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Overweight trends among Polish schoolchildren before and after the transition from communism to capitalism

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ABSTRACT

This study aims to reveal the secular trends in body mass index (BMI) and the prevalence of overweight and obesity among Polish schoolchildren between the years 1966–2012, during which intense socio-political changes took place. Four surveys were conducted in several districts of Poland looking at 69,746 schoolchildren aged 7–18. Significant increase in mean BMI as well as in the prevalence of overweight and obesity was observed. During this time the highest increase in both mean BMI and excess weight was observed between 1988 and 2012, i.e. after the political transformation, resulting in the improvement of living conditions. However, with respect to girls in late adolescence, between these years, the mean BMI as well as the prevalence of overweight were leveling off, while the percentage of boys with excess body fat in the same developmental category significantly increased in 2012. In the years 1966–1978 and 1978–1988 the pattern of changes in the prevalence of overweight and obesity reflected the social and economic circumstances, i.e. temporary economic improvements, or deepening political crises and food shortage. In conclusion, the weight status of schoolchildren strongly reflects socio-political changes that took place in Poland, as well as in most of the Central European countries in the last half century.

1. Introduction

Secular trend in body size is a biological result of changes in environmental conditions. During the last 150 years, among the human population, the progress of civilization, related to the technological development within the areas rising the quality of life (e.g. advanced health-care and food technology) has significantly influenced the rate and direction of secular changes (Cole, 2003; Eveleth, 2001). One particular example in which this phenomenon may be observed is body mass index (BMI). Although it does not measure adiposity directly (compare: e.g. Burkhauser and Cawley, 2008; Ellis et al., 1999), the standardized classification of overweight and obesity, based on this index, is commonly recommended and widely used for a worldwide comparison of its rising prevalence rate (James, 2004). A constantly increasing prevalence of excess body fat has become a serious problem in both Western and Westernizing countries. Economic growth, related to intensified industrialization and market globalization, by its association with a higher standard of living and greater availability of food, has influenced the dietary and lifestyle trends in both developed and developing parts of the world. Studies on adults have revealed a global tendency toward a significant increase in overweight and obesity since 1960s (Freedman et al., 2010; see also Stevens et al., 2012). A secular trend in higher levels of BMI and a vast prevalence of obesity have been observed especially in the USA

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(Komlos and Baur, 2004; Komlos and Brabec, 2010, 2011; Ogden et al., 2014) and Europe (e.g. Gutiérrez-Fisac et al., 2012; Lahti-Koski et al., 2010; Midthjell et al., 2013; Zaninotto et al., 2009; but compare: van Jaarsveld and Gulliford, 2015, where stabilization in the childhood overweight and obesity rates were observed between 2004 and 2013). However, recent research has shown that the secular increase in BMI over a relatively short period of time is observed also in adult citizens of developing countries, such as China (Jin et al., 2013), Mexico (Ferrer et al., 2013) or India (Chopra et al., 2013). Moreover, this problem also refers to children and adolescents in many countries, where secular trends in overweight and obesity have significantly accelerated between the 1980s and late 1990s (Freedman et al., 2010). This phenomenon has been observed particularly among schoolchildren in the USA (e.g. Fels Longitudinal Study, Sun et al., 2012), many European countries (e.g. de Castro et al., 1998; Decelis et al., 2013; Lissner et al., 2013; Parrino et al., 2012; Stamatakis et al., 2010; Vignerová et al., 2007; Zellner et al., 2007), but also in different parts of the world, such as India (Chhatwal et al., 2004; Gupta et al., 2011) and China (Ji et al., 2013; Ying-Xiu and Shu-Rong, 2012; Yu et al., 2012).

In Poland (Central Europe) the obesity rate has been relatively low in the past, however its prevalence has increased from the 1960s through to the 1980s (Rogucka and Bielicki, 1999). One of the most specific features of the communism in Poland was incessant economic crises that threaten economic development. Usually they took place in the middle of the Five-Year Plans (periodic plans of economic improvement). Despite the accelerated economic development strategy, implemented in 1959, and increase of capital expenditures by 80%, national official statistics reported a decline in GDP. At the end of the 1960s and the beginning of the 1970s the deterioration in living conditions was observed. These issues have led to the outbreak of the economic and political crisis in 1970 and the violent suppression of the workers' protests by the police and the army. As a consequence of these events, the leadership in government has been changed as well as a new strategy for economic growth has been established. The government abstained from the increment in prices for food products and increased the minimum salary and, as a result, GDP has grown by 10% in the first half of the 1970s. Consequently, improvement of living conditions has affected the change in consumption patterns. However, in the mid-1970s economic collapse occurred. After 1978 there was a decrease in real income in approximately 50% of the households, while the foreign trade deficit caused a further increase in debt of the country. That caused long-term economic crisis, which has led to the political and social crisis in the mid-1980s. Since the debt was not paid the country's financial liabilities were constantly increasing. First, the inflation, and then – hyperinflation appeared. Moreover, inadequately prepared necessary reforms have not produced the expected effects. The sustained growth of GDP did not come until the political transformation from a centrally planned to a free market economy, which began in 1989. The rapid changes that took place after this event, have contributed to a major shift toward a Western lifestyle, dietary habits (changes in diversity, quality and availability of food, resulting in its increased intake) and leisure-time activities (an increased popularity of television and computer games, especially among children, resulting in a decrease of active leisure).

Moreover, the proportion of overweight young male adults gradually increased according to nationwide research in all socio-economic groups between 1965 and 2010 (Kołodziej et al., 2015; Koziel et al., 2004; Koziel et al., 2006; Lipowicz et al., 2014) as well as in the south-eastern Poland between 2000 and 2010 (Binkowska-Bury et al., 2013). Regarding Polish children and adolescents, the prevalence of obesity among boys from Wroclaw (South-West Poland) was higher in 1997 by more than one percent in comparison with the 1987 sample, whereas overweight was slightly lower in the 1997 sample (Koziel et al., 2000). Referring to young inhabitants of Krakow (South-Central Poland), the rate of overweight and obesity doubled within 30 years (1971–2000) in both sexes, however, there was no positive secular trend in BMI among adolescent girls (Chrzanowska et al., 2007). Based on the above results, estimations of obesity prevalence in various parts of Poland seem to be regionally dependent (Milewicz et al., 2005). Nevertheless, there is a lack of cross-sectional results concerning the secular trend in BMI as well as the prevalence of excess weight in children and adolescents in Poland during last few decades.

Moreover, it is particularly interesting to investigate this issue not only with respect to overall trend in BMI throughout this period, but also within the context of gradual socioeconomic changes, which may be reflected in subtle variations in fatness in subsequent years, depending on the political circumstances. Such linkage between political as well as economic changes and adiposity was found, for instance, in Cuba: at first, adiposity was affected by economic blockade followed by food shortage and increased physical activity caused by fuel shortage, and after economic recovery by improvement in food availability and transportation as well as by rising popularity of computer games, related to rise in nutritional intake and decline in physical activity (Esquivel and González, 2010). Accordingly, this paper aims to describe trends in the weight status of the Polish population of children and adolescents during the last nearly 50 years. These changes in weight (BMI and both overweight and obesity) may reflect social, economic and political transformation, as the sample includes individuals born just after World War II, during long-lasting period of socialism and communism, as well as those who were born after the economic transition from a centrally planned to free-market economy.

2. Materials and methods

2.1. Survey methods and participants

From 1966 to 1988 three cross-sectional anthropometric surveys were conducted in Poland. Parts of these surveys were previously analyzed and described in other publications (Bielecki et al., 2012; Bielicki and Welon, 1982; Hulanicka and Waliszko, 1991; Lipowicz, 1999). However, analyses concerning these studies in the context

of excess weight have not been presented as yet, as large parts of the data were unavailable in electronic form. Therefore, to fill the gap in this area, data related to the concerned problem have recently been computerized. Moreover, in 2012, another cross-sectional survey was carried out in particular areas of Poland, corresponding to those used in the previous surveys.

Data, including boys and girls attending primary and secondary schools of different types, were collected during four Polish Anthropological Surveys carried out repeatedly in 1966 ($N = 19{,}226$), 1978 ($N = 19{,}772$), 1988 ($N = 24{,}609$) and 2012 ($N = 6139$). The total random sample consisted of 69,746 (34,829 boys and 34,917 girls) schoolchildren aged 7–18 years. The 1966 survey was nationwide and was conducted on the territory of 98 contemporary districts. Subjects were chosen by the National Bureau of Statistics (GUS) in a multi-stage procedure of sampling in the following order: regions within Poland, the locations within the regions (particular cities, towns and villages), the schools within the locations, the required number of children within the schools (Gorny, 1976). Due to the high costs of conducting the survey in 1966, the subsequent surveys of children were conducted only in three large cities (Warsaw, Lodz, and Wroclaw), four small towns and in the villages that were within the county districts of these towns (Hulanicka et al., 1990). In the 1978, 1988 and 2012 surveys, schools in urban locations were randomly selected, while the sample in the small towns and villages included the entire population of schoolchildren living within these selected areas. However, due to the legal requirements introduced after 1989, the written consent of parents or legal guardians of the children was required to conduct the examination in 2012. In contrast to previous mandatory surveys, this study, therefore, did not cover all the children of the target population. The same schools were chosen in 1978, 1988 and 2012 and all regions included in these surveys were represented in the 1966 survey.

2.2. Measurements

All surveys included data for multiple anthropometric characteristics. The measurements were taken by anthropologists and trained staff (physical anthropology students). Information on demographic and social characteristics was collected from three sources: interviews with the examined children, information from parents and teachers, and school reports (except for 2012 survey, where all this data was provided exclusively by parents). Height (cm) and weight (kg) were measured to the nearest 1.0 mm and 100 g, using an anthropometer and a weight-meter, respectively. In all four surveys, the children were examined in light clothing without shoes. Body mass index (BMI; kg/m^2) was calculated as weight (kg) divided by height (meter), the quotient squared. The definitions of overweight and obesity, according to the recommendation of the International Obesity Task Force (IOTF) (Cole et al., 2000) were based on data of 190,000 children from six developed and developing countries. The cut-off points are defined in BMI units for young adulthood i.e. 25 kg/m^2 for overweight and 30 kg/m^2 for obesity, and extrapolated to the appropriate value of BMI for the appropriate age in childhood (LMS method; for more details see Cole et al., 2000). Each child's age was rounded to the nearest whole year, for example, the group of 10 year old children includes all children from 9.50 to 10.49 years with their ages coded as 10.0 years. According to Chrzanowska and colleagues (2007) three periods of development in boys and girls were identified: childhood (7–12 and 7–10 years of age for boys and girls, respectively), early adolescence (13–15 and 11–13 years of age for boys and girls, respectively) and late adolescence (16–18 and 14–18 years of age for boys and girls, respectively). Such developmental categories refer to the changes and differences in the rate of growth during human life-cycle as well as to the onset of puberty and adolescent growth spurt, with respect to both sex and years of age (see Bogin, 1999).

2.3. Statistical analyses

Changes in mean BMIs among participants of successive surveys within age classes were analyzed using a two-way analysis of variance where age and survey were factors (independent variables) and values of BMI were dependent variables. The interaction effect between age and year of survey was also analyzed with respect to its influence on dependent variables. Tukey's HSD (Honestly Significant Difference) Test for unequal sample size was used for post hoc comparisons between successive surveys from 1966 and 2012 (assumed a significance level of $p < 0.05$). All calculations were done using Statistica 10.0 (StatSoft, 2011).

3. Results

Tables 1 and 2 presented descriptive statistics of BMI for boys and girls in four surveys by age classes. The results of a two-way analysis of variance were given in Table 3. The BMIs for both boys ($F(33,\ 34{,}781) = 3.50,\ p < 0.001$) and girls ($F(33, 34{,}869) = 10.49, p < 0.001$) differed significantly with respect to age and survey. The second order interaction of the two factors was highly significant, indicating that differences in the mean BMI between successive surveys depended on age. The post hoc comparison revealed the significant differences in mean BMI (in the direction of increasing BMI) especially between 1988 and 2012, for both sexes, except for children aged 7 and girls aged 14–18. Other pronounced, significant changes were observed in girls aged 10–14 between years 1966–1978 (Table 4).

Fig. 1a and 1b demonstrated changes in mean BMI according to four surveys by age classes. For boys (Fig. 1a) the means of BMI were arranged in gradual order. The lowest means were for the earliest survey and the highest for the most recent one. However, in each age class the means for the three earlier surveys were very close to each other, whereas the means for the 2012 survey departed significantly from the three remaining surveys. This pattern consequently repeated itself in each age class except for the 7-year-old boys. For girls (Fig. 1b) the graph was quite different. For age classes from 7 to 14 years the

Table 1
Means and SDs of BMI [kg/m^2] by age in four successive surveys for boys.

Age categories	Survey 1966			Survey 1978			Survey 1988			Survey 2012		
	N	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD
7	506	15.77	1.59	821	15.79	1.85	1043	15.81	1.73	211	16.11	2.04
8	649	15.66	1.51	881	15.95	1.79	1137	15.98	1.83	346	17.18	2.69
9	743	16.00	1.69	885	16.28	2.03	1180	16.47	2.00	327	17.85	2.79
10	734	16.46	1.73	844	16.70	2.17	1131	16.89	2.19	288	18.30	3.03
11	859	16.63	1.72	828	16.94	2.22	1048	17.23	2.40	309	18.74	3.27
12	810	17.13	1.85	847	17.51	2.41	1063	17.72	2.56	265	19.21	3.45
13	886	17.69	1.93	842	18.17	2.57	1026	18.38	2.74	199	20.07	3.43
14	820	18.27	1.89	816	18.70	2.32	947	18.99	2.64	168	20.52	3.65
15	1150	19.39	2.21	855	19.56	2.50	1184	20.00	2.51	147	21.20	3.40
16	1096	20.10	2.18	837	20.37	2.36	1108	20.79	2.36	241	22.17	3.61
17	875	20.84	2.03	764	21.05	2.32	950	21.41	2.44	282	22.54	3.33
18	397	21.14	2.13	650	21.34	2.05	639	21.85	2.24	195	23.05	3.36
N total	9525			9870			12,456			2978		

lowest BMI means were for the earliest survey, significantly deviated from means for two subsequent surveys which were very close to each other. The highest means for this age range were for the last survey, departing significantly from the other means. Then, for ages older than 14 years the means for all surveys converged closely with insignificant differences.

Considering three periods of development in boys (Fig. 2a and b), the prevalence of overweight between 1966 and 2012 increased slightly more than 5 times, both in childhood (from 3.67% to 19.19%) and late adolescence (from 3.72% to 19.64%), and nearly 7 times in early adolescence (from 2.66% to 18.09%). The increase in the prevalence of obesity was much more substantial, reaching values of 11.4 times higher in childhood (from 0.49% to 5.56%), 13.3 times (from 0.35% to 4.67%) and more than 16 times (from 0.30% to 4.87%) larger in early and late adolescence, respectively. Regarding girls, the increase in the prevalence of overweight between years 1966–2012, in childhood and early adolescence, was comparable to that of boys of the same age, being slightly more than 5 times (from 3.26% to 17.53%) and nearly 6 times (from 2.93% to 17.29%), respectively, whereas in the late adolescence it increased only 1.8 times (from 5.63% to 9.88%). Remarkable changes in the female obesity rate were noticed in childhood, reaching an increase of more than 24 times (from 0.26% to 6.30%), compared to a slightly more than 6 times increase during late adolescence (from 0.30% to 1.91%) (Fig. 3a and b).

Table 5 revealed that the largest increase in the mean changes per decade in pooled prevalence of overweight and obesity occurred between 1988 and 2012, except for the late adolescence period in girls, for which this increment was the lowest over the entire time of research in all categories of development among both sexes. On the second place in terms of the intensity of the annual increase in mean excess weight were years 1966–1978, while the lowest growth was observed between years 1978–1988, except for girls in late adolescence.

4. Discussion

The current study is the first investigation with the largest sample of participants revealing an upward secular trend in BMI as well as in the prevalence of overweight and obesity across the population of children and adolescents in Poland (Central Europe) which was subjected to significant political, economic and social changes over the period considered here. In the majority of the previous studies of

Table 2
Means and SDs of BMI [kg/m^2] by age in four successive surveys for girls.

Age categories	Survey 1966			Survey 1978			Survey 1988			Survey 2012		
	N	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD
7	438	15.16	1.43	820	15.51	1.77	1067	15.72	1.72	246	16.56	2.24
8	663	15.22	1.59	793	15.71	1.85	1082	15.69	1.82	336	17.01	2.58
9	756	15.41	1.62	827	16.20	2.10	1061	16.24	2.20	321	17.38	2.93
10	785	15.90	1.84	799	16.49	2.26	1078	16.77	2.24	272	17.87	3.03
11	870	16.51	1.88	824	17.06	2.45	1056	17.28	2.53	326	18.50	3.03
12	940	17.08	2.06	787	17.76	2.41	1112	18.04	2.66	237	19.10	3.24
13	883	17.80	2.20	809	18.57	2.56	986	18.67	2.69	218	20.07	3.46
14	837	18.98	2.32	826	19.76	2.64	1005	19.89	2.97	200	19.89	2.86
15	1042	20.10	2.38	876	20.28	2.48	1081	20.47	2.66	161	20.44	2.51
16	1102	20.77	2.32	907	20.69	2.44	1006	21.26	2.75	305	21.12	3.13
17	971	21.21	2.33	862	21.12	2.30	924	21.54	2.66	304	21.30	3.25
18	414	21.46	2.27	772	21.27	2.22	695	21.51	2.44	235	21.37	3.22
N total	9701			9902			12,153			3161		

Table 3
Results of a two-way analysis of variance where age classes, surveys and their interaction were independent factors for BMI values (kg/m^2) as dependent variable between 1966 and 2012 surveys (for boys and girls).

	Sum square	d.f.	Mean square	*F*	*p*
Boys					
Age	96,157.19	11	8741.56	1685.64	<0.001
Survey	7381.20	3	2460.40	474.44	<0.001
Interaction	599.64	33	18.17	3.50	<0.001
Girls					
Age	109,944.63	11	9994.97	1771.26	<0.001
Survey	4116.05	3	1372.02	243.14	<0.001
Interaction	1953.14	33	59.19	10.49	<0.001

the Polish population, only the prevalence of obesity and overweight, but not its temporal trends, were examined, while the changes in BMI over time were investigated only locally. For instance, Chrzanowska et al. (2007) examined trends in prevalence of overweight and obesity between years 1971–2000 among schoolchildren. However, their study included only inhabitants of the single Polish city, while these surveys were conducted at diverse levels of urbanization as well as in different regions of Poland. Therefore, also the sample size presented in this paper was much larger. Moreover, results presented by Chrzanowska et al. (2007) concerned period of the first years of the free-market system development, while 2012 survey reflects more implemented stage of the capitalism.

The prevalence of obesity and overweight among Polish children and adolescents is much lower than the average estimated for Europe in 2010 by Wang and Lobstein (2006), and ranks well below those of young American (Komlos et al., 2009) or school-aged citizens of many Western European countries (e.g. Blüher et al., 2011; Decelis et al., 2013; Parrino et al., 2012; Stamatakis et al., 2010). Generally the lower level of overweight among children in the countries of Central and Eastern Europe follows the economic and political transition in the late 1980s and 1990s as well as the recession during that period (Lobstein and Frelut, 2003). Therefore, similar results concerning the prevalence of excess adiposity were obtained also in the Czech Republic (Vignerová et al., 2007) and in Eastern Germany (Zellner et al., 2007). Furthermore, results of this broad study are comparable to the most recent data

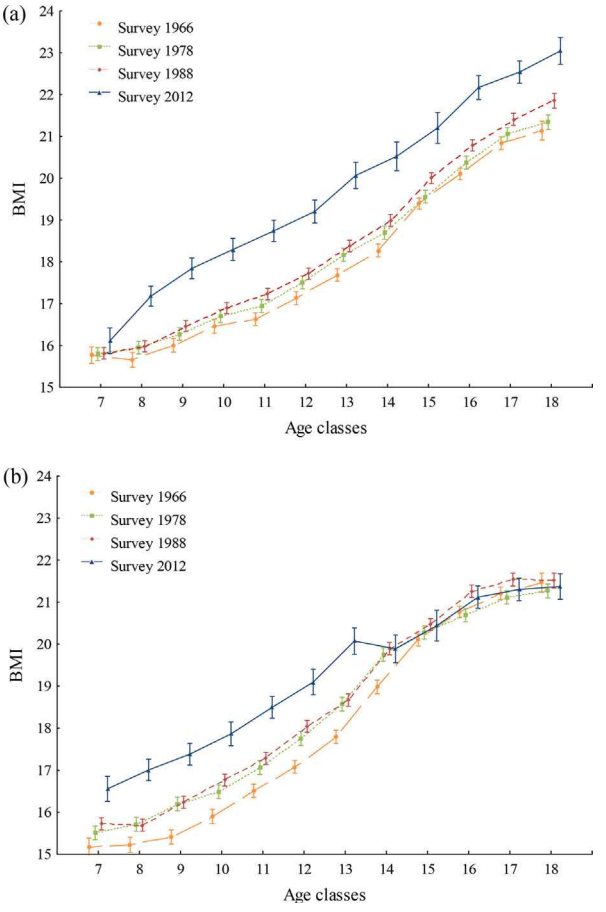

Fig. 1. The mean BMIs by age for boys (a) and girls (b) (vertical lines indicated 95% CI for the Mean) in four successive surveys.

conducted locally on the sample from the selected city of Poland (Krakow, Bac et al., 2012).

Although the prevalence of excess adiposity in school-children gradually increased since 1966, the level of these changes varies, relating to the period when the surveys were conducted as well as to the developmental category. The nutritional status of schoolchildren reflects the effect of improvement or deterioration in the living conditions

Table 4
A post hoc comparison (HSD Tukey's test): changes in the BMI units [kg/m^2] between the years 1966–1978, 1978–1988, and 1988–2012 within age classes for boys and girls.

	7	8	9	10	11	12	13	14	15	16	17	18
Boys												
1966–1978	0.02	0.29	0.27	0.24	0.32	0.38	0.48**	0.43	0.17	0.27	0.21	0.20
1978–1988	0.02	0.03	0.19	0.19	0.28	0.21	0.21	0.29	0.44**	0.41*	0.36	0.51**
1988–2012	0.30	1.20****	1.38****	1.40****	1.51****	1.49****	1.69****	1.53****	1.20****	1.38****	1.13****	1.19****
Girls												
1966–1978	0.35	0.49	0.79	0.59***	0.55**	0.68****	0.78****	0.77****	0.18	−0.08	−0.09	−0.20
1978–1988	0.21	−0.02	0.04	0.28	0.22	0.29	0.10	0.14	0.19	0.57***	0.42	0.25
1988–2012	0.83	1.31****	1.14****	1.10****	1.22****	1.05***	1.40****	0.00	−0.03	−0.14	−0.24	−0.14

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$
**** $p < 0.0001$

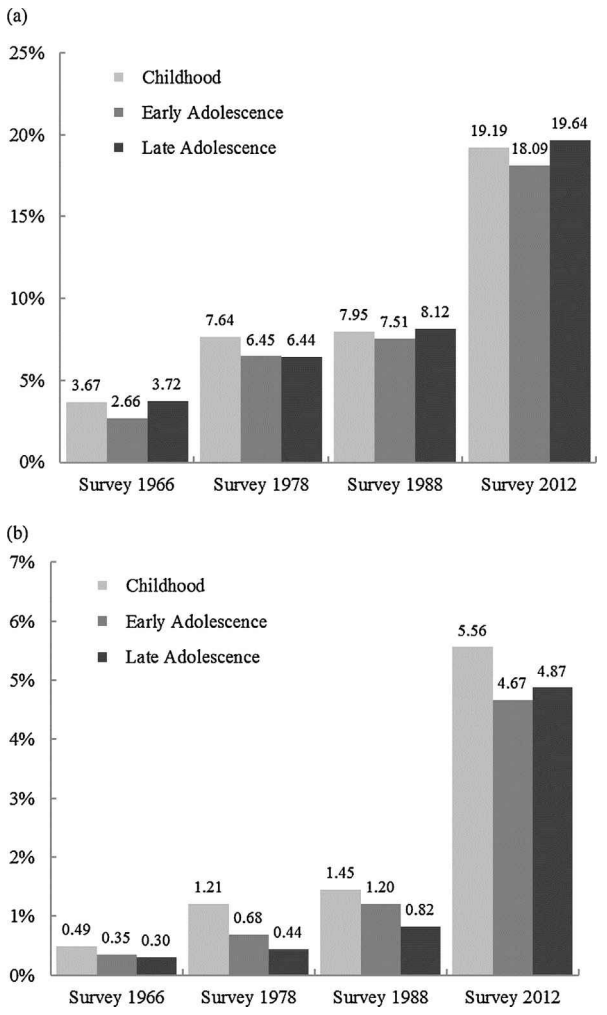

Fig. 2. Prevalence of overweight (a) and obesity (b) in three periods of development for boys (childhood: 7–12 years of age, early adolescence: 13–15 years of age, late adolescence: 16–18 years of age) in four subsequent surveys.

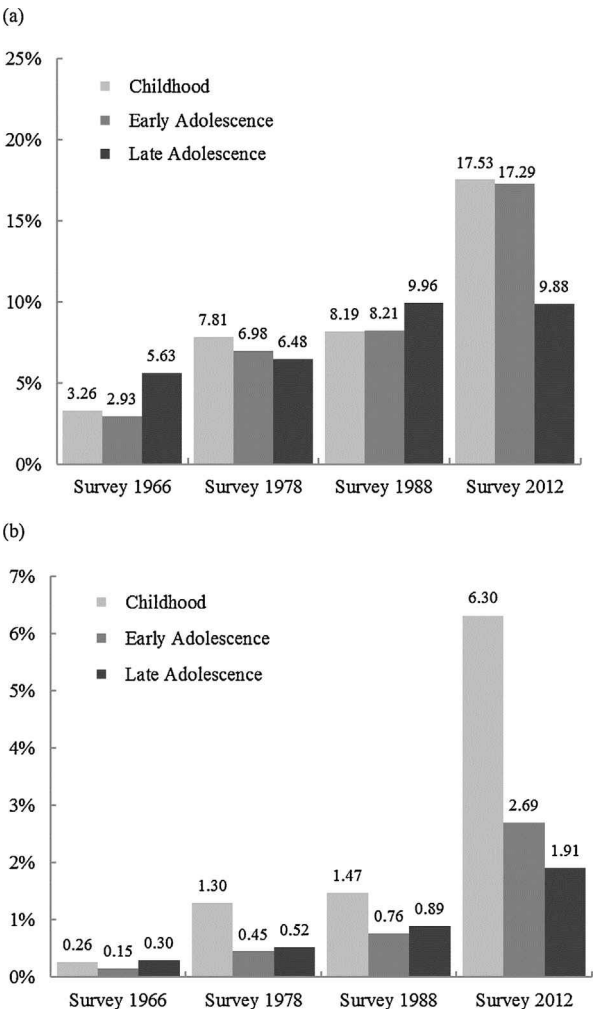

Fig. 3. Prevalence of overweight (a) and obesity (b) in three periods of development for girls (childhood: 7–10 years of age, early adolescence: 11–13 years of age, late adolescence: 14–18 years of age) in four subsequent surveys.

within the historic context as well as different sensitivities to environmental influences, depending on the period of development (see also Bielecki et al., 2012). Communism was characterized by constant economic crises of varying intensity, interspersed with periods of stagnations or moderate economic growth. Children from the 1966 survey were born during the unfavorable period of Stalinism and, then, of growing economic stagnation, accompanied by food shortages. According to data of World Health Organization (WHO, 2000), between 1961 and 2000 in Poland the total dietary energy intake per capita (in kcal) was the lowest in the 1960s. Consequently, indicators related to children's nutritional status (in terms of the over-nutrition) reached the lowest level. Economic improvement, which appeared during the first half of the 1970s (changes in food consumption), was followed by price increases and workers' strikes. In 1976 food rationing was introduced with limited access to nourishment for most people. These unfavorable circumstances might have influenced the lack of increase in mean BMI among boys, the sex with higher eco-sensitivity compared to females. At the same time, growth in the prevalence of male overweight and obesity might reflect the social stratification i.e. the majority of society compared to members of the ruling communist party who were less exposed to these constraints. The economic crisis deepened during subsequent years. In the 1980s many adverse events (e.g. martial law imposition, food price increases) gave rise to a dramatic decrease in total dietary energy intake per capita (WHO, 2000; compare also for fat intake: Fig. 4a). For that reason, the secular changes in BMI and excess weight could be less remarkable than in the previous decade. From the 1970s the economy did not improve until the political changes in Poland after 1989 (compare: Fig. 4b), which led to the fall of communism. Since this time, economic development, followed by the changes in life-style and decline in physical activity, resulted in the rapid growth of the percentage of overweight and obese children. As previous study has shown (Ulijaszek and Koziel, 2007), in many countries of Central and Eastern Europe economic

Table 5
Mean changes per decade in pooled prevalence of overweight and obesity between particular surveys in three developmental categories for boys and girls (in percentage points).

	Boys			Girls		
	Childhood	Early adolescence	Late adolescence	Childhood	Early adolescence	Late adolescence
1966–1978	3.91	3.43	2.38	4.66	3.63	0.89
1978–1988	0.55	1.58	2.06	0.55	1.54	3.85
1988–2012	6.40	5.85	6.49	5.90	4.59	0.39

transition has led to increased real income as well as increased using of cars, televisions, computers that contribute to decrease of physical activity and, afterwards, to higher rates of obesity and overweight. Consequently, the prevalence of excess adiposity in 2012 reached values several times higher than in other surveys (what was also visible in the increase of variation in BMI values; compare: Tables 1 and 2 and Figs. 2 and 3). However, in 2012 it was observed that the considerable variation in adiposity was more dependent on sex and developmental period than in the previous surveys. Precisely, the prevalence of overweight among females in the late adolescence appeared to be significantly lower compared to younger girls. The trend in BMI flattened in the girls aged 14, but increased in boys of all age groups (see also Chrzanowska et al., 2007). Since adiposity in early life is related to the adult level of fatness (Dietz, 1998; Koziel, 2005; Must, 1996), present findings are also in line with the study conducted on adult populations. According to Finucane et al. (2011) between 1980 and 2008 trends in BMI of women from Central and Eastern Europe (including Poland) were relatively flat.

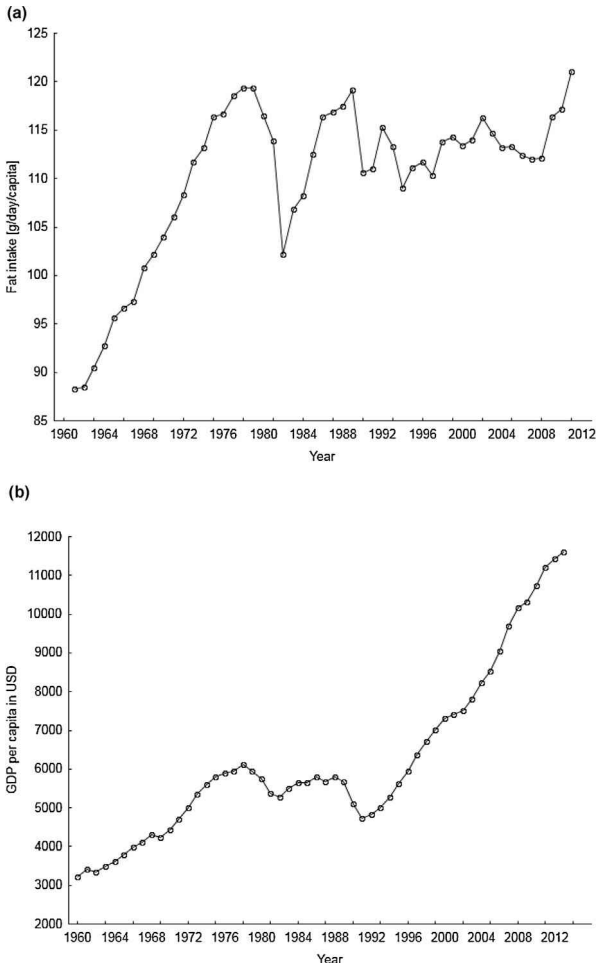

Fig. 4. Changes in fat intake in grams per capita per day (a) (*source: www.faostat.fao.org*) and in GDP in USD per capita (b) (*source: Maddison Historical GDP Data, www.worldeconomics.com*) in Poland between years 1960 and 2012.

One of the possible explanations of the sex differences in overweight/obesity and BMI trends may be related to the emerging social pressure of a preference for thinness among girls, especially in adolescence. In Western cultures the self-perception of physical appearance is an important factor for adolescents' self-esteem (French et al., 1995; Tiggemann, 2005), which is much worse in girls than in boys (Feingold and Mazzella, 1998; Richards et al., 1990; compare: Stice and Whitenton, 2002; Swami et al., 2010). In 2012 the reduced proportion of obese and overweight adolescent girls (14–18 years of age) as well as the flattening off of the BMI trend compared to both younger girls and all age group boys, could be enhanced by the changes in body perception due to the socio-cultural pressures, that appeared in Poland after the political transformation. In 1989 Poland, started to undergo an economic and cultural transition process toward the Western lifestyle. Along with the spread of the free-market system and standards promoted by modern media, an attitude toward Western patterns of attractive (slim) body shape appeared (see also Chrzanowska et al., 2007). Effects of mass media on adolescent body image has been extensively discussed in many studies (Botta, 1999, 2003; Brown and Witherspoon, 2002; Groesz et al., 2002; Hargreaves and Tiggemann, 2002) and it has been revealed, that adolescent girls are more vulnerable to idealized media images than adolescent boys (Hargreaves and Tiggemann, 2004; McCabe and Ricciardelli, 2001). This Westernized ideal-body pressure might lead to development of prevalence of eating disorders in reformed countries (Rathner, 2001), which is one of the most sensitive barometers of cultural changes (e.g. Gordon, 2000; see also Rathner, 2001; Wlodarczyk-Bisaga et al., 1995; Włodarczyk-Bisaga and Dolan, 1996). Recently, 11.5% of Poles aged 15–24 were underweight, with girls being underweight three times more likely than boys (Kaczmarek, 2011). Sociocultural influence in adolescent boys has a different direction, since an achievement of the ideal men's body form is not related to being thin, but to an increase in muscularity (Brown and Witherspoon, 2002; McCabe et al., 2002). This lack of pressure for weight loss

in boys may explain our results regarding male constant patterns in BMI trends and excess adiposity proportions across different ontogenetic stages.

Similar results were obtained in the study conducted on children and adolescents from the Czech Republic, also a country of the former Communist Bloc, that underwent the transformation after 1989. According to Vignerová and colleagues (2007), adolescent girls aged 14 and older are thinner than in the past due to increasing exposure to Western standards of beauty, especially in the context of thinness. However, this phenomenon is not only observed in post-communist countries. In two cohorts of Swedish high school students, born around 1974 and 1990, BMI increased in boys, but was stable in girls (Lissner et al., 2013). This refers also to US children, where after 1990 the rate of changes in BMI was slowing in white girls, but not in white boys (Komlos et al., 2009).

However, there is also another possible explanation of these results, which refers to one of the limitations of this study. A decreased number of participants in the survey conducted in 2012 (compared to previous surveys) might have led to an underestimation of obesity and overweight (see also Lissner et al., 2013). Nevertheless, the number of participants was similar for both sexes. On the other hand, females with excess body fat experience more psychosocial consequences and a higher degree of stigmatization than males. These sex differences in stigmatization are more frequent, especially among adolescents than in the younger ages (Tang-Péronard and Heitmann, 2008). Moreover, there is the evidence indicating that heavier children have a greater risk for being absent from school than their normal-weight peers (Geier et al., 2007) and, additionally, their parents are less willing to provide consent in studies on obesity related issues (Mellor et al., 2008). Although in this paper obesity was not tested directly, part of the questionnaire concerning body measurements could have had an impact on the negative reply to a written consent on the participation of the obese or overweight schoolchildren in the study. However, the number of participants in all age classes was similar in the 2012 survey. Moreover, these findings are in line with the results obtained in nationwide surveys of 19-year-old Polish males obtained by Kołodziej et al. (2015): in our study mean BMI for 18-year old boys increased from 21.14 in 1966 to 23.05 in 2012, while according to Kołodziej et al. (2015) it has increased from 21.73 in 1965 to 22.94 in 2010. Therefore, it can be assumed that the diversity in BMI trend and in prevalence of excess adiposity was probably not affected by the potential lack of consent in particular developmental categories.

A subsequent limitation of the study may be related to the 24-year span between the last two surveys, i.e. 1988 and 2012. This has limited the observation on the rate of changes in BMI trend and the prevalence of overweight and obesity that took place shortly after the onset of transition in relation to the present time. Therefore, it is not clear whether the intense growth in excess adiposity occurred in the first decade after the transformation, and then stabilized, or the increase is relatively constant in time until now. However, according to Bac et al. (2012), the prevalence of obesity and overweight as determined by studies conducted in Krakow in 1971, 2001, 1983, 2000 and 2009, was still increasing. Similarly, Kryst et al. (2012) reported that in young males (3.5–18.5 years) from Krakow the mean values of body weight and BMI has increased, especially in the last decade (see also Woronkowicz et al., 2012). Since results of the current study, regarding the secular trend in BMI or prevalence of obesity and overweight, are comparable to these abovementioned, it can be assumed that the nationwide trend in excess adiposity has been changing at a similar level, rate and direction as in Krakow.

Over the years, socio-political changes had significant impact on human development and health in every post-communist population (compare: Kalediene and Petrauskiene, 2004; Stillman, 2006). During the communism, negative effects of adverse living conditions were observed, such as delayed age of maturity (Popławska et al., 2013) or deceleration in the secular trend in BMI. Transition into free-market system was related to psycho-social stress, resulting in negative health consequences, such as hypertension (Lipowicz, 2007; see also Koziel et al., 2010). Capitalism and economic improvement induced acceleration in the timing of maturity (Popławska et al., 2013) as well as increase in BMI. However, the highest rate of excess adiposity among children, which was found in the present study, is a serious health threat, since the risk of obesity in adulthood is several times greater for obese children than for their normal-weight peers (Serdula et al., 1993). Childhood obesity is also related to adult levels of lipids, lipoproteins, blood pressure, as well as insulin and, by its association with higher risks of various chronic diseases (Freedman et al., 1999; Koziel et al., 2011), and increases of mortality risk in adult life (Hoffmans et al., 1988; Park et al., 2012; Reilly and Kelly, 2010). Moreover, obesity negatively affects psychosocial health and personal quality of life (Friedlander et al., 2003; Williams et al., 2005), economic and social development as well as limits individual opportunities (Branca et al., 2007).

Conflict of interest

The authors declare that they have no conflict of interest.

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Appendix A

See Tables A1–A4.

Table A1
Means and SDs of height [cm] by age in four successive surveys for girls.

Age categories	Survey 1966			Survey 1978			Survey 1988			Survey 2012		
	N	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD
7	438	118.35	5.49	820	120.62	5.71	1067	121.48	5.52	246	124.68	6.00
8	663	122.78	5.74	793	125.80	5.89	1082	126.65	5.92	336	129.72	5.87
9	756	127.77	5.77	827	130.77	6.11	1061	132.08	6.24	321	135.17	6.63
10	785	132.74	6.44	799	136.50	6.23	1078	137.77	6.65	272	141.44	6.73
11	870	138.30	7.15	824	142.34	7.54	1056	144.27	7.24	326	146.06	7.61
12	940	143.12	7.48	787	149.07	7.60	1112	150.48	7.52	237	153.46	7.56
13	883	149.41	7.12	809	154.18	6.77	986	155.42	7.08	218	159.70	7.08
14	837	153.91	6.14	826	158.17	6.26	1005	159.94	6.18	200	162.29	6.28
15	1042	157.32	5.74	876	159.64	5.54	1081	161.27	5.60	161	164.43	5.54
16	1102	158.75	5.46	907	160.84	5.75	1006	162.24	5.69	305	164.43	5.94
17	971	159.09	5.42	862	160.84	5.58	924	162.54	5.80	304	165.24	6.19
18	414	159.18	5.43	772	161.88	5.73	695	163.04	5.73	235	165.54	6.22
N total	9701			9902			12,153			3161		

Table A2
Means and SDs of weight [kg] by age in four successive surveys for girls.

Age categories	Survey 1966			Survey 1978			Survey 1988			Survey 2012		
	N	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD
7	438	21.30	3.02	820	22.68	3.82	1067	23.32	3.80	246	25.91	5.10
8	663	23.02	3.45	793	25.01	4.42	1082	25.30	4.31	336	28.78	5.79
9	756	25.25	3.86	827	27.88	5.29	1061	28.51	5.58	321	32.02	7.26
10	785	28.16	4.86	799	30.91	5.96	1078	32.03	6.17	272	36.05	8.17
11	870	31.77	5.65	824	34.83	7.19	1056	36.21	7.38	326	39.83	9.03
12	940	35.23	6.58	787	39.76	7.90	1112	41.15	8.37	237	45.26	9.78
13	883	39.98	7.21	809	44.40	8.16	986	45.37	8.83	218	51.42	10.55
14	837	45.15	7.37	826	49.58	8.25	1005	51.08	9.31	200	52.51	8.86
15	1042	49.84	7.15	876	51.76	7.41	1081	53.31	7.93	161	55.30	7.41
16	1102	52.39	6.88	907	53.59	7.37	1006	55.98	7.92	305	57.18	9.57
17	971	53.73	6.87	862	54.66	6.73	924	56.97	8.10	304	58.16	9.44
18	414	54.40	6.51	772	55.76	6.76	695	57.24	7.54	235	58.58	9.42
N total	9701			9902			12,153			3161		

Table A3
Means and SDs of height [cm] by age in four successive surveys for boys.

Age categories	Survey 1966			Survey 1978			Survey 1988			Survey 2012		
	N	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD
7	506	119.72	5.54	821	121.73	5.54	1043	122.18	5.35	211	125.23	5.62
8	649	124.37	5.80	881	126.98	5.64	1137	128.13	5.91	346	130.50	5.98
9	743	129.03	6.19	885	131.92	6.16	1180	133.02	5.78	327	135.87	5.64
10	734	133.87	6.20	844	137.10	6.03	1131	138.32	6.28	288	142.23	6.65
11	859	137.64	6.35	828	141.76	6.27	1048	142.91	6.59	309	146.53	6.65
12	810	142.47	6.70	847	147.27	7.44	1063	148.82	7.24	265	152.85	7.99
13	886	148.27	7.96	842	152.99	8.50	1026	154.75	8.55	199	159.99	8.74
14	820	153.70	8.77	816	160.87	9.23	947	162.39	8.54	168	167.43	8.67
15	1150	162.20	8.96	855	166.66	8.74	1184	168.80	7.84	147	172.83	6.94
16	1096	167.76	7.99	837	171.37	7.08	1108	172.78	7.18	241	175.72	6.86
17	875	170.95	6.80	764	172.98	6.85	950	175.10	6.59	282	178.52	6.42
18	397	171.45	6.34	650	174.88	6.26	639	176.38	6.27	195	178.67	6.96
N total	9525			9870			12,456			2978		

Table A4
Means and SDs of weight [kg] by age in four successive surveys for boys.

Age categories	Survey 1966			Survey 1978			Survey 1988			Survey 2012		
	N	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD
7	506	22.65	3.12	821	23.54	4.15	1043	23.71	3.78	211	25.42	4.77
8	649	24.30	3.48	881	25.84	4.30	1137	26.36	4.48	346	29.41	5.97
9	743	26.75	4.28	885	28.50	5.23	1180	29.29	5.16	327	33.17	6.90
10	734	29.63	4.82	844	31.58	5.82	1131	32.50	5.86	288	37.29	8.18
11	859	31.61	4.84	828	34.25	6.33	1048	35.42	7.06	309	40.56	9.41
12	810	34.94	5.73	847	38.29	7.91	1063	39.51	8.06	265	45.28	10.85
13	886	39.15	7.10	842	42.92	9.29	1026	44.40	9.71	199	51.86	12.10
14	820	43.52	8.00	816	48.83	9.82	947	50.50	10.4	168	57.96	12.98
15	1150	51.39	9.30	855	54.71	10.3	1184	57.33	10.2	147	63.56	12.13
16	1096	56.84	9.06	837	60.08	9.43	1108	62.27	9.42	241	68.69	13.21
17	875	61.03	7.88	764	63.10	8.70	950	65.78	9.25	282	71.91	11.72
18	397	62.23	7.79	650	65.34	7.79	639	68.05	8.41	195	73.60	11.53
N total	9525			9870			12,456			2978		

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