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THE RELATIONSHIP OF POLISH STUDENTS' HEIGHT, WEIGHT AND BMI WITH SOME SOCIOECONOMIC VARIABLES

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Summary. The aim of this study was to assess the variation in student body height, weight and BMI in relation to several socioeconomic factors. Data (collected in 1998) were obtained through a structured questionnaire from 2800 students (1023 men and 1777 women) from Wrocław Universities, Poland. Information on students' age, reported height and weight and their place of residence prior to starting university, the number of siblings and parents' education were collected. Students with mothers or fathers with higher education had, on average, higher mean heights, but after correcting for other socioeconomic variables only place of residence showed a significant association with height and BMI, with those living in medium or large urban centres having a higher mean height and those living in small or medium urban areas having a lower mean BMI.

Introduction

A number of studies have shown a relationship between social stratification and body height and BMI (Mascie-Taylor & Boldsen, 1985; Lindgren & Cernerud, 1992; Kaczmarek, 1995; Bielicki *et al*., 1997, 2003, 2005; Kromeyer *et al*., 1997; Kozieł *et al*., 2000; Komlos & Kriwy, 2002). People living in more favourable conditions are more likely to have a higher level of education, better nourishment, higher quality of health care, better hygiene and distribution of family income, and to be, on average, taller than people of lower socioeconomic status. It is also well known that social differences in stature do not disappear even after the attainment of physical maturity (Bielicki, 1986). In addition, differences in body height and other anthropometric features among young people from different socioeconomic classes tend to reduce (Mascie-Taylor & Lasker, 2005).

The data used in this paper were based on self-reported height and weight. Studies comparing self-reported with measured values show high correlations of between 0.86 and 0.99 (Stewart *et al*., 1987; Zhang *et al*., 1993; Nyström-Peck, 1994; Korkeila *et al*., 1998; Nakamura *et al*., 1999; Bolton-Smith *et al*., 2000; Goodman *et al*., 2000; Kuczmarski *et al*., 2001; Krzyżanowska & Umławska, 2002; Spencer *et al*., 2002;

Brener *et al*., 2003; Morrissey *et al*., 2006), justifying the reliance in this study on self-reported values.

Previous studies that showed a relationship between socioeconomic status and anthropometric variables were based on general population samples. The present paper used data from a much more socially homogenous group to test whether there was an association between social diversification and body height, weight and BMI among Polish (Wrocław) university students.

Data and Methods

The data, which were collected in 1998, came from 2800 students (1023 men and 1777 women) from the Universities of Wrocław (population 720,000), Poland. The questionnaire included questions about the students themselves as well as their parents. The questionnaire obtained information on the student's age (in years), reported height and weight (which were used to calculate body mass index (BMI): weight (kg)/height $(m)^2$) as well as information on parental education, number of children in the family (family size) and place of residence prior to the commencement of their studies.

Place of residence was categorized as rural, small urban centre with a population under 30,000, medium-size urban centre with a population between 30,000 and 100,000 and large urban centre with a population over 100,000. Parental education level was classified as low-level (primary or vocational school education), mid-level (secondary, post-secondary school or incomplete studies – without obtaining MA degree) and high (completed MA studies, continuation of education after university studies – postgraduate studies, second line of studies, doctoral studies, etc.). Family size was from 1 to 4+.

The statistical methods used to assess the relationship between social variables and height, weight and BMI were chi-squared tests and various forms of multiple regression analysis (Coolidge, 2000; Stanisz, 2005).

Results

Overall 42.5% of the students came from large urban centres (Table 1) but there was significant heterogeneity between male and female students in residency, with more female students being brought up in rural areas than male students, while males students were more likely to reside in large urban centres ($\chi^2_{(3)}=14.93$, $p=0.002$). There was also significant heterogeneity in family size between male and female students, with males more likely to live in smaller families ($\chi^2_{(3)}=14.38$, $p=0.004$). Males students were more likely to have highly educated parents while female students were more likely to have parents with low or middle education ($\chi^2_{(3)}=22.87$, $p<0.001$ and $\chi^2_{(3)}=19.90$, $p<0.001$ for fathers and mothers, respectively).

Tables 2 and 3 provide a breakdown of mean differences in height, weight and BMI for males and females students separately by father's and mother's education, residence and family size. Overall male students were 13.49 cm taller, weighed 17.15 kg more and had a higher BMI of 2.33 kg m^{-2}, than female students. Initially sequential regression analyses removed the effects of age and sex before testing for the

Table 1. Descriptive statistics of the students

Variable	Male students		Female students		Total	
	n	%	*n*	%	*n*	%
Father's education						
Low-level	266	26.1	515	29.1	781	28.0
Mid-level	297	29.2	623	35.2	920	33.1
High-level	455	44.7	630	35.7	1085	38.9
Mother's education						
Low-level	173	17.0	374	21.1	547	19.6
Mid-level	466	45.8	877	49.5	1343	48.2
High-level	379	37.2	520	29.4	899	32.2
Residence						
Rural areas	104	10.2	262	14.8	366	13.1
Small urban centres	224	21.9	387	21.8	611	21.9
Medium-sized urban centres	225	22.0	405	22.8	630	22.5
Large urban centres	469	45.9	720	40.6	1189	42.5
Family size						
1	209	20.4	275	15.5	484	17.3
2	554	54.3	962	54.4	1516	54.3
3	187	18.3	383	21.6	570	20.4
4+	72	7.0	151	8.5	223	8.0

effect of each socioeconomic variable separately (Model I in Table 4) after having shown that there were no significant sex and socioeconomic variable interactions.

For height there was a significant association with father's and mother's education with an upward trend in means from low to high education, with an overall mean difference of just over 1 cm between high and low groups. There were also mean differences in residency with lower mean in rural and higher mean in large urban centres. Weight only showed a significant association with residency, with students from large urban centres having the highest mean. BMI showed a just-significant association with father's education and a stronger association with residency. For father's education the differences in mean BMI were inconsistent across educational levels, while the patterns of means for residency indicated higher BMI on average in rural and large urban centres and lower BMI in small and medium urban centres.

A series of sequential multiple regression analyses were run in which the effects of age, sex and three of the socioeconomic variables were entered into the model before the socioeconomic variable of interest. The results are presented in Model II in Table 4 with higher education, large urban centres and family size 4+ as the reference values (set to zero). Only residency showed a significant association with height and BMI; for residency the main height difference was between those living in rural areas and small urban centres, who had a lower mean than those living in medium or large urban centres, while for BMI those living in small or medium urban areas had lower means than those living in rural or large urban centres.

Table 2. Descriptive statistics[a] of height, weight and BMI in relation to parents' education

Variable	Sex	Father's education			Mother's education		
		Low	Mid	High	Low	Mid	High
Height	Male	266; 179.6; 6.8	296; 180.6; 6.5	453; 181.0; 6.3	173; 179.8; 7.2	465; 180.2; 6.4	377; 181.2; 6.3
	Female	512; 166.8; 5.8	621; 166.7; 5.6	629; 167.6; 5.4	373; 166.5; 5.9	874; 167.1; 5.5	518; 167.4; 5.5
Weight	Male	263; 73.4; 8.5	294; 73.4; 8.7	451; 74.4; 9.0	171; 73.8; 9.3	460; 73.7; 9.0	377; 74.0; 8.3
	Female	508; 57.1; 7.2	617; 56.2; 7.1	624; 56.6; 6.8	372; 56.7; 6.9	866; 56.7; 6.9	514; 56.4; 7.2
BMI	Male	263; 22.7; 2.2	294; 22.5; 2.2	450; 22.7; 2.1	171; 22.8; 2.3	460; 22.7; 2.3	376; 22.5; 2.0
	Female	508; 20.5; 2.3	16; 20.2; 2.1	624; 20.1; 2.1	372; 20.4; 2.2	866; 20.3; 2.1	513; 20.1; 2.3

[a]Descriptive statistics are, respectively, number of observations (*N*), mean, and standard deviation (SD).

Table 3. Descriptive statistics[a] of height, weight and BMI in relation to place of residence and family size

Variable	Sex	Residence				Family size			
		Rural	Small	Medium	Large	1	2	3	4+
Height	Male	104; 179.8; 6.8	223; 180.2; 6.6	225; 180.5; 6.8	467; 180.8; 6.2	209; 180.6; 6.4	552; 180.8; 6.3	187; 179.8; 6.7	72; 180.2; 8.0
	Female	258; 166.3; 5.7	387; 166.5; 5.8	404; 167.5; 5.3	718; 167.4; 5.6	276; 167.0; 5.8	958; 167.1; 5.4	382; 167.2; 5.9	151; 166.5; 6.1
Weight	Male	101; 73.7; 7.5	221; 73.2; 8.9	225; 73.7; 9.5	465; 74.2; 8.7	208; 74.8; 9.0	550; 73.6; 8.7	185; 73.8; 8.8	70; 72.8; 8.8
	Female	258; 56.9; 6.9	383; 56.1; 6.8	400; 56.2; 6.8	713; 57.0; 7.2	273; 57.3; 7.7	955; 56.5; 6.7	379; 56.3; 7.0	147; 57.0; 7.4
BMI	Male	101; 22.8; 1.9	221; 22.5; 2.3	225; 22.6; 2.4	464; 22.7; 2.1	208; 22.9; 2.2	549; 22.5; 2.1	185; 22.8; 2.2	70; 22.5; 2.6
	Female	257; 20.6; 2.2	383; 20.2; 2.0	400; 20.0; 2.0	713; 20.4; 2.3	273; 20.5; 2.3	954; 20.2; 2.1	379; 20.1; 2.2	147; 20.6; 2.2

[a]Descriptive statistics are, respectively, number of observations (*N*), mean, and standard deviation (SD).

Table 4. Multiple regression analysis of height, weight and BMI in relation to socioeconomic variables

	Height				Weight				BMI			
	Model I		Model II		Model I		Model II		Model I		Model II	
Variable	Mean	*p*	Mean	*p*	Mean	*p*	Mean	*p*	Mean	*p*	Mean	*p*
Father's education	0		0		0		0		0		0	
1	−1.032	0.001	−0.622	ns	−0.090	ns	−0.130	ns	0.243	0.020	0.132	ns
2	−0.735		−0.508		−0.651		−0.643		−0.032		−0.082	
3	0		0		0		0		0		0	
Mother's education												
1	−1.083	0.003	−0.468	ns	−0.013	ns	0.304	ns	0.265	ns	0.201	ns
2	−0.626		−0.254		−0.023		0.332		0.150		0.172	
3	0		0		0		0		0		0	
Residence												
1	−1.015	0.003	−0.670	0.045	−0.180	0.039	−0.032	ns	0.224	0.004	0.177	0.006
2	−0.820		−0.620		−1.022		−0.944		−0.159		−0.185	
3	−0.046		0.129		−0.714		−0.619		−0.254		−0.269	
4	0		0		0		0		0		0	
Family size												
1	0.545	ns	0.212	ns	0.851	ns	0.895	ns	0.087	ns	0.194	ns
2	0.566		0.316		−0.048		0.064		−0.199		−0.090	
3	0.348		0.215		−0.152		0.006		−0.174		−0.081	
4+	0		0		0		0		0		0	

Discussion

Polish students are, on average, taller than non-students of the same age (Gworys, 1978; Kolasa, 1980) and similar results have been found in Japan (Ohyama *et al*., 1987; Takamura *et al*., 1988). The students surveyed here were also taller than conscript soldiers who came from the upper social echelons of large urban centres (Krzyżanowska, 2007). The reason for the greater stature of students is presumably the result of an interaction between more favourable environments as well as better genotypes (Malina & Bouchard, 1991; Kaczmarek, 1995).

Male student height tended to show greater variation than female height. For example, the mean difference between low and high educational groups is 1.4 cm in males but only 0.8 cm in females. It has been argued that this increased variability is because boys are more sensitive to both negative and positive external stimuli than girls (Billewicz *et al*., 1983; Kaczmarek, 1995; Stinson – quoted in Bogin, 1999).

The majority of studies that have examined the relationship between students' height and their place of residence have found higher means in individuals who came from urban centres (Mockus *et al*., 1995; Jopkiewicz & Zabrodzka, 1997; Kolasa, 1997; Gyenis & Joubert, 2004; Tatarczuk, 2006; Kamińska-Czakłosz, unpublished), as did the current study. However, other surveys have found no significant difference in mean stature between Polish urban and rural areas (Gworys, 1978; Kolasa, 1980; Wronka & Pawlińska-Chmara, 2007).

The association between education and height is also contentious. Charzewski *et al*. (2003) argue that parental educational level, especially of the father, constitutes a social variable that leads to greater food diversity, regularity of meals as well as greater hygiene. A number of Polish authors have found that higher education is associated with greater stature (Kolasa, 1980; Jopkiewicz & Zabrodzka, 1997). Tatarczuk (2006) found the highest mean among students whose fathers had higher education and mothers had mid-level education, while the present paper generally found higher mean stature was associated with greater parental education. Gyenis & Joubert (2004), in a Hungarian survey, found that the height of female students correlated only with their mothers' level of education, which is contrary to the present results and other Polish studies (Kamińska-Czakłosz, unpublished; Wronka & Pawlińska-Chmara, 2007).

Kozieł *et al*. (2004) found that in 1986 conscripts from rural areas had the highest mean BMI, whereas those living in small towns had the lowest value. They argued that increased 'urbanization' is leading to less variation in BMI in Poland. However, the present study shows that significant variation in BMI still exists according to place of residence, although the reason for this is unclear.

The students in this sample belonged to a more socially privileged and more homogeneous group than a general population sample (Krzyżanowska, 2007; Krzyżanowska & Borysławski, 2008), and it might be expected that their height, weight and BMI would show very little or no association with socioeconomic variables. However, contrary to expectation, mean differences in stature still exist in relation to the educational level attained by the parents as well as place of residence.

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