Variation in BMI in Middle-Aged Poles and Associated Demographic, Social and Lifestyle Factors

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INTRODUCTION

The middle years of adulthood, defined by Bee (1996) as those between forty and sixty five, have been viewed as a time of profound changes in the continuous process of biological ageing. By the forties, most individuals have experienced a noticeable decline in reproductive capability and physiological capacities. Women have experienced *menopause*, the relatively sudden onset of ovarian failure that causes amenorrhea, end of fertile lifespan and estrogen deficiency, accompanied by a series of endocrinological and clinical signs and symptoms (McKinley, 1972; Leidy, 1996). The worldwide average for age at natural menopause is approximately 51 years and is more or less normally distributed (Thomas, 2001). Men have perceived gradual decline of endo- and exocrine testicular functions that are accompanied by various clinical signs and symptoms. Any or all of these age-related changes in the reproductive system may cause the individual to think he is losing his sexual abilities, however, unlike women, there is no time in man's life when he is completely loses his sexual abilities as a result of ageing per se (Vermeulen, 2000; Wick et al., 2000).

The midlife is associated with a gradual decline in muscle strength, lung capacity, cardiac output and other physiological capacities. It is also time of adverse somatic changes, such as an increase in body weight, especially in adipose tissue, and a decrease in stature resulting in altered body proportion. Significant changes in the weight status, body composition and fat distribution patterns during middle age transition are typical for men and women. They pose a increased risk for cardiovascular diseases, hypertension and stroke, and certain forms of cancer.

The increased number of older people and health consequences of overweight and obesity have prompted numerous studies on this subject. The present study aims to describe variation in BMI among middle-aged Poles and to identify factors associated with this variation.

SUBJECTS AND METHODS

The study sample comes from the baseline of cross-sectional survey carried out in 2000-2004 in Poland among men and women 35 years and older (Kaczmarek, 2004, 2005). It consisted of 2078 men and 4444 women aged 40-65. Participants of the study were administered the Polish version of Menopause- and Andropause- Specific Quality of Life Questionnaires (Kaczmarek, 2000). For purposes of the present study, demographic, socio-economic, health, lifestyle behaviours and the body height and weight measurements were taken. The relative weight was expressed in terms of the BMI, defined as the weight in kilograms divided by the square of the height in metres (kg/m^2), and classified using cut-off points recommended by the WHO (WHO, 2000). Data were stratified by sex, age, marital status, education years completed, place of residence, smoking habit, physical activity, and perceived health. The association of selected biological, demographic, social and lifestyle behaviour characteristics with the obesity was modeled using multiple logistic regression with backward elimination. The odds ratios of the obesity among different subgroups were estimated with simultaneous adjustments for all other statistically significant covariates in the model. For the purpose of Logit analyses, the study variables were classified as binary or multistate categorical variables, with each of *k* states representing a separate group of independent variable. The relative weight was classified as normal (1) BMI 18.5-24.99 and obese (2) BMI>=30. Biological status of men and women that corresponds to andropause and menopause, respectively, was classified in two categories of men (1) younger than 50 years of age and (2) older than 50 years of age. Women were classified by menopausal (natural) status as being before menopause *premenopausal* (1) and after menopause *postmenopausal* (2) (WHO, 1996). Socio-demographic variables included: 5-year interval age categories: (1) 40 – 44.99; (2) 45 – 49.99; (3) 50 – 54.99; (4) 55 – 59.99; (5) 60 – 65; two

categories of marital status: (1) currently partnered (including married, remarried, and unmarried living together) and (2) currently non-partnered (including never married, widowed, divorced and separated); two categories of educational level: (1) 7-11 years completed (primary and vocational) and (2) >12 years completed (academic), and two categories of urbanization: (1) rural and (2) urban (with a population larger than 50 thousand of people). Lifestyle behaviour characteristics included two categories of smoking habit: (1) never smoked and (2) current smoker, and two categories of physical activity: (1) non-active and (2) active.

Analyses were ran using uni-variate and multi-variate statistic procedures for quantitative and qualitative data available in the Statistica 7.1 programme package (Statsoft Inc 2005 Statistica for Windows). Qualitative data were presented in multiway tables and the chi-square test was used to test their interdependence. Thereafter, the association among qualitative data was estimated using Euclidean distances obtained from the Multiple Correspondence Analysis (MCA).

RESULTS

Sample Characteristics: Demographic, social, and lifestyle behaviour characteristics of the middle-aged men and women in the study are presented in Table 1.

The mean age of men was 50.53, 95%CI:50.27-50.79, SD 5.98 years and of women was 49.96; 95%CI: 49.71-50.14; SD 6.96 years. The values of skewness (0.28 and 0.0.39 in males and females respectively) and of kurtosis (–0.63 and –0.56 in males and females, respectively) indicated a fairly symmetric distribution of age in the samples.

The males and females samples did not differ significantly in all sociological and demographic characteristics, but the physical activity and subjective perception of health. Of all subjects being studied, the noticeable majority (88.7% and 77.9% of men and women, respectively) had heterosexual partner (the partnered category of marital status including: married, remarried or unmarried living together). Widowed women almost four times outnumbered widowed men (9.1% vs 2.5%) Significantly higher number of women reported regular physical activity (21.9% vs 8.3%). Smoking habit was extremely common in the sample. There were 41.8% of men and 40.6% of women smoking either occasionally or frequently. An overall picture of health subjective perception indicated men to be more rigorous about their health as 6.5% of men evaluated their health as very poor (compared to 2.7% of women). No men perceived their health excellent whereas 0.3% of women did.

Table 1: Selected demographic, social and lifestyle characteristics of middle-aged Polish men and women

Characteristic	*% reporting characteristic*		
	Males (n=2078)	*Females (n=4444)*	χ^2
Age (years)			ns
40 – 44.99	21.0	23.3	
45 – 49.99	25.2	29.5	
50 – 54.99	31.3	26.3	
55 – 59.99	13.3	13.8	
60 – 65	9.1	7.0	
Marital Status			
Currently married/partnered	88.7	79.9	ns
Never married/partnered	4.2	5.2	
Widowed	2.5	9.1	
Divorced/Separated	4.6	5.8	
Place of Residence			ns
Village	20.7	19.4	
Small town up to 20 thousand people	29.2	31.1	
Medium - large town (50-500 thousand people)	23.7	28.2	
The city (over 500 thousand people)	26.4	21.3	
Education years completed (level)			ns
7 - 11 (primary/vocational school)	42.2	30.5	
12 (secondary school)	35.4	46.6	
> 12 (high school, academic education)	22.4	22.9	
Smoking Status			ns
Never smoked	32.9	31.1	
Past smoker	25.3	28.2	
Current smoker: occasionally	9.9	13.3	
frequently	31.9	27.3	
Physical Activity			**
Non-active	84.1	55.1	
Currently active (more than 1h/per week)	8.3	21.9	
BMI			ns
Underweight <18.5	0.3	1.3	
Normal weight 18.5-24.99	30.9	47.8	
Pre obese 25-29.99	49.9	35.7	
Obese, class I 30-34.99	16.5	12.4	
Obese, class II 35-39.99	1.9	2.5	
Obese, class III >40	0.5	0.2	
Perceived Health			**
Very poor	6.8	2.5	
Poor	34.3	35.9	
Fair	37.5	42.4	
Good	17.7	16.5	
Very good	3.7	2.4	
Excellent	0	0.3	

**p <0.01

The Gender Pattern of BMI Distribution: As to be expected, males and females significantly differ in stature, body weight and BMI (Table 2).

The distribution of BMI by marital status, urbanization and education levels, presented in Table 2, revealed that the overall pattern of BMI diversity within males and females was similar with some minute exceptions. An overall pattern of changes in BMI across age was the same in both sexes, however the rate of weight gain across the age seemed to be more pronounced among women than among men. In females, the BMI had gained for 2.5 units within 25 years whereas in males only 1 unit. It is interesting to note that married/partnered men tend to have higher relative weight as compared to their non-married/non-partnered peers. Women unlike men revealed opposite tendency with married were likely to have the lowest relative weight. Both men and women demonstrated the education and urbanization gradients of relative weight with the lowest value of BMI among highly educated inhabitants of urban areas.

The overall percentage distribution of relative weight status among middle-aged Polish males and females, shown in Figure 1, indicates overweight and obese males outnumbered females.

The percentage distribution of relative weight category in two categories of biological status of middle-aged men and women, shown in Figure 2, revealed significant weight gain after 50 years of age among males and after menopause among females.

Factors Associated with Mid-Life Obesity: The Euclidean distances plotted among the weight status, classified as normal, overweight and obese and the socio-demographic variables are presented in Figure 3.

The goodness of fit of the model, estimated by chi-square value, was overall χ^2 =48196.6; with df = 2078; P = 0 for males and for females: global χ^2 = 65156.6 with df = 4296 and P = 0. Two dimensions of Euclidean distances explained 27.9% of the entire chi-square distribution of BMI among males and 28.9% among females.

Normal and obese men were equally

Table 2: Between and within gender diversity in physique by age, marital status, education and urbanization (results of T^2 Hotelling's test and ANOVA)

Characteristic	*Males*			*Females*			
	N	*Mean*	*F-value*	*N*	*Mean*	*F-value*	*t-value*
Stature, cm	2078	176.0		4442	164.1		90.2**
Body weight, kg	2072	83.4		4406	69.2		45.7**
BMI, kg/m^2	2072	26.9		4406	25.7		11.9**
BMI, kg/m^2							
Age			6.0**			49.0**	
40 – 44.99	431	26.2		1020	24.4		
45 – 49.99	522	26.9		1304	25.3		
50 – 54.99	645	27.1		1158	26.2		
55 – 59.99	274	27.4		609	26.8		
60 – 65	185	27.3		309	26.9		
Marital Status			5.2**			5.2**	
Currently partnered	1826	27.0		3507	25.7		
Never partnered	87	26.5		229	24.8		
Currently non-part	145	26.1		646	25.8		
Education			8.7**			19.2**	
8-11 yrs (prim/voc)	871	27.1		1324	26.9		
12 yrs (secondary)	729	27.1		2036	25.3		
>12 yrs (academic)	462	26.3		1003	24.7		
Urbanization			3.0*			16.3**	
Villages	425	27.3		834	26.4		
Small Towns	601	27.0		1355	25.8		
Medium-Large T	492	26.7		1228	25.5		
Cities	548	26.6		929	25.0		
Smoking Status			23.8**			27.1**	
Never smoked	1193	27.3		2749	26.1		
Current smoker:	869	26.5		1519	24.9		
Physical Activity			11.1**			12.5**	
Non-active	1720	27.1		2219	26.9		
Active	325	26.0		934	25.9		

**p <0.01

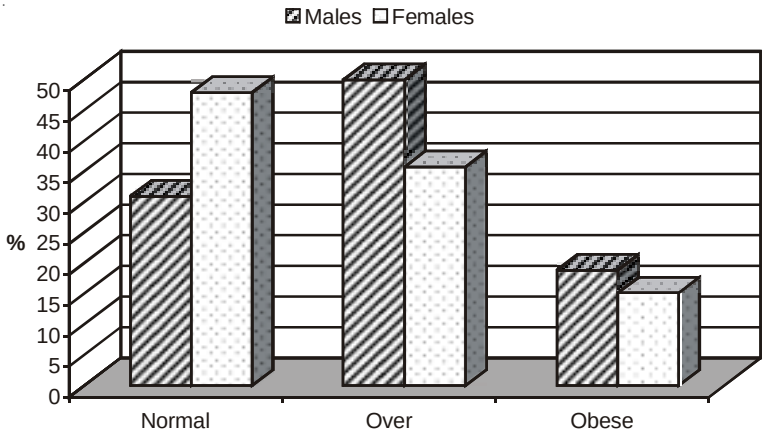


Fig. 1. Percentage distribution of relative weight status among middle-aged Polish males and females

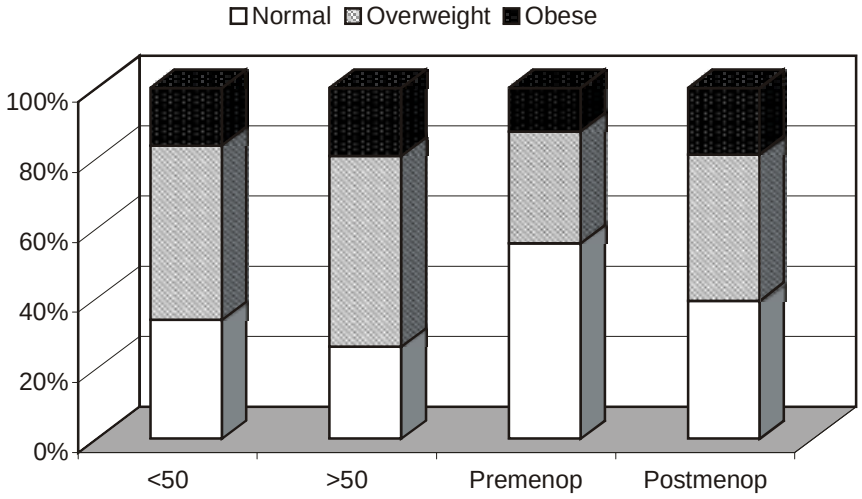
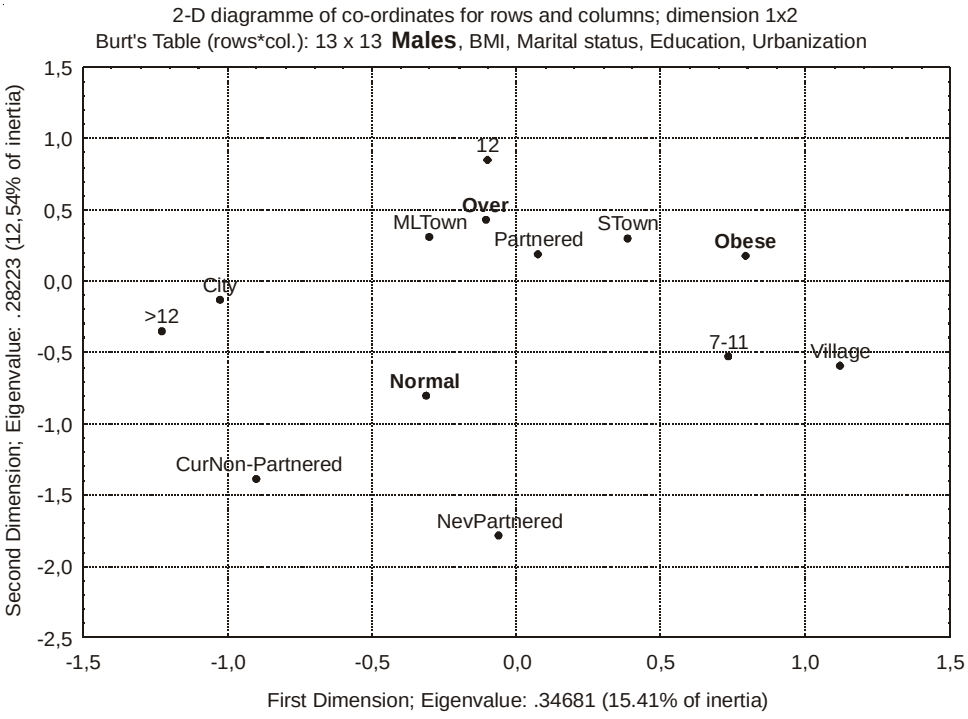


Fig. 2. Prevalence of relative weight status in Polish males and females with respect to their biological status

distributed among all levels of socio-demographic background, whereas overweight men were likely to be in majority among married/partnered, educated on secondary level residents of towns. Normal and overweight women were likely to be in majority among married/partnered and currently non-married/partnered, educated on secondary level residents of towns. Obese women were in majority among rural women educated on poor level. Never partnered, educated on high level residents of the cities were equally distributed among among all levels of socio-demographic background.

Table 3 summarizes the results of the multiple logistic regression analysis with backward elimination procedure. The full model included biological status, age, marital status, level of education, residence, smoking habit and physical activity. In males, the biological status (P=0.30) and place of residence (P=0.64) were deleted from the initial model. Thereby, the final model included age cohort, marital status, educational level, smoking habit and physical activity. In females, the biological status (P=0.81), marital status (P=0.44), residence (P=0.63), and physical activity (P=0.32) appeared not to be significantly



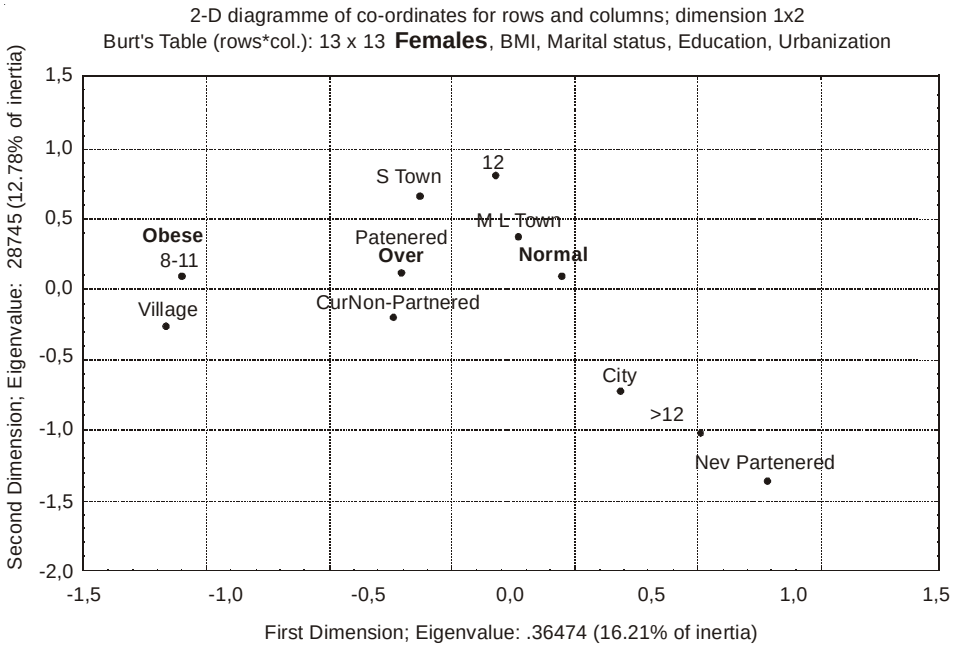


Fig. 3. Euclidean distances between profiles representing contents of rows and columns in contingency Burt's table in males and females for weight status, marital status and education level.

Table 3: Factors associated with obesity in midlife Poles (odds ratios (OR) and 95% confidence intervals (CI) from multiple logistic analysis with backward elimination procedure

Factor	*Males*		*Females*	
	Full Model OR (95% CI)	*Final Model OR (95% CI)*	*Full Model OR (95% CI)*	*Final Model OR (95% CI)*
Biological status	ns		ns	
<50/Premenop				
>50/Postmenop				
Age:	*p*<0.05	p<0.05	*p*<0.001	*p*<0.001
40 – 44.99	1-	1-	1-	1-
45 – 49.99	1.26 (1.04-1.53)	1.23 (1.07-1.41)	1.45 (1.21-1.75)	1.44 (1.31-1.58)
50 – 54.99	1.60 (1.25-1.87)	1.51 (1.32-1.74)	2.10 (1.57-2.58)	2.07 (1.68-2.43)
55 – 59.99	2.03 (1.84-2.45)	1.86 (1.72-2.01)	3.05 (1.98-3.25)	2.99 (2.08-3.05)
60 – 65	2.57 (1.21-5.48)	2.30 (1.33-3.97)	4.44 (2.11-9.31)	4.31 (2.97-6.25)
Marital Status	*p*<0.05	*p*<0.05	ns	
Partnered	1-	1-		
Non-partnered	0.41 (0.19-0.88)	0.54 (0.32-0.91)		
Education	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001
7-11 years	1-	1-	1-	1-
>12 years	0.35 (0.21-0.64)	0.43 (0.29-0.63)	0.31 (0.24-0.42)	0.24 (0.18-0.31)
Residence	ns		ns	
Rural				
Urban				
Smoking	*p*<0.01	*p*<0.001	*p*<0.001	*p*<0.001
Never smoked	1-	1-	1-	1-
Current smoker	0.49 (0.29-0.76)	0.43 (0.31-0.62)	0.48 (0.34-0.69)	0.44 (0.34-0.57)
Physical Activity	*p*<0.01	*p*<0.01	ns	
Non-active	1-	1-		
Active	0.36 (0.17-0.74)	0.51 (0.31-0.83)		

*Odds ratios estimates are adjusted for the other listed variables in the model

associated with obesity and were deleted from the model. The final model included age cohort, educational level and smoking habit.

Both in males and females a trend of increasing risk to obesity with increasing age cohort was observed (*p* for trend <0.05 and <0.001 in males and females, respectively). Men at age 60-65 had 2.3 times higher risk to be obese than men aged 40-44.99 years, whereas the risk for obesity among women 60-65 years old was 4.31 times higher as compared to their 40-44.99 years old peers. Non-married/partnered men had almost two times lower probability for obesity than their married/ partnered peers. Well educated males alike females were likely to be at lower risk for obesity than their poorly educated peers (OR=0.43 and OR=0.24 for males and females, respectively). Smoking habit appeared to be significantly associated with lower risk for obesity both in males and females (OR=0.43 and OR=0.44 for males and females, respectively). Physically active men were likely at two times lower risk to be obese than their non-active peers (OR=0.51).

DISCUSSION

Obesity is defined as multifactorial with the contribution of genetic, social, cultural, and environmental factors (Hill and Peters 1998; Barsh et al., 2000). The weight gain in midlife is most likely due to physiological changes (the decrease in females' estrogen and males' testosterone levels), and individual life history patterns combined with environmental changes such as easy access to large portion sizes of energy-dense foods and sedentary lifestyle (Kirchengast, 2004). Overweight and obesity lead to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance. Indeed, the more life-threatening problems posed by overweight and obesity, fall into four main areas: serious diet-related chronic diseases, including type 2 diabetes, cardiovascular diseases, hypertension and stroke and certain types of cancers, especially the hormonally related and large-bowel cancers; and gallbladder disease. Chronic overweight and obesity contribute significantly to osteoarthritis, a major cause of disability in older population. The health consequences range from an increased risk of premature death, to serious chronic conditions that reduce the overall quality of life (Garrow, 1988).

The purpose of this study was to estimate the diversity in BMI among midlife Polish men

and women and to evaluate the association between BMI and a defined set of demographic, social and lifestyle factors. Overall, the demographic characteristics of the sample correspond to figures for the Polish population with some exceptions relating to the category of urbanization and education (Population Census, 2002). In the sample studied, urban residents outnumbered rural ones as compared to global figures. The percentage of male and female urban residents in the sample is 79.3% and 81.6%, respectively as compared to 62% in the entire Polish population. The same holds for the level of education. In the sample, the percentage of people having the highest level of education was 20% as compared to 16% in the population as a whole (Population Census, 2002). Smoking habit was extremely common in the study sample as men comprised 41.8% and women 40.6% as compared to 40% of all Polish men and 25% of all Polish women older than 15; for all adult population average of 32% (Population Census, 2002). The above mentioned limitations of the present study should be considered when interpreting their findings.

It was found that weight status underlaid age-related changes and these changes were influenced primarily by mid-life physiological changes and socio-demographic background. Age cohort appeared to be most significant factor for variability in weight status, especially among females. These findings correspond well to many others indicating the effect of menopausal transition on weight status and body fat distribution (Panotopoulos et al., 1996; Poehlman and Tchernoff, 1998; Kirchengast et al., 1999; Stoll, 2000). Schuber et al. (2006) found age as important independent predictor for metabolic indicators, such as low-density lipoprotein and total cholesterol in men and women, and as associated factor of the fat and fat-free mass in both sexes.

Married men were likely to be at higher risk to overweight and obesity than their single peers. Umberson (1992) and Sobal et al. (1992) found that prevalence of overweight and obesity among married men were significantly higher than in their single peers. Evers (1987) found that marital status was more powerful risk factor for obesity in men than their age and education. In women unlike men marital status did not effect the weight status although it is known to be significantly associated with later age at menopause (Sievert et al., 2001).

Education level appeared to be significantly associated with obesity in both sexes. Middle-aged people with high level of education were likely to be at lower risk to obesity than their poorly educated peers. This finding corroborates well with data for Finns (Laaksonen et al., 2004) and U.S. adults aged 51 to 61 years (He and Baker 2004). The level of education may be associated with unmeasured health related behaviours and practices, such as diet or stress. Indeed, an overall view of the present data indicate that higher educated men and women are more voluntary to improve their health-related behaviours compared to their lower educated peers. Gofin et al. (1996) have observed the increased prevalence of obesity among middle-aged and elderly men ad women in Jerusalem since 1970 up to 1986. Education contributes significantly in the distribution of BMI in subgroups. Schoenborn et al. (2002) have noted that factors associated with increasing trends of obesity that have recently been observed in Swedish communities are diet and sedentary lifestyle. In the study sample physical activity was also significantly associated factor with male's obesity.

Although, in the present study, the residence place did not appear to be significantly associated with obesity it is known that as incomes rise and populations become more urban, diets high in complex carbohydrates give way to more varied diets with a higher proportion of fats, saturated fats and sugars. At the same time, large shifts towards less physically demanding work have been observed worldwide. Moves towards less physical activity are also found in the increasing use of automated transport, technology in the home, and more passive leisure pursuits (Hill and Peters, 1998; Guo et al., 1999, Ekelund et al., 2005).

Smoking appeared to be negatively associated with obesity in both sexes. However, obesity and smoking have been known to be major risk factors for mid-life chronic diseases, notably cardio-vascular diseases known as the worldwide leading cause of death for both sexes (WHO, 2004)

Overall, middle-aged men appeared to be more sensitive to environmental factors than women. In fact, higher susceptibility of men to environmental factors is well known phenomenon across the life cycle (Tanner, 1999).

CONCLUSION

The mid-life weight gain among males and

females is significantly associated with socio-demographic and life style factors. In males the age cohort, marital status, education level, smoking habit and physical activity were significantly associated with middle-aged weight status, whereas in females there were age cohort, education level and smoking habit. The relationships between weight status and environmental variables reveal the gender pattern of the association and confirm that men are more susceptible for environmental factors than women.

Societal changes and worldwide nutrition transition are driving the obesity among middle-aged and elderly people alike younger adults. Economic growth, modernization, urbanization and globalization of food markets are just some of the forces thought to underlie the epidemic. Effective weight management for individuals and groups at risk of developing obesity demands an integrated, multi-sectoral, population-based approach, which includes environmental support for healthy diets and regular physical activity.

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ABSTRACT This paper describes variation in weight status among middle-aged Poles and evaluate factors associated with this variation. 2078 men and 4444 women, aged 40 – 65 years, were polled in cross-sectional population-based study conducted between 2000-2004 in Poland. Uni-variate and multi-variate analyses were run in order to describe within and between gender variability in BMI. Multiple Correspondence Analysis was computed to evaluate qualitative association of socio-demographic factors and the BMI. The association of selected biological, demographic, social and lifestyle behaviour characteristics with the obesity was modeled using multiple logistic regression with backward elimination. The odds ratios of the obesity among different subgroups were estimated with simultaneous adjustments for all other statistically significant covariates in the model. The findings revealed that age cohort (OR=2.3), marital status (OR=0.54), education level (0.43), smoking habit (OR=0.43), and physical activity (OR=0.51) were significantly associated with risk for obesity among males whereas among females there were: age cohort (OR=4.31), education level (OR=0.24) and smoking habit (OR=0.44). The findings revealed higher susceptibility of middle-aged men to environmental factors compared to their female peers.

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