant relationship with mean BMI *z*-score only among girls (F = 9.63; P < 0.001), and significant differences were noted between the 10 to 13 years group and ≥14 years group (P = 0.003) (Table 2).

3.2. Statistical analysis of abdominal obesity

A WHtR ≥ 0.50 was observed among 27.7% (N = 39) of pupils. The prevalence of AO in boys and girls was 32.9% (N = 26) and 21.0% (N = 13), respectively, but this difference was not significant (ch^2 = 2.48; P = 0.12). A relationship which approached significance was observed between distribution of WHtR ≥ 0.50 and age of the study groups (ch^2 = 5.67; P = 0.60; phi = 0.20); the prevalence of AO observed in the various age groups was as follows: 7 to 9 years: 30% (N = 6); 10 to 13 years: 40.5% (N = 17); ≥14 years: 30.3% (N = 16).

The mean WHtR in the study group was 0.47 ± 0.06. Even though mean WHtR values were higher in boys than girls (0.47 ± 0.07 and 0.46 ± 0.06, respectively), the difference was not statistically significant (result of Mann–Whitney *U* test [z] = 0.87; P = 0.39). Furthermore, there was a significant relationship

Table 2

Mean body mass index *z*-scores according to age group and gender.

Age (years)	All pupils		Gender: Boys		Gender: Girls			
	Mean ± SD	Median	Mean ± SD	Median	Mean ± SD	Median	*t*	*P*
7–9 years	0.80 ± 1.08	0.83	0.74 ± 1.35	0.76	0.88 ± 0.69	0.90	0.27	0.79
10–13 years	0.95 ± 1.39	1.18	0.76 ± 1.59	1.10	1.27 ± 0.93	1.20	1.18	0.25
≥14 years	0.14 ± 1.39	0.06	0.35 ± 1.50	0.21	−0.09 ± 1.23	−0.17	1.43	0.16
Total	0.48 ± 1.39	0.41	0.54 ± 1.50	0.41	0.40 ± 1.24	0.30	0.58	0.56
According to the age groups	$F=5.62$; $P=0.005$		$F=0.70$; $P=0.50$		$F=9.63$; $P<0.001$			
	7–9 years vs 10–13 years: $P=0.94$		7–9 years vs 10–13 years: $P>0.99$		7–9 years vs 10–13 years: $P=0.73$			
	7–9 years vs ≥14 years: $P=0.27$		7–9 years vs ≥14 years: $P=0.82$		7–9 years vs ≥14 years: $P=0.16$			
	10–13 years vs ≥14 years: $P=0.02$		10–13 years vs ≥14 years: $P=0.60$		10–13 years vs ≥14 years: $P=0.003$			

SD = standard deviation.

between mean WHtR values in the entire group when subanalyzed by age group (7–9 years: 0.48 ± 0.05; 10–13 years: 0.48 ± 0.07; ≥14 years: 0.45 ± 0.06; $H=8.73$; $P=0.02$). It was also determined that mean WHtR values were significantly higher in the group of students in early adolescence than students in late adolescence ($z=2.27$; $P=0.02$), and that the effect size of the aforementioned relationship was medium (Cohen $d=0.48$) (Table 3).

The mean WHtR value in girls was also significantly dependent on age ($H=8.39$; $P=0.02$); the highest mean WHtR value was found in the 10 to 13 years age group and was significantly higher than in the age group of above 14 years ($z=2.70$; $P=0.02$). This relationship was strong (Cohen $d=0.83$). In the boys, no significant differences in mean WHtR value were found between the age groups.

3.3. Statistical analysis of sociodemographic factors

Multivariate logistic regression analysis for the entire group showed that the sociodemographic variables examined such as living in a boarding house, place of residence, living with both parents, and having siblings did not have any significant influence on the occurrence of overweight, obesity, and AO in the entire group as well as in gender groups. WHtR ≥ 0.50 occurred 4 times more frequently in people with no siblings that in those with siblings (OR = 4.22; 95% CI = 1.33–17.8; $P=0.01$) (Tables 4 and 5).

3.4. Statistical analysis of participation in PEC

Overweight and obesity were almost 4 times more frequent (OR = 3.74; 95% CI 0.81–17.4), and AO was 3 times more frequent (OR = 3.18; 95% CI 0.71–14.2) among students not participating in PEC than among students who could actively participate. In the group of boys exempted from PEC, excess weight and obesity were 6 times more frequent (OR = 6.56; 95% CI 0.82–52.4; $P=0.07$) and AO over 3 times more frequent (OR = 3.46; 95% CI 0.47–25.5; $P=0.21$) than in boys who could exercise without any limitations. In girls exempted from PEC, overweight and obesity were 2 times more frequent (OR = 2.08; 95% CI 0.31–5.28; $P=0.71$), while AO was also twice more frequent (OR = 2.05; 95% CI 0.06–74.5; $P=0.69$), compared to girls who participated in PEC classes without limitations. In addition, overweight and obesity were 12 times more frequent in girls who participated in PEC with some restrictions (OR = 12.4; 95% CI 0.77–98.4; $P=0.99$) and AO was over 4 times more frequent (OR = 4.43; 95% CI 0.33–59.1; $P=0.25$) than in girls who participated actively in PEC (Tables 4 and 5).

4. Discussion

In the present study, over 21% of subjects with visual impairment were found to be overweight and about 15% suffered from obesity. Age group had a significant impact on BMI *z*-score distribution, with almost 60% of students aged 10 to 13 years being overweight or obese. Our results are close to those of the Montero study,[14] which found overweight and obesity to be present in 37% of visually impaired Spanish pupils aged 8 to 18 years. A study of a small group of pupils aged 8 to 14 years by Greguol et al[13] found over 66% of Brazilian students and 17.2% of Italian students to be overweight or obese. Chen et al[4] observed overweight and obesity in 18% of subjects aged 7 to 17 years, with sensory disabilities including visual impairment. The Polish Report of Health Behaviour in School-Aged Children

Table 3

Mean WHtR according to age group and gender.

Age (years)	All pupils		Gender: Boys		Gender: Girls			
	Mean ± SD	Median	Mean ± SD	Median	Mean ± SD	Median	*z*	*P*
7–9 years	0.48 ± 0.05	0.459	0.48 ± 0.06	0.46	0.47 ± 0.05	0.46	0.00	>0.99
10–13 years	0.48 ± 0.07	0.476	0.48 ± 0.07	0.48	0.49 ± 0.06	0.48	0.43	0.67
≥14 years	0.45 ± 0.06	0.442	0.46 ± 0.07	0.45	0.45 ± 0.05	0.44	1.12	0.27
Total	0.47 ± 0.06	0.452	0.47 ± 0.07	0.46	0.46 ± 0.06	0.45	0.87	0.39
Analysis according to age groups	$H=8.73$; $P=0.02$		$H=2.06$; $P=0.36$		$H=8.34$; $P=0.02$			
	7–9 years vs 10–13 years: $z=0.09$; $P>0.99$				7–9 years vs 10–13 years: $z=0.45$; $P>0.99$			
	7–9 years vs ≥14 years: $z=1.94$; $P=0.16$				7–9 years vs ≥14 years: $z=1.67$; $P=0.282$			
	10–13 years vs ≥14 years: $z=2.66$; $P=0.02$				10–13 years vs ≥14 years: $z=2.70$; $P=0.02$			

SD = standard deviation.

Table 4

Sociodemographic variables, PEC classification, and prevalence of overweight and obesity.

Variables	OR	95% CI	*P*
Gender			
Girls	1.00		
Boys	1.32	(0.56–3.05)	0.53
Age			
7–9 years	1.00		
10–13 years	0.86	(0.21–3.48)	0.84
≥14 years	0.17	(0.04–0.66)	0.01
Living in boarding school			
No	1.00		
Yes	0.65	(0.26–1.65)	0.36
Place of residence			
Residence with ≥500k population	1.00		
Residence with 50–500k population	0.82	(0.22–3.11)	0.77
Residence with <50k population	0.85	(0.31–2.34)	0.75
Family situation			
Living with 2 parents	1.00		
Living with either mother or father	0.81	(0.33–2.01)	0.65
Siblings			
Yes	1.00		
No	1.44	(0.44–4.72)	0.54
Type of participation in PEC			
Participation in PEC without any restriction	1.00		
Restricted participation in PEC depending on health condition	2.11	(0.69–6.47)	0.19
Unable to attend PEC because of health condition	3.74	(0.81–17.4)	0.10

CI = confidence interval, OR = odds ratio, PEC = physical education classes.

(2014) indicated that overweight and obesity are present in about 18% of students aged 11 years, 14.5% of students aged 13 years, and over 12% of students aged 15 years.[26] The Olaf Project confirmed that 14% of female students and 18% of male students in Poland aged 7 to 18 years are overweight or obese.[22] Polish reports indicate that early adolescence is the period when overweight and obesity are most commonly observed;[22,26] this tendency was also seen in the present study. In our study, AO was observed in almost 33% of male and 21% of female subjects with visual impairment. Previous studies based on groups of randomly

Table 5

Sociodemographic variables, PEC classification, and prevalence of WHtR ≥0.50.

Variables	OR	95% CI	*P*
Gender			
Girls	1.00		
Boys	1.85	(0.85–4.02)	0.12
Age			
7–9 years	1.00		
10–13 years	1.44	(0.34–6.04)	0.61
≥14 years	0.48	(0.11–1.97)	0.30
Living in boarding school			
No	1.00		
Yes	1.03	(0.39–2.74)	0.95
Place of residence			
Residence with ≥500k population	1.00		
Residence with 50–500k population	1.07	(0.26–4.43)	0.92
Residence with <50k population	1.71	(0.62–4.76)	0.30
Family situation			
Living with 2 parents	1.00		
Living with either mother or father	1.02	(0.39–2.63)	0.98
Siblings			
Yes	1.00		
No	4.22	(1.33–17.8)	0.01
Type of participation in PEC			
Participation in PEC without any restriction	1.00		
Restricted participation in PEC depending on health condition	1.23	(0.40–3.86)	0.71
Unable to attend PEC because of health condition	3.18	(0.71–14.2)	0.13

CI = confidence interval, OR = odds ratio, PEC = physical education classes.

selected, healthy Polish children and teenagers aged 7 to 18 years found that 8.5% of boys and 5.3% of girls demonstrated central obesity.[27]

The prevalence of excessive body weight and AO was not found to be related with any sociodemographic variables, which corroborates findings reported elsewhere.[28,29] However, it should be noted that excessive body weight and AO were observed more often in pupils who were the only child in the family. Hence, presence of siblings could represent a protective factor against excessive weight or AO.

Low levels of physical activity (PA) are strongly associated with cardiovascular and metabolic disorders in all age groups[30]; screen time represents a central lifestyle component for children and adolescents. Sedentary behavior has been associated not only with obesity but also with depression,[31,32] and a reduction in TV viewing (also among pupils with VI, who may spend more of their free time in front of screens) and promotion of PA should be encouraged from adolescence to adulthood.[33] This may have an impact not only on the prevention of cardiovascular diseases[34] but may also improve rehabilitation of diseases,[35] and reduce future healthcare expenditure.[36] Modern technologies and the use of the PA Vital Sign questionnaire are recommended in monitoring every patient's exercise habits to assess barriers to being more active.[37]

Over 13% of the study group was unable to participate in PEC because of their health condition. It has been found that about 3.5% of Polish students without disabilities had medical certification allowing them to not participate in PEC.[21] Several studies show that pupils with visual impairment have lower levels of physical activity than those with motor disabilities or their sighted peers.[13] Our research confirmed that students exempted from PEC are particularly prone to excess body weight and AO. Furthermore, girls exempted from PEC, as well as girls who had restricted participation in PEC, were more often overweight, obese, or abdominally obese than those who participated without any restrictions. This phenomenon could be accounted for by the observation that although girls have permission to take part in the PEC, they were less likely to participate than boys.[21]

In conclusion, the prevalence of excessive body weight and AO was more common among visually impaired pupils than in their Polish peers without visual impairment. Our results indicate that, in view of their increased risk of excessive body mass and AO, pupils who are unable to participate in PEC due to their visual impairment should be awarded special consideration with regard to access to equipment specially adapted for those with impairments. This equipment is associated with high costs or specialized programs.[38] Unfortunately, socioeconomic status and the associated inequalities are strong determinants of health and are a strong predictor of cardiovascular diseases and mortality.[39] Health promotion actions should reduce differences in health status and should provide equal access for people of all socioeconomic strata to resources facilitating a healthy lifestyle.[40] Promoting healthy diet and physical activity should be emphasized in obesity prevention campaigns targeted at youths.[41] Moreover, multicomponent family-based interventions are noted to be an effective treatment for childhood obesity.[42,43] Taxation of sugar-sweetened beverages by the government is associated with a decrease in consumption of soft drinks.[44] Finally, limiting social events and TV programs targeting children, which are sponsored by companies associated with unhealthy food and drink brands, may have an impact on reducing the prevalence of obesity.[45]

This study had some limitations including small sample size. This was because some children did not want to participate in the examination due to their fear of contact with the medical staff or their lack of willingness to allow the medical equipment to be used on them, which could be attributed to the disruption of nonverbal communication in the daily functioning of visually impaired schoolchildren. Another important limitation is the lack of data regarding certain characteristics including eating habits, sedentary lifestyle, and family characteristics of the study subjects. Different criteria for defining overweight or obesity, or variations in sociodemographic data, might be among the reasons for the differences observed between our results and those of other studies.

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