Socioeconomic Status and Overweight Prevalence in Polish Adolescents: The Impact of Single Factors and a Complex Index of Socioeconomic Status in Respect to Age and Sex

*Joanna KOWALKOWSKA, Lidia WADOLOWSKA, Justyna WERONIKA WUENSTEL, Małgorzata Anna SŁOWIŃSKA, Ewa NIEDŹWIEDZKA

Dept. of Human Nutrition, Faculty of Food Science, University of Warmia and Mazury in Olsztyn, Poland

*Corresponding Author: Email: joanna.kowalkowska@uwm.edu.pl

Abstract

Background: The aim of this study was to analyze the association between overweight prevalence and socioeconomic status (SES) measured by complex SES index and single SES factors in Polish adolescents in respect to age and sex.

Methods: This cross-sectional study was conducted in 2010-2011. A total of 1,176 adolescents aged 13.0-18.9 years were included. The respondents were students of junior-high and high schools from northern, eastern and central Poland. Quota sampling by sex and age was used. The SES was determined by: place of residence, self-declared economic situation, and parental education level. Respondents with low, average or high SES index (SESI) were identified. The level of overweight was assessed using Polish and international standards.

Results: The odds ratio (OR) for overweight prevalence in the oldest girls (aged 17.0-18.9 years) with high SESI was 0.34 (95%CI:0.13-0.92; $P<0.05$) by Polish standards and 0.22 (95%CI:0.05-0.95; $P<0.05$) by international standards, in comparison to the reference group (low SESI). In total girls who had mothers with higher education level, the OR adjusted for age was 0.44 (95%CI:0.21-0.90;$P<0.05$) by Polish standards and 0.35 (95%CI:0.15-0.81;$P<0.05$) by international standards, in comparison to the reference group (maternal elementary education). The other single SES factors were not significant for overweight prevalence.

Conclusions: The relationship between socioeconomic status and prevalence of overweight was related to sex and age. The high socioeconomic status strongly lowered the risk of overweight prevalence in the oldest girls, but not in boys, irrespective of age. Maternal education level lowered risk of overweight prevalence in girls.

Keywords: Socioeconomic status, Overweight, BMI, Adolescents, Mother's education

Introduction

The prevalence of overweight and obesity is a growing problem, both worldwide and in Poland. Excessive bodyweight more often affects young people. According to Health Behavior in School-aged Children study (HBSC) overweight and obesity are seen in 17% of boys and 11% of girls aged under 13 yr in different countries in the world (1). In Poland, overweight affects 14.8% of boys and 11.4% of girls in the same age group, yet obesity is diagnosed in 4.5% of boys and 2.8% of girls (2). Overweight and obesity increase the risk of diet-related diseases in children and adolescents, e.g. cardiovascular diseases, diabetes and psychological-social problems such as lower self-esteem and depression (1).

In general, the association between socioeconomic status and overweight prevalence in developing countries is direct and in developed countries it is

Available at: http://ijph.tums.ac.ir

inverse (3-5). In developing countries, higher socioeconomic status is associated with the prevalence of overweight, although in developed countries the prevalence of overweight is rarer. The influence of socioeconomic status on overweight prevalence also depends on the sex and age of respondents (3,5,6). The results are clear and well-confirmed in women, but not in men and children (6).

The relationship between socioeconomic status and overweight prevalence depends, to a large extent, on the applied indicator of socioeconomic status (3,5,7). The place of residence, educational status, income and occupation are important indicators of socioeconomic status (1,3,5,8-11). Using these easily measurable indicators, we can profoundly investigate social, cultural and economic causes of health status. Generally, higher cultural capital has more influence on health-promoting behaviour and, consequently, the health of young people than higher family affluence (9). Numerous studies have demonstrated the strongest impact of parental education status, especially mothers, on the prevalence of overweight in adolescents (7,12,13). The potential for interrelations between different single factors of socioeconomic status justifies applying a complex indicator to evaluate the total impact of socioeconomic status on diet, lifestyle and health (8,11).

The available papers are related to studies carried out 10 years ago and before (3,14). After Poland entered to the European Union (in 2004) a substantial transformation in the socioeconomic situation of Polish society was observed. This prevents an unambiguous assessment the impact of socioeconomic status on the actual prevalence of overweight in Polish adolescents (8,10,15). Some recent studies have described the relationship between socioeconomic status (SES) and overweight in adolescents of different ages and sexes from many different countries, but have not examined the levels of SES in each country (1,14) or have not analysed the association in age groups (13). In older adolescents increase their independence from their parents and susceptibility to environmental influences, especially regarding dietary behavior and lifestyle (e.g. physical activity) (1,16). Therefore it is necessary to explain the impact of socioeconomic status and its single factors on the overweight prevalence in adolescents of different ages and sexes from Poland after the social transformation. It may be assumed that the effect of different single socioeconomic status factors on the prevalence of overweight is different in younger and older adolescents and in boys and girls.

The aim of the study was to analyze the association between overweight prevalence and socioeconomic status measured by complex socioeconomic status index as well as single socioeconomic factors in Polish adolescents with respect to age and sex groups.

Materials & Methods

Ethics statement
The study was approved by the Bioethics Committee of the Faculty of Medical Sciences, University of Warmia and Mazury in Olsztyn in 2010.

Study design and sample collection
This cross sectional study was conducted in 2010-2011 among adolescents aged 13-18 years. The respondents were students of junior-high and high schools from northern, eastern and central Poland. The schools were selected and then classes were chosen. The consent of the school principals and students' parents or guardians to participate in our research was required. We used quota sampling to ensure the same numbers of participants in all sex and age groups. The present study is a part of a larger study focused on food and dietary fibre consumption as well as on body weight and socioeconomic status determinants (Fig.1,2) (17). The research was conducted by well-trained interviewers.

The sample collection with inclusion and exclusion criteria is presented in Fig. 1.
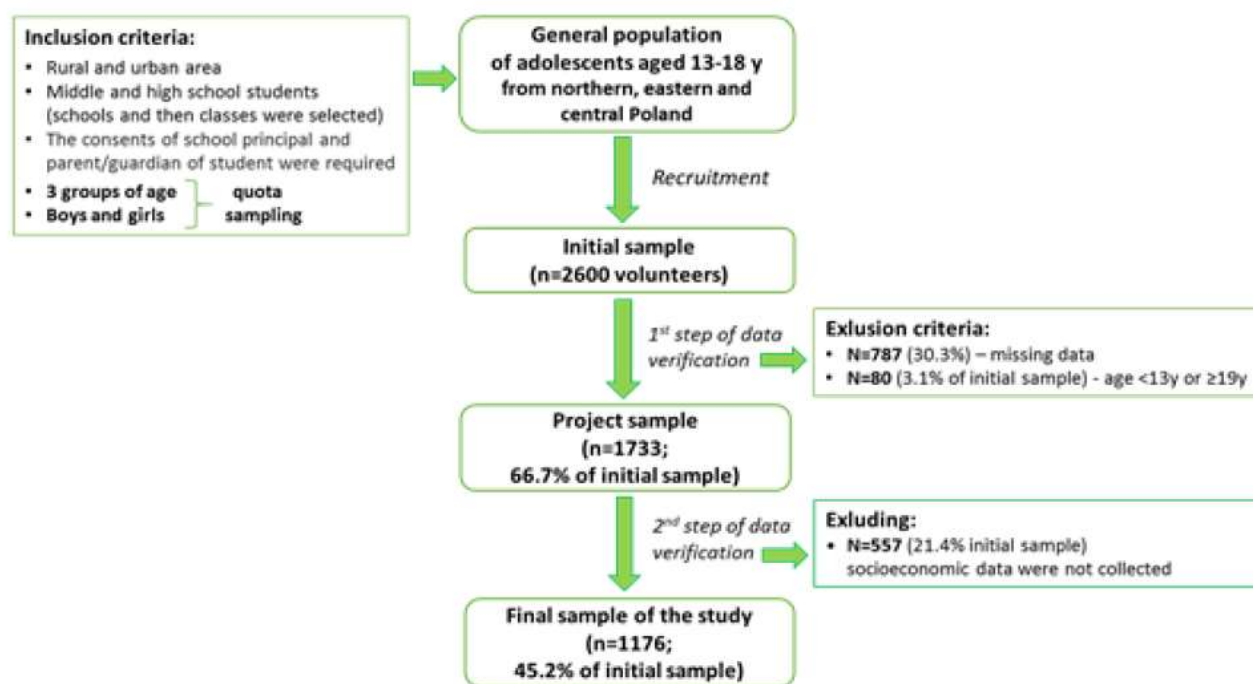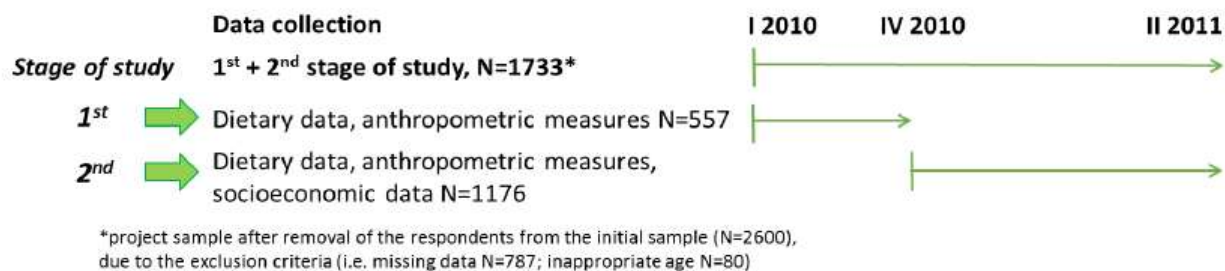
Fig. 1: Sample collection

Fig. 2: Timetable of study

Initially, a total of 2,600 volunteers participated. The respondents were precisely instructed on how to complete the dietary questionnaire. Incomplete or incorrect questionnaires were obtained from 787 respondents (30.3% of initial sample). A further 80 participants were removed due to an inappropriate age (<13 or ≥19 years; 3.1% of initial sample), because age was calculated with an accuracy of one month. Furthermore, the socioeconomic data were not collected in 557 participants (21.4% of initial sample) at the first stage of study (Fig.1, 2). The present paper concerns only the second stage of the study.

In total, the study involved 1,176 people, 551 boys (46.9% of final sample) and 625 girls (53.1%) aged from 13.0 to 18.9 years (Table 1). According to initial quota sampling, despite the exclusion criteria, a similar sample size in sex and age subgroups was obtained. Participants aged 13.0-14.9 years represented 31.2% of the final sample, 15.0-16.9 years represented 29.4% and 17.0-18.9 years represented 39.4%. Furthermore, the rural-to-urban inhabitant ratio in Poland was quite properly reflected: 51.3% of the participants were from rural areas and 48.7% were from urban areas (18).

Table 1: Socioeconomic status, single socioeconomic factors and anthropometric measures in Polish boys and girls aged 13.0-18.9 years (n=1176)

Variables	Boys+girls		Boys		Girls	
	n	%	n	%	n	%
Sample size	1176		551		625	
Age						
13.0-14.9 years	374	31.8	174	31.6	200	32.0
15.0-16.9 years	346	29.4	169	30.7	177	28.3
17.0-18.9 years	456	38.8	208	37.7	248	39.7
Socioeconomic status index (SESI)						
low	389	33.1	167	30.3	222	35.5
average	414	35.2	194	35.2	220	35.2
high	373	31.7	190	34.5	183	29.3
Place of residence						
rural	603	51.3	271	49.2	332	53.1
urban	573	48.7	280	50.8	293	46.9
Self-declared economic situation of family						
average and worse	965	82.1	425	77.1	540	86.4
above average	211	17.9	126	22.9	85	13.6
Self-declared economic situation of household						
we live thriftily or poorly	604	51.4	306	55.5	298	47.7
we live very well	572	48.6	245	44.5	327	52.3
Paternal education						
elementary	415	35.3	174	31.6	241	38.6
secondary	541	46.0	263	47.7	278	44.5
higher	220	18.7	114	20.7	106	17.0
Maternal education						
elementary	338	28.7	145	26.3	193	30.9
secondary	511	43.5	239	43.4	272	43.5
higher	327	27.8	167	30.3	160	25.6
Anthropometric data						
Height [cm]	169.9 (169.4; 170.5)		175.4 (174.6; 176.1)		165.1 (164.6; 165.7)	
Weight [kg]	61.2 (60.5; 61.8)		66.7 (65.7; 67.6)		56.3 (55.6; 57.0)	
Body mass index, BMI [kg/m²]	21.1 (20.9; 21.2)		21.6 (21.4; 21.8)		20.6 (20.4; 20.8)	
Polish standards[1]	n	%	n	%	n	%
underweight	25	2.1	9	1.6	16	2.6
normal weight	980	83.3	445	80.8	535	85.6
overweight+obesity	171	14.5	97	17.6	74	11.8
International standards[2]						
underweight	89	7.6	18	3.3	71	11.4
normal weight	917	78.0	416	75.5	501	80.2
overweight+obesity	170	14.5	117	21.2	53	8.5

N – sample size; ( ) – in brackets is given 95% confidence interval; [1]Polish standards – underweight BMI<5th percentile, normal weight BMI=5-84th percentile, overweight+obesity BMI≥85th percentile (2); [2]International standards – underweight BMI<18.5 kg/m², normal weight BMI=18.5-24.9 kg/m², overweight+obesity BMI≥25.0 kg/m² after conversion of BMI according to age and sex specific criteria proposed by Cole et al. (19, 20)

Body weight status and outcomes variables

Height (to the nearest 0.1 cm) and weight (to the nearest 0.1 kg) were measured in adolescents and the body mass index (BMI) was calculated. Two types of BMI classification were used: Polish percentile charts (2) and cut-off points for BMI by Cole et al. (19,20). According to Polish standards, participants were categorized as follows: underweight (BMI<5th percentile), normal weight (5th≤BMI<85th percentile) and overweight/obesity (BMI≥85th percentile) (2). According to international standards, the BMI of adolescents was converted to correspond to the categories for adults and was categorized as follows: underweight (BMI<18.5 kg/m^2), normal weight (18.5≤BMI<25 kg/m^2) and overweight/obesity (BMI≥25 kg/m^2) (19,20).

In the present study, participants with overweight including obesity (study group) and normal weight (control group) were taken into consideration. Participants with underweight (n=25, 2.1% of final sample according to Polish standards; n=89, 7.6% by international standards) were not analyzed.

Explanatory variables

The standard questions, which were well-suited to young respondents, regarding socioeconomic status were used (18). In our study, 6 single SES factors were examined.

The more favourable categories of SES factors were assigned with higher numerical values (given in brackets):

1. place of residence – response categories: village [1], town <100,000 inhabitants [2], city ≥100,000 inhabitants [3];
2. self-declared economic situation of family: below average [1], average [2], above average [3];
3. self-declared economic situation of household: we live very poorly – we do not have enough resources even for the cheapest food and clothing [1], we live poorly – we do not have enough resources for housing fees [2], we live modestly – we have enough resources only for food and clothing [3], we live very thriftily [4], we live relatively thriftily [5], we

live very well – we can afford everything without limitations [6];
4. paternal education: elementary [1], secondary [2], higher [3];
5. maternal education: elementary [1], secondary [2], higher [3];
6. number of education years: 9 years and less [1], 10-13 years [2], 14 years and more [3].

The complex SES index was calculated as the product of numerical values assigned to the individual categories of each SESI factor. The SESI was then logarithmically transformed and the tertile SESI distribution was used to identify respondents with low, average or high SES. The same approach was used in our previous studies (8) and research in a representative sample of Polish girls and young women (21).

Originally, the alpha-Cronbacha for six SES factors was calculated (0.571). One factor (number of education years) clearly weakening the SESI value was found (data not shown). It was decided not to include this factor to develop the SESI. The alpha-Cronbacha for five factors of SESI was 0.610 for total sample, 0.584 for boys and 0.639 for girls. The SESI with 5 factors was then calculated. Adolescents with low (33.1% of final sample), average (35.2%) or high (31.7%) SES was identified (Table 1).

Statistical analysis

The means and 95% confidence interval (95% CI) were calculated for height, body mass and BMI (Table 1). The percentage distribution of adolescents by Polish and international standards of BMI classification in total sample and sex groups were calculated as well. The impact of socioeconomic status (SES) and single SES factors on overweight (including obesity) prevalence was tested using the logistic regression analysis (22). Two models were determined as follows: model 1 – the odds ratios (ORs) were not adjusted, model 2 – ORs were adjusted for sex and/or age as confounding variables (other confounders of association SES-overweight was not investigated in this research) (Tables 2-3). The 95% confidence intervals (95% CI) for ORs were calculated. The significance of the odds ratio was assessed by Wald's

statistics. To assess the impact of socioeconomic status on overweight (including obesity) prevalence, the reference group were participants with low SESI (OR=1.00).

On the basis of large epidemiological studies on overweight prevalence among Polish adolescents and assuming 5% error of estimation of overweight prevalence, it was assumed that the minimum sample size in adolescent subgroups by sex, age and single SES factors equals 140, especially for the reference group in the logistic regression analysis. Therefore, the small sample-size categories were combined and the newly-created categories were used for logistic regression analysis (Table 1):

- place of residence:
  - (i) "rural" (i.e. village – reference group; OR=1.00),
  - (ii) "urban" (created by summing two categories: "town" and "city");
- self-declared economic family situation:
  - (i) "average or worse" (reference group; created by summing two categories: "below average" and "average"),
  - (ii) "above average";
- self-declared economic household situation:
  - (i) "we live thriftily or poorly" (reference group; created by summing four categories: "we live very poorly", "we live poorly", "we live modestly" and "we live very thriftily" and "we live relatively thriftily"),
  - (ii) "we live very well".

The grouping into categories was not changed for the paternal education and maternal education as single SES factors.

The *P*-value <0.05 was considered as statistically significant. Statistical analysis was performed using STATISTICA statistical package (version 10.0 PL; StatSoft Inc., USA, Tulsa; StatSoft Polska, Kraków).

Results

Overweight (including obesity) was found for 14.5% adolescents according to Polish standards as well as international standards (Table 1). Overweight (including obesity) affected 17.6% boys and 11.8% girls according to Polish standards and 21.2% boys and 8.5% girls by international standards.

Impact of complex index of socioeconomic status on overweight prevalence

The odds ratio of overweight (including obesity) prevalence in total girls (13.0-18.9 years) with high SESI was 0.61 in Model 1 (95%CI:0.33-1.14; *P*>0.05; Table 2) and 0.58 in Model 2 (95%CI:0.31-1.09; *P*>0.05) by Polish standards and 0.60 in Model 1 (95%CI:0.29-1.24; *P*>0.05) and 0.59 in Model 2 (95%CI:0.29-1.24; *P*>0.05) by international standards in comparison to girls with low SESI (reference group; OR=1.00). The significant OR of overweight prevalence in girls aged 17.0-18.9 years with high SESI was 0.34 in Model 1 (95%CI:0.13-0.92; *P*<0.05) by Polish standards and 0.22 in Model 1 (95%CI:0.05-0.95; *P*<0.05) by international standards. The odds ratio for overweight (including obesity) prevalence in boys aged 17.0-18.9 years with average SESI was 3.49 in Model 1 (95%CI: 1.08-11.30; *P*<0.05) by Polish standards, but according to international standards OR was not significant (OR=1.96; 95%CI:0.77-5.00; *P*>0.05).

Impact of single factors of socioeconomic status on overweight prevalence

There was no influence of place of residence, economic situation of family, economic situation of household or paternal education level on overweight (including obesity) prevalence in either boys or girls (Table 3).

Maternal education level influenced overweight prevalence in girls, but not in boys, irrespective of age. The odds ratio of overweight (including obesity) prevalence in girls with mothers with higher education was 0.47 in Model 1 (95%CI:0.23-0.95; *P*<0.05) and 0.44 in Model 2 (95%CI:0.21-0.90; *P*<0.05) by Polish standards and 0.37 in Model 1 (95%CI:0.16-0.84; *P*<0.05) and 0.35 in Model 2 (95%CI:0.15-0.81; *P*<0.05) by international standards, compared to girls with mothers with elementary education (OR=1.00). Moreover, using international standards, the OR of overweight prevalence in girls of mothers with secondary education was 0.54 in Model 1 (95%CI:0.29-1.00; *P*≤0.05) and 0.50 in Model 2 (95%CI:0.26-0.94; *P*<0.05).

Table 2: Odds ratio (OR) of overweight (including obesity) prevalence in adolescents aged 13.0-18.9 years depending on the socioeconomic status

Variables		OR (95%CI) of overweight (including obesity) vs. normal weight					
		Boys+girls N=1176		Boys N=551		Girls N=625	
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Polish standards[1]							
SESI	Age (years)						
Low		1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Average							
	Total	1.02 (0.70; 1.47)	0.98 (0.66; 1.44)[#]	1.33 (0.76; 2.32)	1.36 (0.77; 2.38)[&]	0.75 (0.43; 1.32)	0.64 (0.36; 1.14)[&]
	13.0-14.9	0.65 (0.30; 1.43)	0.53 (0.24; 1.20)[$]	0.86 (0.32; 2.31)	-	0.14 (0.02; 1.13)	-
	15.0-16.9	0.97 (0.48; 1.97)	0.95 (0.47; 1.92)[$]	0.97 (0.39; 2.42)	-	0.91 (0.29; 2.82)	-
	17.0-18.9	1.30 (0.70; 2.42)	1.28 (0.69; 2.39)[$]	3.49* (1.08; 11.30)	-	0.75 (0.34; 1.62)	-
High							
	Total	0.95 (0.63; 1.43)	0.92 (0.61; 1.39)[#]	1.29 (0.73; 2.27)	1.30 (0.74; 2.29)[&]	0.61 (0.33; 1.14)	0.58 (0.31; 1.09)[&]
	13.0-14.9	1.01 (0.41; 2.48)	0.85 (0.41; 1.77)[$]	1.07 (0.41; 2.76)	-	0.59 (0.17; 2.03)	-
	15.0-16.9	1.06 (0.51; 2.24)	1.05 (0.49; 2.22)[$]	0.92 (0.34; 2.50)	-	1.24 (0.40; 3.91)	-
	17.0-18.9	0.83 (0.42; 1.64)	0.84 (0.42; 1.65)[$]	2.73 (0.83; 8.98)	-	0.34* (0.13; 0.92)	-
International standards[2]							
SESI	Age (years)						
Low		1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Average							
	Total	0.99 (0.45; 2.16)	0.96 (0.64; 1.44)[#]	1.20 (0.72; 2.01)	1.22 (0.73; 2.05)[&]	0.67 (0.35; 1.29)	0.61 (0.31; 1.19)[&]
	13.0-14.9	0.62 (0.29; 1.32)	0.48 (0.22; 1.05)[$]	0.70 (0.27; 1.81)	-	0.14 (0.02; 1.10)	-
	15.0-16.9	1.27 (0.64; 2.54)	1.25 (0.62; 2.53)[$]	1.25 (0.54; 2.91)	-	1.25 (0.34; 4.63)	-
	17.0-18.9	1.11 (0.58; 2.13)	1.14 (0.59; 2.20)[$]	1.96 (0.77; 5.00)	-	0.63 (0.25; 1.62)	-
High							
	Total	0.95 (0.63; 1.43)	0.89 (0.59; 1.35)[#]	1.09 (0.65; 1.83)	1.09 (0.64; 1.84)[&]	0.60 (0.29; 1.24)	0.59 (0.29; 1.24)[&]
	13.0-14.9	0.97 (0.48; 1.94)	0.77 (0.38; 1.59)[$]	0.86 (0.35; 2.14)	-	0.63 (0.18; 2.21)	-
	15.0-16.9	1.33 (0.64; 2.77)	1.29 (0.61; 2.73)[$]	1.13 (0.45; 2.82)	-	1.71 (0.46; 6.44)	-
	17.0-18.9	0.72 (0.35; 1.48)	0.71 (0.35; 1.46)[$]	1.41 (0.54; 3.65)	-	0.22* (0.05; 0.95)	-

[1]Polish standards – normal weight BMI=5-84th percentile, overweight+obesity BMI≥85th percentile (2); [2]International standards – normal weight BMI=18.5-24.9 kg/m^2, overweight+obesity BMI≥25.0 kg/m^2 after conversion of BMI according to age and sex specific criteria proposed by Cole et al. (19); N – sample size; SESI – socioeconomic status index; OR – odds ratio; 95% CI – 95% confidence interval; *$P \leq 0.05$; Model 1 - OR not adjusted; Model 2 – OR adjusted for: [#]sex and age, [$]sex or [&]age

Table 3: Odds ratio (OR) of overweight (including obesity) prevalence in adolescents aged 13.0-18.9 years depending on the factor of socioeconomic status

Factor of socioeconomic status	OR (95% CI) of overweight (including obesity) vs. normal weight					
	Boys+girls N=1176		Boys N=551		Girls N=625	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Polish standards[1]						
Place of residence						
rural	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
urban	0.96 (0.69; 1.32)	0.93 (0.67; 1.29)	0.98 (0.62; 1.55)	0.98 (0.63; 1.52)	0.89 (0.54; 1.46)	0.84 (0.51; 1.38)
Self-declared economic situation of family						
average and worse	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
above average	1.01 (0.72; 1.42)	0.94 (0.61; 1.43)	0.99 (0.47; 2.08)	1.02 (0.60; 1.71)	0.86 (0.41; 1.81)	0.85 (0.40; 1.80)
Self-declared economic situation of household						
we live thriftily or poorly	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
we live very well	0.78 (0.57; 1.09)	0.82 (0.59; 1.13)	0.91 (0.59; 1.43)	0.91 (0.58; 1.42)	0.71 (0.43; 1.15)	0.74 (0.45; 1.21)
Paternal education						
elementary	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
secondary	0.94 (0.66; 1.34)	0.90 (0.63; 1.30)	1.10 (0.67; 1.80)	1.09 (0.67; 1.80)	0.73 (0.43; 1.24)	0.69 (0.41; 1.18)
higher	0.70 (0.43; 1.15)	0.68 (0.41; 1.12)	0.71 (0.36; 1.40)	0.66 (0.33; 1.30)	0.64 (0.30; 1.36)	0.62 (0.29; 1.33)
Maternal education						
elementary	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
secondary	0.98 (0.66; 1.47)	0.97 (0.65; 1.44)	1.23 (0.70; 2.16)	1.19 (0.59; 2.40)	0.78 (0.46; 1.34)	0.68 (0.39; 1.19)
higher	0.88 (0.57; 1.35)	0.84 (0.54; 1.30)	1.30 (0.72; 2.37)	1.27 (0.70; 2.33)	0.47* (0.23; 0.95)	0.44* (0.21; 0.90)
International standards[2]						
Place of residence						
rural	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
urban	0.87 (0.63; 1.21)	0.84 (0.60; 1.17)	0.91 (0.60; 1.37)	0.92 (0.61; 1.40)	0.71 (0.40; 1.26)	0.70 (0.39; 1.24)
Self-declared economic situation of family						
average and worse	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
above average	0.92 (0.59; 1.42)	0.80 (0.51; 1.24)	0.79 (0.48; 1.32)	0.81 (0.49; 1.35)	0.79 (0.32; 1.91)	0.78 (0.32; 1.91)
Self-declared economic situation of household						
we live thriftily or poorly	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
we live very well	0.78 (0.56; 1.09)	0.84 (0.60; 1.17)	0.82 (0.54; 1.25)	0.82 (0.54; 1.25)	0.87 (0.49; 1.54)	0.88 (0.50; 1.56)
Paternal education						
elementary	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
secondary	1.00 (0.76; 1.31)	0.93 (0.64; 1.34)	1.10 (0.69; 1.76)	1.10 (0.69; 1.75)	0.69 (0.37; 1.26)	0.67 (0.37; 1.24)
higher	0.71 (0.43; 1.17)	0.65 (0.39; 1.07)	0.76 (0.41; 1.40)	0.71 (0.38; 1.32)	0.48 (0.19; 1.22)	0.47 (0.19; 1.20)
Maternal education						
elementary	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
secondary	0.85 (0.58; 1.26)	0.82 (0.55; 1.22)	1.09 (0.65; 1.83)	1.06 (0.63; 1.78)	0.54* (0.29; 1.00)	0.50* (0.26; 0.94)
higher	0.85 (0.55; 1.30)	0.78 (0.50; 1.20)	1.12 (0.65; 1.95)	1.09 (0.63; 1.91)	0.37* (0.16; 0.84)	0.35* (0.15; 0.81)

[1]Polish standards – normal weight BMI=5-84th percentile, overweight+obesity BMI≥85th percentile (2); [2]International standards – normal weight BMI=18.5-24.9 kg/m^2, overweight+obesity BMI≥25.0 kg/m^2 after conversion of BMI according to age and sex specific criteria proposed by Cole et al. (19); N – sample size; OR – odds ratio; 95% CI – 95% confidence interval; *$P≤0.05$; Model 1 - OR not adjusted; Model 2 – OR adjusted for: sex and age (boys+girls), age (boys or girls)

Discussion

The prevalence of overweight (including obesity) was influenced by socioeconomic status as well as sex and age. The relation was strong and clear in the oldest girls between opposite socioeconomic status level (low-high) which was determined by maternal education level as a single socioeconomic factor. In boys, the association was only significant for the oldest boys between the low and average socioeconomic status and it was confirmed for overweight prevalence assessed by Polish standards but not international standards.

In our study, high socioeconomic status favoured a lower prevalence of overweight (including obesity) in the oldest girls (17.0-18.9 years). In the oldest girls with high socioeconomic status, the risk of overweight prevalence was 3 times lower by Polish standards and 5 times lower by international standards than in girls with low socioeconomic status. The lower prevalence of overweight and obesity in persons with high socioeconomic status has been confirmed by numerous studies conducted in developed countries (5, 7, 12, 15, 23, 24) and by some studies carried out in developing countries (25,26). This association has been well-confirmed for women, although it has not been confirmed in men (27,28). Similar relations have been demonstrated in Chinese 17-18-year-old girls (29). The girls with high socioeconomic status were slimmer than girls with low socioeconomic status. This could have resulted from low body esteem and/or higher social pressure felt by women with high socioeconomic status, living in different countries and trying to obtain a fashionable, slim figure (1,11,29).

Our study showed the impact of maternal education level as a single factor of socioeconomic status on overweight (including obesity) prevalence but no relationship was found for other single factors of socioeconomic status. The strongest impact of parental education, especially that of the mother, on the prevalence of overweight and obesity in children has been confirmed by many studies (7,12,30,31). Children of mothers with the highest educational level had lower mean BMI and/or lower prevalence of overweight or obesity (13,30-32) than children of low-educated mothers. The children of mothers with low educational level exhibited approximately 1.5-2-fold higher risk of overweight and over 4-fold higher risk of obesity than children of mothers with the highest educational level (30,31). In our study, the risk of overweight including obesity prevalence in the oldest girls decreased with a higher level of mother's education about 2-3-fold, but there was no effect among boys or younger girls (below 17 years). Studies carried out among a representative sample of Polish children and adolescents (7-18 years) confirmed the lower risk of overweight, including obesity prevalence in girls with highly-educated mothers, but not in boys (13). The risk was about 25% lower than in girls of mothers with the lowest education level. In other studies, it was stated that the prevalence of overweight in older girls (18 years) decreased with higher level of mother's education, but in younger girls (11 years) the association was inconsistent (33). These relations are explained by better nutritional behaviours and higher physical activity of children with high-educated parents, especially mothers (25,30) as well as with higher social pressure and higher parental requirements in relation to the appearance and silhouette of girls (1). The impact of maternal education is more stable over time than the influence of other factors of socioeconomic status (30) although the consequences of favourable impact of higher maternal education on the prevalence of overweight are manifested only in the oldest girls (33).

It is curious that there was a lack of impact of single factors of socioeconomic status on the prevalence of overweight in boys observed in our study. An inverse association between the socioeconomic status as a complex index and prevalence of overweight was confirmed only in the oldest boys with average but not high socioeconomic status, and only by Polish standards used to assess overweight prevalence. Studies by different authors have demonstrated that in boys, in

contrast to girls, high socioeconomic status was associated with a higher risk of overweight (14,29,33,34). The impact of single factors of socioeconomic status – educational level and income on weight perception and weight control behaviour – was also stronger in women (27). In men, there was an impact of other factors of socioeconomic status on overweight prevalence than in women, e.g. occupational status associated with different amounts of leisure-time and different levels of physical activity (35). It may be assumed that in our study the lack of association between single factors of socioeconomic status and overweight prevalence in boys was a result of the impact of other opposing factors, e.g. peers or physical activity, whose influence was not investigated in our study. Many other environmental and socio-cultural factors influence attitudes to health and nutrition and dietary behaviours and could modify the relation between socioeconomic status and body weight of adolescents (31). Further studies should be taken to determine whether the lack of association between single factors of socioeconomic status and overweight prevalence in boys is typical for the Polish male adolescent nowadays or results from an opposing effect of other socioeconomic, environmental and lifestyle factors.

Study strengths and limitations
The sample was chosen by quota sampling and is well-fitted to the socio-demographic structure of Polish society (18). Secondly, the prevalence of overweight (including obesity) found in our sample (about 15%) is similar to the results provided by a large-scale representative national sample (2,13) and other studies (8) carried out in recent years. This increases the strength of conclusions and makes it possible to generalize the results despite not being randomly-selected sample.
The strength of the study is that two types of BMI classification were used to assess overweight prevalence in adolescents. Moreover, both standards – Polish and international –provided the same significant associations between socioeconomic status or single factors and overweight prevalence. Furthermore, the height and weight

were measured, in contrast to other larger studies among representative samples of adolescents from different countries (1,14,23). However, the declared height and weight were indicated as a source of bias and limitation of other studies, due to the possible underestimation of weight and/or overestimation of height by adolescents, especially girls.
Next, the question concerning the single factors of socioeconomic status were very simple and matched young respondents very well. The size of place of residence assessed by three categories was checked using name of village, town or city written by respondents. In our study, single factors regarding economic situation, as well as parent's education level were used, in contrast to larger studies among adolescents based on only self-declared indicators of economic situation (e.g. Family Affluence Scale) (1,14,23). It was found that a higher cultural capital has more influence on health-promoting behaviour and adolescent's health than higher family affluence (9). However, all self-declared indicators of socioeconomic status could produce some bias in our study as well as in other studies (1, 14, 23). The strength of the study is that the impacts of a complex index, as well as single factors of socioeconomic status on overweight prevalence were shown. This produces new interesting conclusions regarding overweight prevalence in Polish adolescents and different aspects of socioeconomic status nowadays, after the accession of Poland to the European Union and socioeconomic transformation.

Conclusions

The relationship between socioeconomic status and overweight prevalence (including obesity) was related to sex and age. A high socioeconomic status strongly lowered the risk of overweight prevalence in the oldest girls, but not in boys irrespective of age. Maternal education level was only one single SES factor influencing risk of overweight prevalence in the oldest girls. A better understanding of the determinants affecting

overweight prevalence in boys and younger girls requires further research and explanation. Further studies should also include other factors influencing or modifying the socioeconomic status and overweight prevalence association, such as genes, lifestyle and peer or neighbourhood environment. In view of the results of the present paper, the efforts to prevent overweight in Polish adolescents should be focused on low-educated mothers and their daughters. Moreover, nutrition and health education should be conducted at an early school level for women with low socioeconomic status to gain this knowledge, who will not continue their education.

Ethical considerations

Ethical issues (including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgments

References

1. WHO (2012). Social determinants of health and well-being among young people. Health Behaviour in School-aged Children (HBSC) study: international report from the 2009/2010 survey. Currie C et al. (Eds.). WHO, Copenhagen, Denmark.

2. Kulaga Z, Litwin M, Tkaczyk M et al. (2011). Polish 2010 growth references for school-aged children and adolescents. *Eur J Pediatr*, 170: 599-609.

3. McLaren L (2007). Socioeconomic status and obesity. *Epidemiol Rev,* 29: 29-48.

4. Jones-Smith JC, Gordon-Larsen P, Siddiqi A, Popkin BM (2011). Cross-National Comparisons of Time Trends in Overweight Inequality by Socioeconomic Status Among Women Using Repeated Cross-Sectional Surveys From 37 Developing Countries, 1989-2007. *Am J Epidemiol*, 173: 667-675.

5. Ball K, Crawford D (2005). Socioeconomic status and weight change in adults: a review. *Social Science & Medicine*, 60: 1987-2010.

6. Ball K, Mishra G, Crawford D (2002). Which aspects of socioeconomic status are related to obesity among men and women? *Int J Obesity*, 26: 559-565.

7. Shrewsbury V, Wardle J (2008). Socioeconomic Status and Adiposity in Childhood: A Systematic Review of Cross-sectional Studies 1990-2005. *Obesity*, 16: 275-284.

8. Dlugosz A, Niedźwiedzka E, Dlugosz T, Wądolowska L (2014). Socio-economic status as an environmental factor: incidence of underweight, overweight and obesity in adolescents from less-urbanized regions of Poland. *Ann Agric Environ Med* (accepted to print)

9. Fismen A-S, Samdal O, Torsheim T (2012). Family affluence and cultural capital as indicators of social inequalities in adolescent's eating behaviours: a population-based survey. *BMC Pub Health*, 12: 1036-1044.

10. Tabak I, Oblacińska A, Jodkowska M, Mikiel-Kostyra K (2012). Zmiany w strukturze i sytuacji ekonomicznej rodziny jako czynniki warunkujące nadmierną masę ciała nastolatków [Changes in structure and socioeconomic position of the family as determinants of overweight in adolescents]. *Pediatr. Edocrinol*, 18 (2): 70-75. (English abstract)

11. Wądolowska L (2010). *Żywieniowe podłoże zagrożeń zdrowia w Polsce [Nutrition as an Underlying Cause of Health Hazards in Poland]*. UWM, Olsztyn, Poland (in Polish).

12. Serra-Majem L, Bartrina JA, Pe´rez-Rodrigo C, Ribas-Barba L, Delgado-Rubio A (2006). Prevalence and determinants of obesity in Spanish children and young people. *Br J Nutr*, 96 (Suppl. 1): S67-S72.

13. Gurzkowska B, Kułaga Z, Litwin M, Grajda A, Świąder A, Kułaga K, Góźdź M, Wojtyło M (2014). The relationship between selected socioeconomic factors and basic anthropometric parameters of school-aged children and

adolescents in Poland. *Eur J Pediatr*, 173: 45-52.

14. Due P, Damsgaard MT, Rasmussen M, Holstein BE, Wardle J, Merlo J, Currie C, Ahluwalia N, Sørensen TIA, Lynch J (2009). Socioeconomic position, macroeconomic environmental and overweight among adolescents in 35 countries. *Int J Obes*, 33 (10): 1084-1093.

15. Oblacińska A, Kololo H, Mazur J (2008). Socjoekonomiczne uwarunkowania dysharmonii rozwoju fizycznego młodzieży 15-letniej w Polsce. [Socio-economic determinants of physical development disorders among 15-year-olds in Poland]. *Med Wieku Rozwoj*, 12 (2): 549-557. (English abstract)

16. Jeżewska-Zychowicz M (2004). *Zachowania żywieniowe i ich uwarunkowania [Dietary habits and its determinants]*. SGGW, Warsaw, Poland (in Polish).

17. Wuenstel JW, Wądołowska L, Słowińska MA, Niedźwiedzka E, Kowalkowska J, Antoniak L (2015). Consumption of Fruit Juices and Sweetened Beverages: Differences Related to Age, Gender and Weight among Polish Adolescents. *PJFNS*, 65, 3 (in press)

18. GUS [Central Statistical Office] (2013). *Rocznik demograficzny Polski [Demographic Yearbook of Poland]*. GUS, Warsaw, Poland.

19. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*, 320: 1-6.

20. Cole TJ, Flegal KM, Nicholls D, Jackson AA (2007). Body mass index cut offs to define thinness in children and adolescents: international survey. *BMJ*, 335: 1-8.

21. Czarnocińska J, Jeżewska-Zychowicz M, Babicz-Zielińska E, Kowalkowska J, Wądołowska L (2013). *Postawy względem żywności, żywienia i zdrowia a zachowania żywieniowe dziewcząt i młodych kobiet w Polsce [Attitudes towards food, nutrition and health and dietary behaviors of girls and young women in Poland]*. UWM, Olsztyn, Poland (in Polish).

22. Stanisz A (eds.) (2007). *Przystępny kurs Statystyki z Zastosowaniem STATISTICA PL na Przykładach z Medycyny: Modele Liniowe i Nieliniowe [Accessible Course of Statistics with Application of STATISTICA PL Using Medical Examples. Linear and Nonlinear Models]*. StatSoft, Kraków, Poland (in Polish).

23. Dupuy M, Godeau E, Vignes C, Ahluwalia N (2011). Socio-demographic and lifestyle factors associated with overweight in a representative sample of 11-15 year olds in France: Results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) cross-sectional Study. *BMC Pub Health*, 11: 1-11.

24. O'Dea JA, Wilson R (2006). Socio-cognitive and nutritional factors associated with body mass index in children and adolescents: possibilities for childhood obesity prevention. *Health Educ Res*, 21 (6): 796-805.

25. Fokeena WB, Jeewon R (2012). Is There an Association between Socioeconomic Status and Body Mass Index among Adolescents in Mauritius? *The Scientific World Journal*, vol. 2012: 1-9.

26. Fernald L (2007). Socio-economic status and body mass index in low-income Mexican adults. *Soc Sci Med*, 64 (10): 2030-2042.

27. Joh H-K, Oh J, Lee H-J, Kawachi I (2013). Gender and Socioeconomic Status in Relation to Weight Perception and Weight Control Behaviour in Korean Adults. *Obes Facts*, 6: 17-27.

28. Tchicaya A, Lorentz N (2012). Socioeconomic inequality and obesity prevalence trends in Luxembourg, 1995-2007. *BMC Research Notes,* 5: 467-475.

29. Chen W, Shi Z (2013). Trend in gender disparities of BMI and height between 2004 and 2011 among adolescents aged 17-18 years in Changzhou China. *Asia Pac J Clin Nutr*, 22 (3): 466-473.

30. Keane E, Layte R, Harrington J, Kearney PM, Perry IJ (2012). Measured Parental Weight Status and Familial Socio-Economic Status Correlates with Childhood Overweight and Obesity at Age 9. *PLoS ONE*, 7 (8): 1-9.

31. Veldhuis L, Vogel I, van Rossem L, Renders CM, HiraSing RA, Mackenbach JP, Raat H (2013). Influence of Maternal and Child Lifestyle-Related Characteristics on the Socioeconomic Inequality in Overweight and Obesity among 5-year-old Children; The "Be Active, Eat Right" Study. *Int. J. Environ. Res. Public Health*, 10: 2336-2347.

32. Biehl A, Hovengen R, Grøholt E-K, Hjelmesæth J, Strand BH, Meyer HE (2013). Adiposity among children in Norway by urbanity and

maternal education: a nationally representative study. *BMC Public Health*, 13: 842-849.

33. Matijasevich A, Victora CG, Golding J, Barros FC, Menezes AM, Araujo CL, Smith GD (2009). Socioeconomic position and overweight among adolescents: data from birth cohort studies in Brazil and the UK. *BMC Public Health*, 9: 105-111.

34. Seubsman S, Lim L, Banwell C, Sripaiboonkit N, Kelly M, Bain C, Sleigh AC (2010). Socioeconomic Status, Sex, and Obesity in a Large National Cohort of 15–87-Year-Old Open University Students in Thailand. *J Epidemiol*, 20 (1): 13-20.

35. Vernay M, Malon A, Oleko A, Salanave B, Roudier C, Szego E, Deschamps V, Hercberg S, Castetbon K (2009). Association of socioeconomic status with overall overweight and central obesity in men and women: the French Nutrition and Health Survey 2006. *BMC Public Health*, 9: 215-222.