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INDEPENDENT EFFECTS OF SOCIAL POSITION AND PARITY ON BODY MASS INDEX AMONG POLISH ADULT WOMEN

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Summary. This study evaluated the strength of the independent effects of social position (expressed by educational level) and number of childbirths on body mass index (BMI) variation of Polish adult females. The material comprised 2045 pre-menopausal women aged 35–50, who were healthy and occupationally active inhabitants of the city of Wrocław, Lower Silesia, Poland. Two-way analysis of variance (ANOVA) revealed that both educational level ($F=34{\cdot}7$; $p=0{\cdot}0001$) and parity ($F=5{\cdot}6$; $p=0{\cdot}001$) exerted independent significant effects on BMI. The mean BMI of women who had attended basic vocational or trade school at the very most (27·0 kg/m^2) was greater than that of women who had completed secondary school education or had graduated from university (25·3 kg/m^2). However, it is worthy of note that there were no social differences in BMI values between childless women. Nevertheless, an increasing number of childbirths was essentially related to increasing female BMI in each social group, and this tendency was most marked among women of lower social position. Regardless of educational level, the highest prevalence of obesity (BMI exceeding 30 kg/m^2) was found among females with at least three children (15·6% and 26·4% of women from higher or lower social groups, respectively).

Introduction

The greater accumulation of adipose tissue in women than in men can be at least partially attributed to women's reproductive history and sex differences in hormonal metabolism (Brown, Kaye & Folsom, 1992; Kanadys & Oleszczuk, 1999). Pregnancy (and accompanying hormonal alterations) is known to promote weight gain in women (Harris, Ellison & Holliday, 1997; Brown *et al.*, 1992; Kanadys & Oleszczuk, 1999).

Number of childbirths has been shown to be related to increased general adiposity in women (Arroyo *et al.*, 1995; Tavani, Negri & Vecchia, 1994; Brown *et al.*, 1992; Bjorkelund *et al.*, 1996). Unfortunately, in most publications the analysed associations between parity and BMI were not adjusted for confounding variables (Arroyo *et al.*, 1995; Tavani *et al.*, 1994; Brown *et al.*, 1992; Bjorkelund *et al.*, 1996), i.e. sociodemographic and/or behavioural factors, which are generally known to affect these relationships (Lahmann *et al.*, 2000; Forster *et al.*, 1986; Wolfe *et al.*, 1997a, b; Walmala *et al.*, 1997). The results of studies on the relationships between adiposity and parity, evaluated independently on socioeconomical status, are rather inconsistent (Lahmann *et al.*, 2000; Forster *et al.*, 1986; Gigante *et al.*, 1997).

Hence, this study was carried out to evaluate the strength of independent effects of social position (expressed by educational level) and number of childbirths upon BMI variation of Polish adult females.

Methods

The data used were from 2045 females aged 35–50 (all pre-menopausal), all of whom were healthy and occupationally active inhabitants of the city of Wrocław, Lower Silesia, Poland. They were medically examined in the Silesian Centre for Preventive Medicine 'DOLMED' in Wrocław in the course of health screening surveys. Women included in the study did not suffer from any chronic diseases and had not done so in the past.

The following variables were taken into account: (1) the subject's social position expressed by educational level, (2) parity (number of childbirths) and (3) body mass index (BMI = weight/height^2 [kg/m^2]) as a measure of general fatness. Bielicki *et al.* (1997) confirmed that in Poland, among women the correlation between educational level and occupational status was 0·9. Hence, it is assumed that educational level reliably and precisely reflects the social position of Polish females (Bielicki *et al.*, 1997). The two factors were scored on an ordering scale as follows: Educational level: 1, college and secondary school; 2, basic vocational and primary school; Parity: 1, no child; 2, one child; 3, two children; 4, three or more children.

The two-way analysis of variance (ANOVA), as described by Federer & Zelen (1966), was used in order to assess the relative strength of influence of examined factors (social position and parity) upon variation in BMI. The details of this method have been described previously (Bielicki & Szklarska, 1999). All between-group differences in mean values of BMI for different categories of education and parity were estimated using the Tukey post-hoc test. Following the WHO cut-offs for BMI, in the whole analysed group there were 50·3% women with BMI $<$ 25, 33·2% women with 25 $\leq$ BMI $<$ 30 and 16·5% women with BMI $\geq$ 30. The incidence of obesity in the analysed sample was expressed, separately for each category of social position and for each category of parity, by proportions of subjects with BMI values exceeding 27 kg/m^2.

Finally, the multiple binomial logistic regression was applied in order to estimate the relative risk of being overweight (BMI $\geq$ 27) for women depending on their social position and number of childbirths. Hence, BMI (encoded as: 1, BMI $<$ 27; 2, BMI $\geq$ 27) was a dependent variable, whereas social position expressed as educational level (encoded as: 1, college and secondary school; and 2, basic vocational and primary school) and parity (encoded as: 1, no child; and 2, three or more children) were used as determining factors. Initially, BMI = 30 kg/m^2 was used as the

Table 1. Mean values of select anthropometric variables in different social groups of Polish females

Anthropometric variables	Educational level	*n*	Mean ± SD
Height (cm)	1+2	2045	160·7 ± 5·8
	1	1431	161·6 ± 5·6
	2	614	158·5 ± 5·8
Weight (kg)	1+2	2045	66·6 ± 12·2
	1	1431	65·9 ± 11·3
	2	614	68·3 ± 13·9
BMI (kg/m^2)	1+2	2045	25·8 ± 4·6
	1	1431	25·2 ± 4·3
	2	614	27·1 ± 5·1

1, college and secondary school; 2, basic vocational and primary school.

borderline value differentiating obese and non-obese females. Unfortunately, there were insufficient women with BMI ≥ 30 kg/m^2 in order to perform a full analysis. A BMI of 27 kg/m^2 was therefore used as the borderline value discriminating overweight and non-overweight women, as is widely used in epidemiological studies (Roberts, 1995; Green *et al*., 1997).

Results

The mean values of selected anthropometric variables in different social groups of Polish females are shown in Table 1.

The magnitude of the *net* effect of each of two factors on BMI, independent of the influence of the other, can be assessed using a two-factor analysis of variance (ANOVA). The results of the analysis are given in Tables 2 and 3. Values of the main effects in ANOVA reflect the distance for each factor, for its particular level, from the population mean BMI value. These main effects inform whether, and by how much, the condition of being situated on a particular level of that factor (e.g. with regard to number of children or educational level) results in an increase or decrease in BMI relative to the mean population BMI. The two factors together account for 4·4% of total variation in BMI. In spite of the small proportion of total BMI variation explained by this classification, both factors exert significant independent effects on BMI (even when the effect of the other factor is simultaneously statistically controlled). These effects are expressed as F values (Table 3). The F values of both factors are statistically highly significant, but it should be emphasized that F and the mean squares of factor A are greater than F and the mean squares of factor B: hence, education level has a greater effect than number of children. Finally, it is worthy of note that an interaction (A × B) is not significant.

Table 4 presents the results of multiple binomial logistic regression estimating the relative risk of being overweight (BMI ≥ 27) with regard to (separately) educational

Table 2. Mean values of female BMI for different categories of education and parity with the respective factor level-specific main effects*

Factors	*n*	Mean	Main effect
Factor A (educational level)			
College and secondary school	1431	25·32	− 0·80
Basic vocational and primary school	614	26·92	+ 0·80
Factor B (number of children)			
0	219	25·21	− 0·91
1	557	26·04	− 0·08
2	999	26·18	+ 0·07
3+	270	27·04	+ 0·92
Empirical population mean		25·82	
Unweighted mean of the eight subgroups formed by the 2 × 4 classification		26·12	

*Differences between empirical means reported in the table and the unweighted mean of means of the $2 \times 4 = 8$ combinations of factor levels.

Table 3. A two-way ANOVA of BMI in adult Wrocław women

Source of variation	df	Mean square	*F*
Total	2044	21·71	
Within groups	2037	20·82	
Between groups	7	281·56	13·53**
Factors:			
A (educational level)	1	721·90	34·68**
B (number of children)	3	115·29	5·54*

*$p < 0{\cdot}05$; **$p < 0{\cdot}01$.
None of the interactions (A × B) is statistically significant.
Note: proportion of total variation explained by factors A and B is 4·4%.

level and parity. The goodness-of-fit of the model was assessed by the chi-squared test ($\chi^2 = 20{\cdot}6$, $p < 0{\cdot}0001$). The odds ratio (OR) for women of lower social position compared with better-educated females is 1·77. In other words, the relative risk of exceeding BMI = 27 for women of lower social position is 77% greater than among better-educated females. Regardless of the effect of social status, women who have at least three children are more likely to be overweight (BMI ≥ 27) in comparison with childless females (OR = 1·18, $p < 0{\cdot}01$).

Mean values of BMI with regard to women's educational level and parity are shown in Fig. 1. There are no social differences in BMI among childless women, but

Table 4. Results of multiple binomial logistic regression evaluating effect of education level and parity on female BMI

Determining variables	β coefficient	OR	($\pm$95% CI)
Intercept	−1·73		
Educational level:			
1, college and secondary school			
2, basic vocational and primary school	0·57	1·77***	1·19–2·66
Number of children:			
1, none			
2, three or more	0·17	1·18**	1·03–1·36

1, BMI < 27 versus 2, BMI ≥ 27.
**$p < 0{\cdot}01$; ***$p < 0{\cdot}001$.

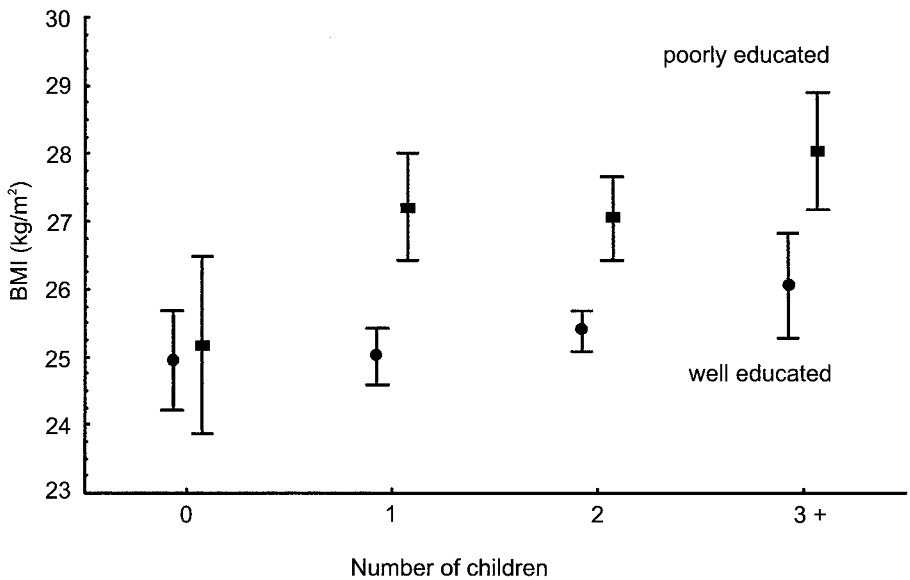

Fig. 1. BMI (arithmetic means with SEM) for different categories of educational level and parity among 2045 healthy Polish pre-menopausal women. Squares, poorly educated women; circles, well educated women.

the greater the number of children, the higher the BMI of women from both social positions. Nevertheless, the much greater increment of adiposity (parallel to increasing parity) is seen among poorly educated women when compared with their better-educated peers. The differences in mean BMI between well and poorly educated women were statistically significant in the following categories of childness: (one child,

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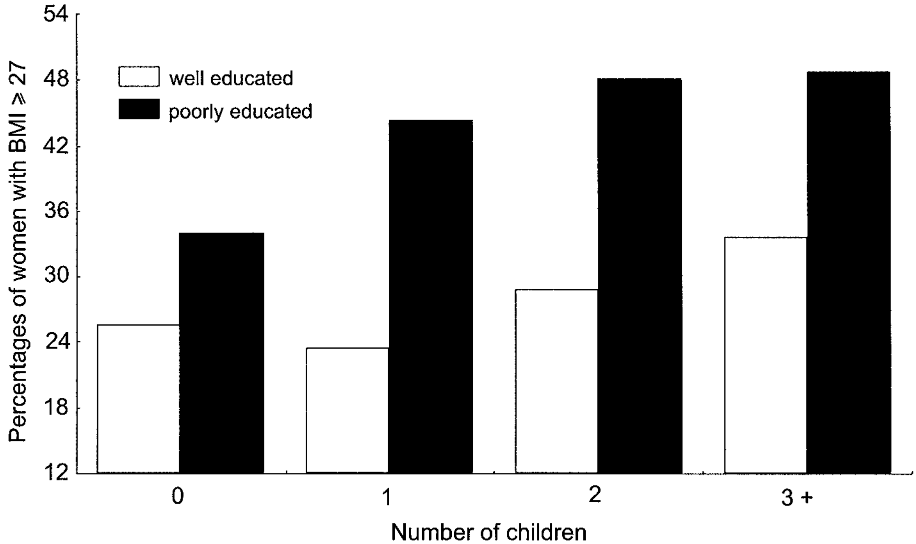

Fig. 2. Percentages of women with BMI ≥ 27 for different categories of educational level and parity among 2045 healthy Polish pre-menopausal women.

$p = 0{\cdot}001$; two children, $p = 0{\cdot}00004$; at least three children, $p = 0{\cdot}009$), which was revealed using the Tukey post-hoc test.

Figure 2 presents the percentages of women with BMI ≥ 27 for different categories of educational level and parity. The percentages of women with BMI ≥ 27 increase regularly with increasing position on the parity scale, regardless of educational level. Moreover, the social differences are also marked: there are more women with BMI ≥ 27 among poorly educated subjects than in females of higher social position (and this tendency is observed in each category of parity).

It is worth noting that among better-educated women, the increment of percentage of subjects with BMI exceeding 27 between different categories of parity is relatively regular, whereas for women of lower social position the greatest difference in percentages of women with BMI ≥ 27 is seen between childless females and those with one child. Poorly educated women with more children have a tendency to be heavier; nevertheless the increase of those with BMI ≥ 27 in subsequent parity categories is not so dramatic.

Discussion

Educational level is a fundamental factor differentiating the various biological features of urban dwellers in Poland, e.g. stature and some anthropometric indices of fatness (Bielicki & Szklarska, 1999; Bielicki *et al.*, 2000). Therefore, the observed social position differences in BMI of examined women are in accordance with previous studies of the Wrocław adult population (Bielicki *et al.*, 2001; Rogucka & Bielicki, 1999) and with analogous results from other industrialized countries (Walmala *et al.*, 1997; Oken *et al.*, 1977). This phenomenon is at least partially due

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to the social position differences in dietary habits, intensity of physical activity during leisure time and other elements of lifestyle of the inhabitants of Wrocław (Jankowska, Kwiatkowska-Szleszkowska & Łopuszañska, 2000).

In women an additional factor – i.e. their reproductive history – is of great importance within the pathogenesis of obesity. Parity-related changes of metabolism are presumed to promote an excessive accumulation of adipose tissue in women (Kanadys & Oleszczuk, 1999). In the study of Walmala *et al*. (1997), reproductive history (i.e. parity), irrespective of unfavourable psychosocial factors and unhealthy lifestyle, accounted for an essential part of the relationship between social status and obesity. It is generally known that both obesity and higher parity are related to low social position (Walmala *et al*., 1997). Hence, the socioeconomical status of examined women should be taken into account when evaluating the associations between parity and general fatness.

There are numerous publications showing significant relationships between parity and obesity in women (Arroyo *et al*., 1995; Tavani *et al*., 1994; Brown *et al*., 1992; Bjorkelund *et al*., 1996). Unfortunately, these studies did not control for social position, and are therefore rather unreliable. For example, in a population-based study from southern Brazil, women from the poorest social strata were found to present greater BMIs, but when controlling for some lifestyle-related confounders there was no effect of parity on female fatness (Gigante *et al*., 1997).

The current analysis, despite social differences in BMI, showed an independent effect of number of childbirths on relative weight, i.e. a greater number of childbirths was essentially related to greater female BMI in each social group. Moreover, regardless of educational level, a highest prevalence of obesity (BMI exceeding 30 kg/m^2) was found among women with at least three children. It should be emphasized that the effect of parity on BMI varied between subjects belonging to different social groups, and was most marked among women of lower social status. It is tempting to speculate that the absence of the effect of educational status on BMI among childless women is due to the fact that these women, both from the higher and lower levels of socioeconomic status, simply had no need to adjust their weight-control habits to the number of concluded pregnancies.

These results are in accordance with the multivariate analysis performed by Lahmann *et al*. (2000), where a high weight gain of Swedish adult women was linked to high parity, low education and low socioeconomic status. Parity and age increased the risk of being overweight in low and middle socioeconomic level urban women from Mexico City (Arroyo *et al*., 1995). In the study of Forster *et al*. (1986) among white (but not black) females, number of births was independently related to BMI, even when age, education and income were simultaneously included in the same regression equation.

It was not surprising that better education, as an estimator of higher social status, was significantly related to reduced BMI in adult Polish women. However, the analysis additionally proved that the unfavourable influence of parity on female general adiposity was much stronger among women of lower educational level. This fact probably reflects social differences in lifestyle. Parity-related weight gain varied in relation to some sociodemographic and behavioural factors, e.g. race, habits, recreational exercise and other lifestyle factors (Wolfe *et al*., 1997a). Some sociodemographc and behavioural factors modify the relationships between parity increase and weight gain (Wolfe *et al*., 1997b). In the study of Wolfe *et al*. (1997b), lower income and/or lower education augmented the parity-associated weight increase, whereas the healthy lifestyle realized by educated women can at least partly reduce the disadvantageous effect of parity on women's fatness.

This study indicates that multiparous women – in particular those of lower educational level – are at increased risk of being obese. Moreover, it indirectly confirms that people can, through their lifestyle and environmental life conditions, modify their physiology (to a certain degree, of course).

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