



Changes in BMI and the prevalence of overweight and obesity in children and adolescents in Cracow, Poland, 1971–2000

Maria Chrzanowska^a, Sławomir Koziel^{b,*}, Stanley J. Ulijaszek^c

^a *Department of Anthropology, Academy of Physical Education, Av. Jana Pawla II 78, 31-571 Krakow, Poland*

^b *Institute of Anthropology, Polish Academy of Sciences, ul. Kuźnicza 35, 50-951 Wrocław, Poland*

^c *Institute of Social and Cultural Anthropology, University of Oxford, 51 Banbury Road, Oxford OX2 6PF, UK*

Abstract

The aim of this study is to examine changes in prevalence of overweight and obesity, using International Obesity Task Force criteria, in three cohorts of children and youth living in Cracow, Poland, in 1971, 1983 and 2000. Rates of overweight and obesity doubled among boys and girls, from 7.5% and 6.5% in 1971, to 15.2% and 11.8% in the year 2000. The greatest increases in prevalence occurred in the youngest age groups (7–12 years for boys and 7–10 years for girls), increases being less extensive among adolescents, and lowest of all in the oldest age groups (16–18 years in boys and 14–18 years in girls). The absence of a positive secular trend in BMI among adolescent females relative to males may be due to sociocultural pressures associated with transition to a free market economy in Poland. The extent to which girls attempt to achieve the ideal body, as portrayed by media and society more generally, increases across adolescence.

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1. Introduction

Rates of obesity and overweight have increased in adult populations of most Western countries since the 1960s, most noticeably in the United States (Flegal et al., 1998; Flegal et al.,

* Corresponding author. Tel.: +48 71 3438675; fax: +48 71 3438150.

E-mail addresses: wachrzan@cyf-kr.edu.pl (M. Chrzanowska), slawek@antro.pan.wroc.pl (S. Koziel), Stanley.ulijaszek@anthro.ox.ac.uk (S.J. Ulijaszek).

2002) and Western Europe (Lobstein et al., 2005). A similar trend became evident in Central and Eastern Europe more recently. In Poland, a nationally representative survey of 19-year-old males showed a trend towards increased overweight and obesity, which in 2001 reached 14.4% (Bielicki et al., 2003; Koziel et al., 2004). Among Polish adults in Warsaw aged 35–65 years, obesity rates increased from 28% and 18% in females and males, respectively, in 1984, to 29% and 22%, respectively, in 1993 (Rywik et al., 1995).

Among children, the general trend toward increasing overweight and obesity in North America and Western Europe began in the 1980s, rates reaching epidemic proportions by the late 1990s (Livingstone, 2000). In Sweden, overweight and obesity among children aged 6–11 years increased from 11.5% in 1986 to 23% in 2001 (Petersen et al., 2003). In Finland, Kautiainen et al. (2002) documented increases in overweight and obesity from 8.3% and 4.4% for boys and girls aged 12–18 years in 1977, to 19.4 and 11.2% in 1999. In Poland, there is lack of nationally representative data which can be used to estimate rates of overweight and obesity for recent years. However, a survey of adolescents aged 11–15 years, carried out in Warsaw in the year 2000, showed 20.2% of boys and 10.9% of girls to be overweight, and 2.7% of boys and 2.2% of girls to be obese (Charzewska et al., 2004). Much of the more recent increase might be attributable to the economic transition that began in 1989, after the sudden collapse of the Soviet Union. The dramatic economic, political and social changes that took place affected all social strata and all spheres of daily life, including eating habits and leisure-time activities, both of which influence energy balance.

This study examines the changing distribution of body mass index (BMI), and the proportion of overweight and obese children, as determined using International Obesity Task Force references (Cole et al., 2000) in three successive cohorts in Cracow, the third largest city of Poland.

2. Data and methods

Heights and weights were measured in three successive cohorts of Cracow children, 1971, 1983 and 2000, within the framework of a repeated local survey called “The Cracow Child” (Gołąb, 1979; Chrzanowska et al., 1988; Gołąb et al., 2002). The three studies were conducted in randomly-selected primary and secondary schools of all types in 1971, and kindergartens, primary and secondary schools in 1983 and 2000. In 1971, the age range of the study was 7–20 years, while in 1983 and 2000, it was 4–19 years. The studies were carried out in four quarters of Cracow: the City Centre, Krowdrza, Podgórze and Nowa Huta. Measurements were taken in accordance with the recommendations of Martin and Saller (1957) by trained staff of the Department of Anthropology and the Department of Anatomy of the Academy of Physical Education in Cracow. In this analysis, only children aged 7–18 years were included. Sample sizes were 1969 (males) and 2003 (females) for 1971, 2621 (males) and 2659 (females) for 1983, and 2032 (males) and 1755 (females) for the year 2000. In the year 2000 survey, anonymous questionnaires were used to determine the educational status of parents, of whom 28.1% (males) and 28.1% (females) had higher education, 37.5% (males) and 47.3% (females) had secondary or postsecondary education, while 34.3% (males) and 24.9% (females) had primary or basic vocational education. The most representative occupational group among the fathers of these children were: skilled workers, engineers and technical staff, and entrepreneurs. Among the mothers, most were of the intelligentsia, office employees and skilled workers (Gołąb et al., 2002). This mix of occupations among men and women does not differ from those found in other big Polish cities.

Changes in mean BMIs of successive cohorts within age classes were analyzed using two-way analysis of variance where age and cohort were factors (independent variables) and values of BMI were dependent variables. Tukey's HSD (Honestly Significant Difference) Test for unequal sample size was used for post hoc comparisons between cohorts from 1971 and 2000.

Estimates of the prevalence of overweight and obesity were made using the International Obesity Task Force cut-offs according to age. In this scheme, cut-offs for overweight and obesity of 25 kg/m² and 30 kg/m² are extrapolated back to the appropriate age of childhood (Cole et al., 2000). Cracow children were assigned to one of three groups in each half-year age class: normal, overweight, or obese. The prevalences of overweight and obesity were then compared between cohorts in whole-year age classes. Additionally, prevalences of overweight and obesity were calculated for children and adolescents according to stage of development, as defined in the following way: childhood (7–12 years in boys and 7–10 years in girls), early adolescence (13–15 years in boys and 11–13 years in girls), and late adolescence (16–18 years in boys and 14–18 years in girls). The age groups are different for boys and girls because of differences in tempo of maturity.

3. Results

Descriptive statistics of BMI for boys and girls for three cohorts by age class are given in Table 1, while Table 2 shows results of two-way analyses of variance and post hoc comparisons.

Table 1
Means, medians and standard deviations of BMI for boys and girls in three successive cohorts

Age	1971				1983				2000			
	N	Mean	Median	S.D.	N	Mean	Median	S.D.	N	Mean	Median	S.D.
Boys												
7	42	15.53	14.76	2.39	371	16.44	16.14	2.18	72	16.23	16.01	2.28
8	146	15.59	15.27	2.08	188	16.73	16.54	2.02	132	16.72	16.11	2.48
9	130	15.69	15.37	2.06	105	16.44	16.15	2.12	194	17.12	16.46	2.95
10	137	16.31	15.59	2.53	227	17.02	16.61	2.53	125	17.68	16.82	2.96
11	120	16.59	15.98	2.36	217	17.68	17.29	2.34	138	18.11	17.20	3.00
12	200	16.90	16.51	2.44	185	17.72	17.10	2.53	198	18.21	17.40	3.24
13	164	17.48	17.21	2.15	231	18.32	18.02	2.97	143	18.85	18.37	3.07
14	204	18.40	17.92	2.66	227	19.25	18.71	2.85	260	19.13	18.60	2.95
15	166	19.42	19.21	2.40	242	19.83	19.43	2.79	188	20.02	19.37	3.08
16	294	20.79	20.52	2.53	232	20.79	20.45	2.46	233	20.77	20.21	2.98
17	196	20.65	20.24	2.09	232	21.17	21.07	1.96	165	21.17	20.71	2.66
18	170	21.42	21.22	2.17	164	21.44	21.35	2.07	184	21.65	21.23	2.94
Girls												
7	25	14.60	14.38	2.01	235	16.07	15.92	1.95	86	15.85	15.40	1.98
8	162	15.08	14.64	1.85	194	16.56	16.18	2.22	139	16.46	15.80	2.36
9	152	15.72	15.47	2.07	200	16.22	16.06	2.13	143	16.62	16.16	2.48
10	141	16.23	16.00	2.30	214	17.34	16.73	2.81	115	17.44	16.71	2.87
11	143	16.67	16.04	2.36	209	17.73	16.97	2.78	154	17.47	16.87	2.77
12	167	16.91	16.44	2.55	232	18.11	17.66	3.13	198	18.37	17.95	2.68
13	188	18.29	17.98	2.85	220	18.82	18.60	2.93	175	18.59	18.18	2.83
14	227	18.64	18.36	2.39	196	19.57	19.14	2.78	238	19.47	18.99	3.17
15	195	20.16	19.93	2.64	245	20.80	20.51	2.90	167	20.45	20.08	2.64
16	290	20.79	20.68	2.31	246	20.98	20.58	2.44	132	20.20	19.98	2.38
17	194	20.90	20.76	2.23	217	21.11	20.97	2.22	107	20.82	20.26	2.45
18	119	20.69	20.69	2.07	251	21.50	21.04	2.52	101	20.70	20.16	2.50

Table 2

Results of two-way analysis of variance where age classes and cohorts were factors and results of post hoc (Tukey's HSD Test for unequal sample size) comparison between cohort of 1971 and 2000 within age classes for boys and girls

	Sum square	d.f.	Mean square	F	p
Boys					
Age	20038.69	11.00	1821.70	274.51	0.0000
Cohort	749.43	2.00	374.72	56.47	0.0000
Interaction	339.26	22.00	15.42	2.32	0.0004
Girls					
Age	19606.53	11.00	1782.41	274.89	0.0000
Cohort	653.31	2.00	326.66	50.38	0.0000
Interaction	434.17	22.00	19.73	3.04	0.0000

Post hoc comparison (HSD Tukey's Test)

7	8	9	10	11	12	13	14	15	16	17	18
Boys											
n.s.	n.s.	<0.01	<0.05	<0.01	<0.001	<0.01	n.s.	n.s.	n.s.	n.s.	n.s.
Girls											
n.s.	<0.01	n.s.	n.s.	n.s.	<0.001	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

d.f., degree of freedom; n.s., not significant.

For both boys and girls, BMI differs by both age and cohort, there being a highly significant interaction between the two factors in both sexes.

Fig. 1 illustrates these data. Between the ages of 9 and 13 years, BMI of males is lowest in the 1971 cohort and highest in the year 2000 cohort. Post-hoc comparisons show that within age class, means differ significantly between these two cohorts. After the age of 13 years, differences between cohorts disappear, showing nearly identical values at the age of 16 years. In girls aged

Table 3

Prevalences of overweight and obese boys (estimated by using IOTF criteria, Cole et al., 2000) in three subsequent cohorts by age classes

Age	1971			1983			2000		
	N	OW%	OB%	N	OW%	OB%	N	OW%	OB%
7	42	9.52	7.14	371	16.17	4.31	72	11.11	5.56
8	146	8.22	2.05	188	14.89	5.32	132	21.21	3.03
9	130	7.69	0.00	105	11.43	0.00	194	13.92	5.15
10	137	9.49	1.46	227	8.37	2.64	125	17.60	4.00
11	120	8.33	0.83	217	9.22	0.92	138	15.94	2.17
12	200	5.50	1.00	185	11.89	0.00	198	12.12	3.03
13	164	4.27	0.61	231	6.49	1.73	143	15.38	0.70
14	204	5.39	0.98	227	11.45	1.76	260	11.92	1.15
15	166	6.63	0.00	242	9.92	0.83	188	9.04	3.19
16	294	7.82	1.70	232	7.76	0.86	233	8.58	2.15
17	196	4.08	0.00	232	4.74	0.00	165	11.52	0.61
18	131	3.05	0.76	117	7.69	0.00	155	9.03	1.94
Total	1930	6.42	1.04	2574	10.26	1.79	2003	12.68	2.55

OW, overweight; OB, obese.

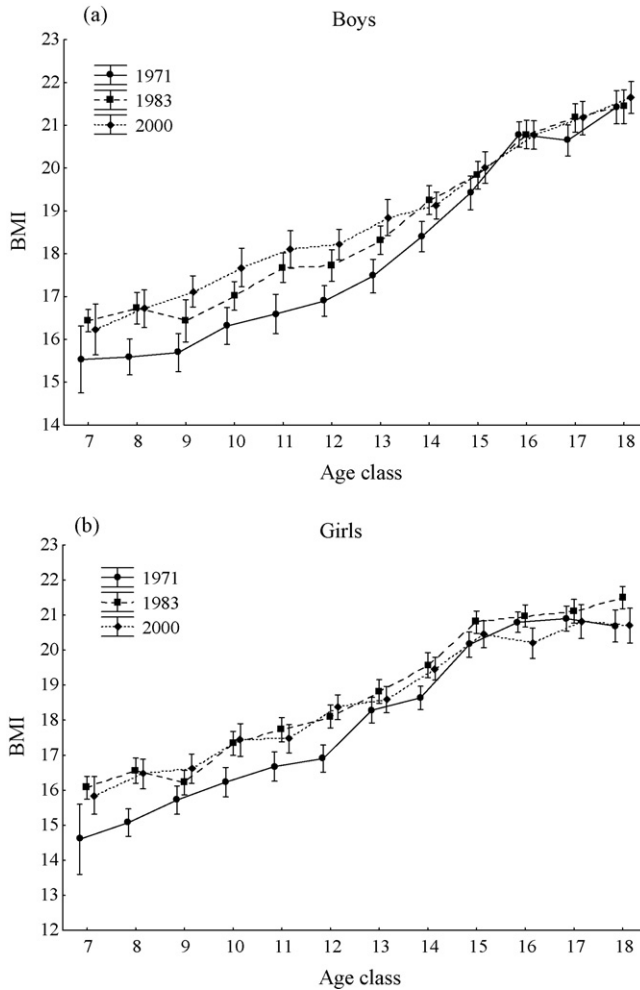


Fig. 1. Means BMIs by age in boys (a) and girls (b) (vertical lines indicated Standard Error) in three successive cohorts.

10–14 years, mean BMI values are lowest in the 1971 cohort, whereas the means for the other two cohorts are almost identical. Comparison of the 1971 and 2000 cohorts shows significant differences only at 8 and 12 years of age. After the adolescent period, there are no differences among the three cohorts of females.

Tables 3 and 4 present the prevalence of overweight and obesity by age for the three cohorts. There is a gradual increase of overweight and obesity for the total sample of boys. However, among the girls, increase of overweight between 1983 and 2000 was very slight, while for obesity there was a slight decline. Table 5 shows differences in the percentages of children classified as overweight or obese between 1971 and 1983, and 1983 and 2000. Between 1971 and 1983 there was an increase in the prevalence of overweight and obesity in the majority of age groups and both sexes. In boys, the greatest increase in prevalence of overweight and obesity between 1983 and 2000 took place among those aged 10 years. In girls, the rates of increase in BMI were lower than among boys, with declines in mean BMI occurring in some age groups.

Table 4

Prevalences of overweight and obese girls (estimated by using IOTF criteria, Cole et al., 2000) in three subsequent cohorts by age classes

Age	1971			1983			2000		
	<i>N</i>	OW%	OB%	<i>N</i>	OW%	OB%	<i>N</i>	OW%	OB%
7	25	0.00	4.00	235	15.32	2.98	86	12.79	3.49
8	162	6.79	0.00	194	15.46	3.61	139	17.99	2.16
9	152	5.92	0.66	200	11.00	0.00	143	13.29	1.40
10	141	7.09	0.00	214	13.08	2.34	115	16.52	0.87
11	143	6.99	0.00	209	12.44	0.96	154	12.34	0.65
12	167	4.19	0.60	232	9.05	0.86	198	11.11	0.51
13	188	7.45	0.53	220	11.36	0.45	175	8.00	0.57
14	227	4.85	0.00	196	9.69	0.51	238	8.40	1.26
15	195	7.69	0.00	245	8.16	2.45	167	11.38	0.00
16	290	8.28	0.00	246	5.69	0.81	132	5.30	0.00
17	194	6.19	0.00	217	5.99	0.46	107	8.41	0.00
18	97	2.06	0.00	204	7.84	0.49	76	6.58	0.00
Total	1981	6.31	0.20	2612	10.34	1.34	1730	10.92	0.87

OW, overweight; OB, obese.

The prevalence of overweight and obesity in the three developmental stages for the three cohorts is presented in Table 6. There was a gradual increase in the prevalence of overweight and obesity between 1971 and 2000 among boys of all developmental categories, except late adolescence, where the prevalence of obesity decreased between 1971 and 1983. The greatest increase in overweight and obesity across the period 1971–2000 was in childhood. It was moderate in early adolescence and very small in late adolescence. Generally, the prevalence of overweight and obesity among males doubled from 7.5% in 1971 to 15.2% in the year 2000. The girls show a similar pattern with respect to the prevalence of overweight. However, the prevalence of obesity fell among early and late-adolescent females between 1983 and 2000. As among the boys, the greatest increase in overweight occurred in childhood. In general, the

Table 5

Changes in prevalences (percentage points) of overweight and obesity between 1971–1983 and 1983–2000 years in boys and girls from Cracow

Age	Boys		Girls	
	1971–1983	1983–2000	1971–1983	1983–2000
7	3.82	–3.81	14.30	–2.02
8	9.94	4.03	12.28	1.08
9	3.74	7.64	4.42	3.69
10	0.06	10.59	8.33	1.97
11	0.98	7.97	6.41	–0.41
12	5.39	3.26	5.12	1.71
13	3.34	7.86	3.83	–3.24
14	6.84	–0.14	5.35	–0.54
15	4.12	1.48	2.92	0.77
16	–0.90	2.11	–1.78	–1.20
17	0.66	7.39	0.26	1.96
18	3.88	3.28	6.27	–1.75

Table 6

Prevalences of overweight and obesity in three periods of development in boys and girls in three subsequent cohorts

Age	1971			1983			2000		
	N	OW%	OB%	N	OW%	OB%	N	OW%	OB%
Boys									
Childhood	775	7.74	1.42	1293	12.45	2.63	859	15.25	3.73
Early adolescence	534	5.43	0.56	700	9.29	1.43	591	11.84	1.69
Late adolescence	621	5.64	0.97	581	6.54	0.34	553	9.58	1.63
Girls									
Childhood	480	6.25	0.42	843	13.76	2.25	483	15.32	1.86
Early adolescence	498	6.22	0.40	661	10.89	0.76	527	10.44	0.57
Late adolescence	1003	6.38	0.00	1108	7.40	0.99	720	8.33	0.42

Table 7

Changes in prevalences (percentage points) of overweight and obesity between 1971–1983 and 1983–2000 years in three periods of development in boys and girls

	Boys		Girls	
	1971–1983	1983–2000	1971–1983	1983–2000
Childhood	5.92	3.90	9.34	1.17
Early adolescence	4.73	2.81	5.03	–0.64
Late adolescence	0.27	4.33	2.01	0.36

prevalence of overweight and obesity among girls almost doubled, from 6.5% in 1971 to 11.8% in the year 2000.

Table 7 shows changes in the proportion of overweight and obese children combined, between 1971 and 1983, and 1983 and 2000, according to sex and the three developmental stages. In all developmental stages, increases between 1971 and 1983 were slightly higher among girls than boys. Conversely, between 1983 and 2000, increases were higher among boys than girls, especially in childhood and early adolescence.

4. Discussion

The prevalence of overweight and obesity among Polish children and adolescents doubled between 1971 and the year 2000, from 7.5% and 6.5% to 15.2% and 11.8% among boys and girls, respectively. The greatest increases took place between 1971 and 1983, and in the youngest age groups (7–12 years for boys and 7–10 years for girls). A comparison with other industrialized countries shows the prevalence of overweight and obesity among Cracow children to be much lower than in most Western countries, but little higher than in Slovakia and the Netherlands (International Obesity Task Force, 2006).

Mean BMI of boys aged 7–18 years increased between 1971 and the year 2000, but only up to 14 years of age. In girls, mean BMI increased between 1971 and 1983, remaining more-or-less stable between 1983 and 2000. A similar pattern was observed for changes in the prevalence of overweight and obesity, where the greatest increase occurred in the youngest age groups (between 7 and 12 years for boys and 7 and 10 years for girls). In early adolescence, those increases were less extensive, being lowest among boys aged 16–18 years, and in girls aged 14–18 years. These

findings are in accord with studies carried out in the United Kingdom (Bundred et al., 2001; Chinn and Rona, 2001), East Germany (Zellner et al., 2007) and the Czech Republic (Vigenerova et al., 2007). In the latter study, boys aged 9–13 years showed gradual increases in mean BMI between 1951 and 2001, the differences disappearing in older age groups. Among Czech girls, there are no differences in mean BMI among cohorts until 14 years of age. In older Czech adolescent girls, there is an inverse relationship between mean BMI and cohort, mean BMI decreasing between 1951 and 2001. Zellner et al. (2004) showed a trend towards increased BMI in children aged 7–14 years in Jena, East Germany across the years 1975, 1985, 1995 and 2001. In the decade 1985–1995, BMI increase was nearly twice as great among girls than boys. After 1995, the increase in BMI of girls decelerated while among boys it continued to increase at the same rate.

In most Western countries the prevalence of overweight and obesity is higher in girls than in boys (Bundred et al., 2001; Chinn and Rona, 2001). This is also true of Eastern Germany (Frye and Heinrich, 2003; Zellner et al., 2004, 2007). However, the opposite is the case for three Eastern European countries undergoing economic transition: Poland; the Czech Republic (Vigenerova et al., 2007); and Lithuania (J. Tutkoviene, personal communication). An absence of a positive secular trend in BMI in adolescent girls may be due to sociocultural pressures emerging with transition to free market economic systems in these nations. During the course of transition teenage girls have been exposed, by mass media, to Western standards of beauty which strongly emphasize thinness (Vigenerova et al., 2007; Contento et al., 2003). Media pressure imposed on girls has involved the creation of a general desire among girls to be thin and/or to lose weight, and among boys to increase muscle tone (McCabe et al., 2002). The extent to which girls attempt to achieve the ideal body as portrayed by media and society more generally increases across adolescence. Older adolescent girls tend to be less satisfied with their weight and perceive more pressure from the media to lose weight. However, preadolescent girls are more likely to engage in strategies to increase weight in an attempt to reach puberty and to look more like the older girls. This process is much more pronounced in big cities than in rural areas (Hoek and van Hoeken, 1996), perhaps because of greater media exposure and social networks of adolescent girls that desire thinness. In the United States, obesity appears to spread across social networks (Christakis and Fowler, 2007), and it may be that the desire and expression of thinness among adolescent girls in Eastern Europe may also spread in such ways.

Puberty is generally perceived to play a more salient role in body dissatisfaction and eating problems for females than males (Keel et al., 1997; Richards et al., 1990), and this might offer another reason for the pattern of sex differences in mean BMI observed in Cracow. In females, pubertal maturation and the increase in body fat that comes with it is associated with greater body dissatisfaction (Swarr and Richards, 1996) and increased dieting and disordered eating (Killen et al., 1992). Among adolescent boys, pubertal status has no negative effect on body image and is associated with weight gain rather than weight loss behaviours.

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