

# Ten-year secular trend of overweight and obesity in school children in south-eastern Poland

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## Abstract

**Objective.** To examine the trend in prevalence of overweight and obesity in schoolchildren from south-eastern Poland over a 10-year period.

**Materials and Method.** A cross-sectional study was conducted in randomly selected primary schools. In total, 4,248 children (2,182 boys and 2,066 girls), mean age 10.5±2.4 years, were examined in 1998, and 2,412 children (1,184 boys and 1,228 girls), mean age 10.5±2.3 years in 2008. In each school the entire population was studied.

**Results.** In 2008, the prevalence of overweight in girls was 13.3% and obesity 7.7%, compared to 12.0% and 10.1% in 1998. The decrease in obesity prevalence was statistically significant. In boys, the prevalence of overweight in 2008 was 14.2% and obesity 6.4%, compared to 10.5% and 6.8% in 1998. The increase in overweight prevalence among boys was statistically significant.

**Conclusions.** A trend toward stabilization of the prevalence of overweight and obesity was noted in school children from south-eastern Poland between 1998–2008. The declining prevalence of obesity in girls and increased prevalence of overweight in boys demonstrates that in this age group of children the secular trend is gender dependent.

## Key words

obesity, children, prevalence, risk factors

## INTRODUCTION

In many countries, obesity has taken on the proportion of an epidemic and has become a problem for public health. Unfortunately, this problem also concerns children and youths [1, 2]. Moreover, childhood and adolescence seem to be critical periods in the development of obesity. Several studies provide evidence that a high Body Mass Index (BMI) in children predicts overweight in later life [3]. From the 1970–90s, the number of school children with excess weight and obesity doubled or even tripled in several developed countries such as the USA and Canada. There are also alarming data on a childhood obesity trend in Europe, reported in Finland, Germany, Greece, Spain and the United Kingdom [4, 5, 6, 7, 8, 9]. However, the latest reports from France, Sweden, Switzerland and Norway show stabilization and even a slight decrease of overweight and obesity prevalence in children [10, 11, 12, 13]. In Poland and other Central-East European countries, epidemiologic research on overweight and obesity prevalence in children and adolescents has seldom been carried out, and changes in these prevalences over time have been even more rarely analyzed [14, 15, 16, 17, 18].

The aim of this study was to examine the secular trend of overweight and obesity in primary school-aged children from south-eastern Poland, defined on the basis of international standards.

## MATERIALS AND METHOD

The first study was carried out in 1998 and its details and results have been published elsewhere [18]. In summary, the population of the Podcarpathian Province in south-eastern Poland comprised 146,000 school-age children. The Podcarpathian Province has a population of about 2,000,000 inhabitants, with no ethnic minorities present. The level of education, material status and unemployment rate in region are similar to the rest of Poland.

In order to select the sample, a block randomization method was used. In 1998, 14 schools from a total of 841 were randomly selected and the entire school populations were included in the study. In all schools, a questionnaire was used to obtain the parents' consent and data on general health status of their offspring and use of medications. It also requested information on parents' education level, socio-economic status (SES), number of children in the family and mother's employment outside the home. In addition, social risk factors for obesity were investigated.

In total, the families of 5,205 children (2,785 boys and 2,420 girls) were asked to participate in the study. Written informed consent was obtained from the families of 4,415 children, and complete data collected from 4,265 families. The response rate was valued at 84.8%.

The study was repeated in 2008 in the same schools as in 1998, according to the previous protocol. A total of 14 schools participated in the survey and, as in 1998, the entire school population was studied. From the 3,864 families approached, 2,592 completed the questionnaire (67%), 146 parents refused consent for their children to be

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examined, and 25 questionnaires were not fully completed. Nine children, suffering from chronic diseases or taking medicines which could have influenced their development, were excluded. In total, height and weight of 2,412 children's (1,184 boys and 1,228 girls) were measured and available for analysis. The mean age of the girls was 10.5±2.4 years and of the boys 10.5±2.3 years. The difference in the mean ages between the examined groups of girls and boys in the years 1998 and 2008 was statistically insignificant. The reduction in the number of students participating in the study over time resulted both from the significant reduction in the number of new born children observed in Poland in the years 1990–2010, and the emigration between 2000–2004 of more than 2.5 million Polish people, mainly aged 18–30 years.

Children wearing casts or orthopedic appliances, or those with chronic or genetic diseases that could impair their growth or require prolonged drug therapy, especially corticosteroid therapy, were also excluded. Data from 4,248 children (2,066 girls and 2,182 boys) were collected. The mean age of the girls was 10.4 years (SD 2.4, range 6.7–14.9). The mean age of the boys was 10.5 years (SD 2.3, range 6.9–14.9). The age difference between the girls and boys was statistically insignificant. Children were weighed and measured in their underwear and without shoes. Weight was recorded to the nearest 100g using a standardized RADWAG WPT 60/150 scale. Height was measured in the standing position with a fixed stadiometer to the nearest 1 mm. Three separate measurements were obtained for both weight and height and body mass index (BMI) was calculated from the mean 56 of the 3 measurements. Gender specific average values of BMI and standard deviations for each year groups from age 7–14 years were estimated. Overweight and obesity was defined on the basis of the criteria of the International Obesity Task Force (IOTF) [19].

The study was approved by the Ethics Committee of the Regional Chamber of Medicine in Rzeszów.

**Statistical analysis.** Analysis was carried out with the use of STATISTICA v. 6.0 software and additionally the EXCEL spreadsheet package. Comparisons of body mass, height and BMI between the surveys in 1998 and 2008 (for particular age groups and genders) were made with the use of Student t78 test with a separate evaluation of variance. Prevalence's of overweight and obesity in 2008, defined on the basis of IOTF criteria for particular age groups and gender, were calculated and compared with those observed in 1998 using a  $\chi^2$  test. A  $\chi^2$  test was also used for verification 81 of differences between frequency of occurrence of excess weight and obesity between girls and boys in particular age groups in the surveys in 1998 and 2008, respectively. Student t test was used for verification of differences in average age of the girls and boys in the years 1998–2008 [20]. Analysis of the social risk factors was made with the use of  $\chi^2$  test.

## RESULTS

In Table 1 the mean values and standard deviations of BMI for the girls examined in 1998 and in 2008 are presented by age group. Mean values of BMI in the groups of girls aged 10–14 were significantly lower in 2008 compared to 1998. Only in 7-year-old girls this value was found to be significantly higher.

**Table 1.** Comparison of the mean BMI values in girls in 1998 and 2008 in individual age groups

Age	1998		2008		p		
	N	BMI		N		BMI	
		Mean	SD			Mean	SD
7	226	15.41	2.52	205	16.15	2.32	<0.05
8	237	16.36	2.64	147	16.8	3.04	NS
9	249	17.81	2.85	121	17.44	2.76	NS
10	252	18.97	3.69	134	18.04	3.15	<0.05
11	250	20.04	2.74	146	18.28	3.66	<0.001
12	265	21.12	3.09	161	19.53	3.74	<0.001
13	276	22.07	3.49	110	19.64	4.11	<0.001
14	310	22.01	3.91	204	20.83	3.95	<0.001
<b>Total</b>	<b>2066</b>	<b>19.49</b>	<b>3.58</b>	<b>1228</b>	<b>18.35</b>	<b>3.72</b>	<b>&lt;0.001</b>

N – No. of respondents

NS – Statistically not significant

**Table 2.** Comparison of the mean BMI values in boys in 1998 and 2008 in individual age groups

Age	1998		2008		p		
	N	BMI		N		BMI	
		Mean	SD			Mean	SD
7	257	15.29	2	161	16.36	2.37	<0.05
8	267	16.07	2.16	166	16.73	2.13	<0.05
9	278	17.05	2.83	117	17.5	2.94	NS
10	276	18.06	2.41	126	18.2	3.25	NS
11	270	18.79	2.28	152	18.36	3.47	NS
12	270	19.52	2.47	174	19.25	3.13	NS
13	271	20.36	2.81	140	20.09	3.3	NS
14	302	21.22	3.08	148	20.71	3.46	NS
<b>Total</b>	<b>2192</b>	<b>18.36</b>	<b>3.2</b>	<b>1184</b>	<b>18.39</b>	<b>3.38</b>	<b>NS</b>

N – No. of respondents

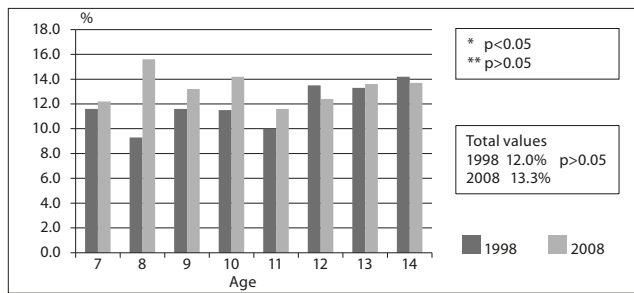
NS – Statistically not significant

Table 2 shows the mean values and standard deviations of BMI for boys across the age groups examined in 1998 and 2008. The means of BMI did not differ significantly except for the 7 and 8-year-olds in whom the means were significantly higher in 2008 when compared to the 1998 data.

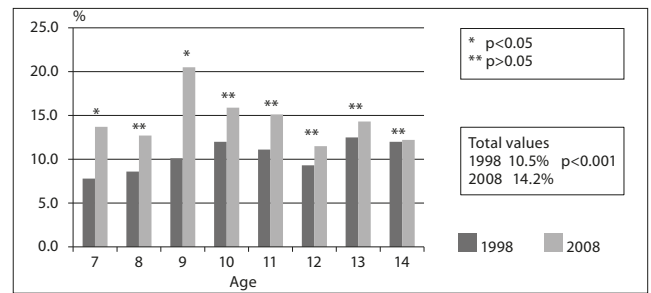
Data on the proportion of overweight and obese girls from the children examined in 1998 and 2008 are presented across the age groups in Figures 1 and 2, respectively. Differences in the prevalence of overweight in the particular age groups of girls from both surveys were not statistically significant. In 14-year-old girls obesity was also significantly lower in 2008 than in 1998. In the remaining age groups no significant differences in the prevalence of obesity were found.

Prevalence of overweight and obesity in boys in 1998 and 2008 are presented across the age groups in Figures 3 and 4, respectively. The proportion of overweight boys in 2008 was significantly higher than in 1998, due to a significant increase in the prevalence of overweight among 7 and 9-year-olds. Differences in obesity prevalence among boys between 1998 and 2008 were not statistically significant, neither overall nor in any of the age groups examined.

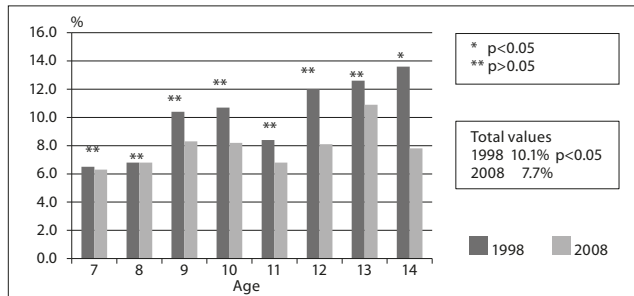
Analysis of the social risk factors for obesity in girls and boys in both studies is shown in Table 3. In the group examined in 1998, a smaller number of siblings living in the same household significantly increased the risk of obesity



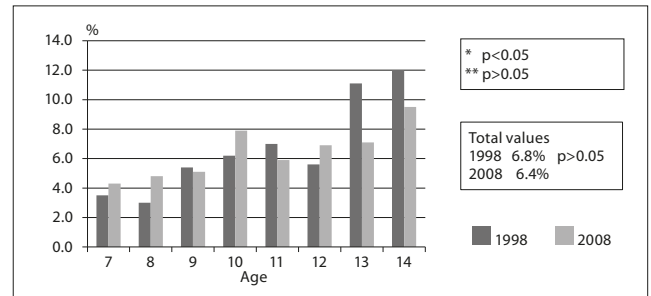
**Figure 1.** Comparison of overweight prevalence in girls in 1998 and 2008 in individual age groups



**Figure 3.** Comparison of overweight prevalence in boys in 1998 and 2008 in individual age groups



**Figure 2.** Comparison of obesity prevalence in girls in 1998 and 2008 in individual age groups



**Figure 4.** Comparison of obesity prevalence in boys in 1998 and 2008 in individual age groups

prevalence in both girls and boys. Low socio-economic status, low level of parental education, or mother's employment outside the household, did not significantly affect the risk of obesity in girls or boys. In the study performed in 2008, none of the social factors investigated were statistically significant predictors of risk for childhood obesity or overweight.

Mean BMI values were significantly higher in the group of girls examined in 1998 in comparison to the group examined in 2008. In the individual age groups, mean BMI values in girls in 1998 were higher than in group in 2008 in 7,10,11,12,13, and 14-year-old girls. In 8- and 9-year-old girls,

mean BMI values in the analyzed groups were statistically not significant. In the same age groups, a significantly lower z-score BMI values in girls examined in 2008 was noted, in comparison to the group examined in 1998. Only in 8- and 9-year-old girls the differences were statistically not significant.

Differences in mean BMI values in boys in 1998 and 2008 were not statistically significant. In the individual age groups, mean BMI values in 7 and 8-year-old boys in 2008 were higher than in group in 1998. Differences in mean BMI values in other age groups of boys were not statistically significant between 1998 and 2008.

**Table 3.** Analysis of social risk factors of obesity in girls and boys

	Girls						Boys					
	1998		p	2008		p	1998		p	2008		p
OR	95% CI	OR		95%CI	OR		95% CI	OR		95%CI		
<b>Number of children in the family</b>												
1-2 vs 3-4	1.60	1.17-2.27	<0.05	1.15	0.73-1.81	NS	1.63	1.15-2.30	<0.05	1.56	0.90-2.70	NS
1-2 vs 5 or more	2.34	1.27-4.31	<0.05	1.30	0.62-2.74	NS	2.13	1.09-4.15	<0.05	0.92	0.32-2.62	NS
<b>Bad financial situation vs</b>												
medium	1.63	0.92-1.56	NS	0.75	0.49-1.17	NS	1.36	0.94-1.82	NS	1.32	0.82-2.13	NS
good	0.64	0.33-1.22	NS	0.84	0.48-1.45	NS	1.23	0.6-2.41	NS	0.81	0.48-1.38	NS
<b>Father's education</b>												
elementary vs vocational	1.21	0.86-1.70	NS	0.71	0.35-1.42	NS	1.06	0.72-1.55	NS	0.93	0.57-1.52	NS
elementary vs secondary	1.60	1.10-2.32	<0.05	0.51	0.11-2.27	NS	1.52	1.00-2.33	NS	1.01	0.39-2.61	NS
elementary vs university	1.61	0.89-2.93	NS	0.45	0.02-12.83	NS	0.93	0.37-2.31	NS	0.94	0.22-4.04	NS
<b>Mother's education</b>												
elementary vs vocational	0.90	0.52-1.30	NS	0.74	0.19-2.75	NS	1.10	0.74-1.64	NS	0.52	0.11-2.30	NS
elementary vs secondary	1.00	0.70-1.44	NS	0.99	0.54-1.82	NS	1.21	0.81-1.83	NS	1.21	0.65-2.28	NS
elementary vs university	1.07	0.60-1.89	NS	1.08	0.31-3.78	NS	1.49	0.77-2.86	NS	1.24	0.34-4.56	NS
<b>Mother's employment outside home</b>												
unemployed vs employed	1.30	0.96-1.76	NS	1.00	0.85-1.18	NS	1.35	0.73-2.22	NS	1.46	0.89-2.40	NS

NS – statistically not significant



## DISCUSSION

The presented data indicate a trend toward stabilization in prevalence of obesity in schoolchildren from south-east Poland between 1998–2008. Although overweight in boys increased significantly from 10.5% to 14.2%, obesity remained on the same level. In girls, the data are even more optimistic, as overweight increased only insignificantly while obesity prevalence decreased significantly from 10.1% to 7.7%. On the other hand, obesity remained more prevalent in the female than in the male gender, but when the difference was considered by age group, compared to boys of the same age, the difference was statistically significant only in girls aged 7–9 years and 12 years.

The long-term observation of trends in the prevalence of childhood obesity encounters several difficulties which result mainly from evolving definitions of overweight and obesity in children. Other obstacles to comparative studies include different age brackets used in obesity prevalence studies, different methods of subject selection, and the statistical methods used for research [1, 8].

The presented results are similar to the findings of two recent national studies on French children, based on a random selection of schools and on the IOTF definition of overweight and obesity. Salanve et al. [13] observed that rates of overweight and obesity had not changed significantly between 2000 (18.1%) – 2007 (15.8%) in children aged 7–9, based on two repeated cross-sectional surveys performed according to the European Childhood Obesity Group ECOG protocol. Another cross-sectional survey including children aged 10–11, conducted in 2001–2002 and repeated in 2004–2005, indicated similar trends [21]. In Europe, Switzerland seems to be experiencing a similar phenomenon on a national scale. Two cross-sectional studies among children aged 6–13 were performed in 2002 and 2007, based on a three-stage, probability-proportionate-to-size cluster sampling of primary schools throughout the country [10]. The prevalence of overweight in girls was significantly lower in 2007 than in 2002, and the prevalence of obesity decreased in both genders. In Sweden, the same trend was recently observed, based on a cross-sectional survey performed in children aged 10 living in Goteborg [11]. Between 2000–2001 and 2004–2005, the prevalence of overweight and obesity in girls decreased from 19.6% to 15.9% ( $p < 0.01$ ), while in boys the difference was statistically insignificant. Also, Mitchell et al. [22] found that the prevalence of obesity in Scottish schoolchildren has declined between 1997–2004 from 14.7% to 10.2%, and the difference was statistically significant. In the same study, BMI centiles and BMI standard deviation scores also declined considerably over time.

The paper by Ogden et al. [5], based on the National Health and Nutrition Examination Surveys, showed not only that there was no significant change in the prevalence of high BMI for age among children and adolescents in the US between 2003–2004 and 2005–2006, but also that there were no significant changes between 1999–2006.

In the post-Communist era, several Central-Eastern European countries reported an increase in prevalence of overweight and obesity in children and adolescents. Blaha et al. [17] in the Czech Republic found an increase in prevalence of obesity from 3–6%, and an increase in the prevalence of overweight from 10–13% in a group of children aged 7–11. However, to define overweight and obesity they used local BMI centile charts.

Meszaros et al. [6] also found in Hungary a considerable increase in the prevalence of overweight and obesity in boys aged 7–18. In former East Germany in 1985–1995, in the period after the unification of Germany and the economic transformation, the prevalence of obesity rapidly increased [15]. However, over the next six years the prevalence of obesity increased only insignificantly.

In our study, there were significant gender differences in secular trends of overweight and obesity prevalences. Prevalence of obesity in girls stabilized in the pre-puberty period and significantly decreased at the start of adolescence particularly in the group of 14 years old. In boys, there was a some what concerning trend toward increasing overweight at ages 7 and 9 years. High body weight at this age is known as 'adiposity rebound' and may have an unfavourable effect on obesity in adulthood [4]. In 2008, overweight occurred more frequently in boys than in girls, whereas obesity was more common in girls. However, these differences were not statistically significant.

In the study performed in 1998, the low level of fathers' education and small number of children in the families increased the risk of development of childhood obesity. Results of the current study are supported by Chen et al. [7] who found strong evidence that children who had no siblings were at greatest risk for childhood obesity. However, in the study performed in 2008, social factors did not modify the risk of obesity in children. In the environmental context of industrialized countries, excess weight gain in children has been found to be more prevalent among lower income families [2]. This inverse relationship between socio-economic status and obesity was confirmed in French children, based on a French food consumption survey, using the head of household's occupation as a measure of socio-economic status [21].

A recent review by Shrewsbury and Wardle [22] highlighted a relationship between childhood overweight and obesity and social risk factors dependent on the social indicator used, and that it is important to understand how socio-economic status and childhood obesity are correlated in order to design effective prevention strategies.

The stabilization of the prevalence of overweight and obesity in France has been explained by the introduction of a programme for the prevention of obesity in children [13]. The reasons for stabilization of overweight and obesity in schoolchildren in south-eastern Poland seem to be more complex. Replacement of traditional food selections with a westernized high calorie diet based on meats, high carbohydrate snacks and processed foods, could be potential culprits for the increase in obesity rates. On the other hand, the last ten years was a time of positive socio-economic changes in Poland, when the level of unemployment decreased, income level increased, and the number of people with higher education grew considerably.

However, throughout that period, there was no coordinated programme of obesity prevention in children, although public policy initiatives may have had an impact on the stabilization or decrease of obesity rates. Obligatory duration of physical education classes was increased from 45 minutes to 180 minutes per week in primary and junior high schools, and several sports fields and swimming pools were constructed. Vending machines with sweet beverages and high calorie snacks were removed from primary and secondary schools. In 2007, a national educational program



'Keep Fit!' promoting principles of a balanced diet and physical activity among school youth was established [25]. Finally, in the same year, following the guidelines of the European Union 'The national program for prevention of obesity and non-infectious chronic diseases by improving feeding and physical activity for the years 2007–2011' was introduced [25]. All these factors might have had an influence on the results of the presented study.

A weakness of this study is that it was conducted in a single region of Poland. Its population has a rather low SES, and the family model with the father being wage earner and mother the homemaker is still very common. Parents in the area have a relatively low education with almost 60% of them completing only primary or vocational education. However, it seems that one can extrapolate the obtained results to the whole country, since most socio-economic changes and preventive programmes have occurred at the national level.

In comparison with other European countries, the prevalence of overweight and obesity in children in Poland is at a medium level. However, comparative analysis of these studies is very difficult due to differences in the criteria for the selection of research groups in terms of age, gender, as well as methods for determining overweight and obesity. In 1994–95, a nationwide survey was conducted involving a coordinated nationally representative population of students in primary and secondary schools. Overweight and obesity were determined based on correlated grids, percentile weight and height, developed by the authors. Overweight occurred in 8.7% of children and adolescents aged 7–17 years, including 3.4% obese. The proportion of children with overweight and obesity increased with age from 6.1% at age 7–8 years to 14.8% at age 16–17 years in boys and 7.9%, respectively, from 13.7% of girls [16].

In 2001, Małacka-Tendera et al. conducted a nationwide survey on a representative sample of children aged 7–9 years. IOTF criteria were used in determining overweight and obesity. Overweight and obesity was found in 15.8% of girls and 15% boys, including obesity in 3.7% of girls and 3.6% of boys [17]. This indicates a significant increase in overweight and obesity in the studied age group, compared to the results of studies conducted in the 1990s. Results of these studies, however, may not be entirely comparable because of the different methods for determining overweight and obesity in children.

In 2007, Jodkowska et al. examined the prevalence of overweight and obesity in adolescents aged 13–15 years in several regions of Poland. These authors reported overweight in 8.1–8.5% of boys and in 8.1–10.1% of the girls; obesity was present in 2.9–3.6%, respectively, in boys and girls 5.2–6.2%. However, they used their own developed BMI centile charts to define overweight and obesity [16].

Further studies are needed to investigate whether or not the trend in the stabilization and decline in obesity prevalence continues. It is also important to monitor the patterns of overweight while especially bearing in mind the increases observed among 7 and 9-year-old boys in this study. Gender differences' in secular trends for overweight and obesity also require further attention.

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