Overweight and obesity and their determinants among men from Podlasie region in the years 1987-1998

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Abstract

The goal of the study was to determine the frequencies of occurrence of obesity and overweight among men from Podlasie region of Poland, as well as nutritional and environmental factors related to these conditions.

During 9-year period (1987-1998), dietary habit of each of 556 men was evaluated three times using 24-hour consumption questionnaire. At the same time body mass index (BMI) was also calculated.

BMI increased significantly from 26.2 kg/m^2 to 27.6 kg/m^2 during discussed period, while percentage of overweight grew up from 62.7% to 73.2% and percentage of obesity rose from 14.5% to 22.5%. Executed multiple regression analysis revealed a variety of predictors of obesity and overweight. Among nutritional factors, the increase of energy and carbohydrates (especially saccharose) in diet were the reasons of increasing BMI. Considering psychological, sociological and economical features, multi-shift work provoked increase of BMI, while decrease of BMI was induced by smoking.

Observed increase of spread of overweight and obesity among men, had its nutritional and environmental reasons.

Key words: men, overweight, obesity, dietary habit, environmental factors, a prospective study.

Introduction

Obesity is a risk factor of many contemporary diseases, such as coronary heart disease, hypertension, diabetes mellitus and cancer. Obesity itself induces also other risk factors of coronary heart disease, such as hiperlipidemia, hypertension and diabetes mellitus [1-4].

The main cause of increasing obesity is positive energy balance, arising from improper nutrition and from the other hand from low physical activity. The development of populations in last half-age is accompanied by rapid increase of overweight and obesity, which cannot be stopped and therefore is called an epidemic or even a pandemic of obesity [5-7].

In this paper we decided to evaluate the occurrence of overweight and obesity in men inhabitants of Podlasie region and refer it to the dietary habit and other environmental determinants.

Material and methods

The study was conducted in the years 1987-1998 and it was concerning men, inhabitants of north-eastern region of Poland. All participating 556 men were examined three times. First study was conducted in the years 1987-1989, the second one in the years 1991-1993 and third in the years 1996-1998.

Based on the measurement of men' height and weight we calculated the body mass index (BMI). The value of BMI was referred to: age, the period of study birth cohort, physical activity, the character of work, education, work shifts, the marital status, the number of people in the family, the income per person in a family, smoking, leisure time, the skill to evaluate own nutrition and the features consisting the A model of behaviour (the need of achievements, domination tendency, aggressiveness, behaviour dynamics, hurry and impatience).

The quantitative evaluation of nutrition was conducted with the use of 24-consumption questionnaire. Based on quantity and kind of consumed products and meals we calculated the nutritive value of daily consumption.

To determine the influence of nutritional and environmental factors on the BMI, a multidimensional linear regression was used. In statistical analysis we used SAS statistical set. To com-

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Table 1. **Body mass index (BMI) of 556 men examined three times in the years 1987-1998. And the number and percent of people in distributed classes of BMI (according to WHO)**

Examined parameter		I study	II study	III study	Statistically significant differences
BMI	Mean	26.2	26.8	27.6	I-II, II-III, I-III*
	SD	3.5	3.8	3.8	
BMI<18.5	n	1	1	0	
	%	0.2	0.2	0	
8.5≤BMI<25	n	206	187	149	I-II-III**
	%	37.1	33.6	26.8	
25≤BMI<30	n	268	258	282	
	%	48.2	46.4	50.7	
30≤BMI<35	n	72	97	104	I-II-III**
	%	12.9	17.4	18.7	
35≤BMI<40	n	9	10	19	
	%	1.6	1.8	3.4	
BMI≥40	n	0	3	2	
	%	0	0.5	0.4	

* Dunn test ** χ^2 test

Table 2. **The influence of energy value of 24-hour consumption on body mass index of 556 men. Linear regression analysis included age, period of study and cohort were included additionally**

Independent variables / Dependent variable		Age Δ=1.0 year	Differences between periods		Differences between cohorts		Energy value of the diet Δ=1.0 kcal
			I-II	I-III	A-B	A-C	
BMI	Δ	0.011	0.53	1.21	-0.48	-0.96	0.0001
	p	0.84	0.02*	0.02*	0.48	0.38	0.03*

* statistically significant variable

pare the BMI between particular periods of study we used Dunn test. The evaluation of the significance of change of the number of particular BMI classes in the next studies during 9 years was done based on χ^2 test. Hypotheses in all statistical tests were verified at significance level $\alpha=0.05$.

Results

The value of the body mass index of men during 9 years is presented in *Tab. 1* and *Fig. 1*. Body mass index (BMI) increased significantly from 26.2 kg/m^2 in the 1st study to 27.6 kg/m^2 in the 3rd study. The percent of men with overweight also increased (BMI≥25 kg/m^2) from 62.7% in the 1st study to 73.2% in the 3rd study, and at the same time in a group of obese men (BMI≥30 kg/m^2) an increase of percent from 14,5 % in the 1st study to 22.5% in the 3rd study was the highest.

The analysis presented in *Tab. 2* shows that increasing age of men was not influencing the body mass index and similarly the affiliation of men to the particular birth cohort has not had an influence on BMI. On the contrary the differences between the periods of study had a significant influence on the increase of body mass index. The variance of BMI connected with the period of study certainly was not the consequence of the differences in the measurement procedure, because it was relatively simple and easy to keep in standard, so an influence of "study period" may only arise from an influence of many particular features, creating the characteristic of a certain period. An influence on BMI of several of these features, which were not appearing in models presented in *Tab. 2*, is presented in *Tab. 5*. In a multidimensional regression analysis, concerning actual caloric values of the diet we observed that increasing caloric values of the diet significantly (p=0.03) influenced the body mass index.

As you can see in *Tab. 3*, the value of the body mass index was increasing significantly with an increase of amount of total

Figure 1. **Overweight and obesity among men during next 3 studies in 9-year observation period**

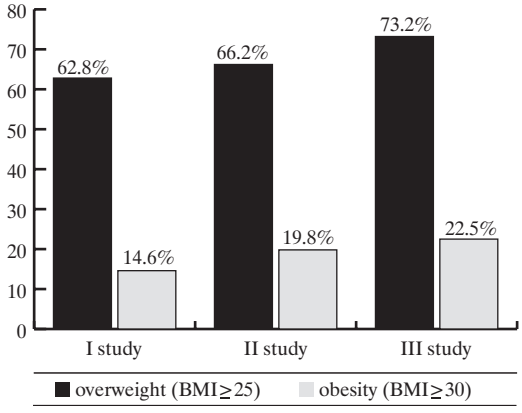

***Table 3*. The influence of nutrients from the diet of men on body mass index. Linear regression analysis included age, period of study and cohort were included additionally**

Dependent variable		Independent variables	Age Δ=1.0 year	Differences between periods I-II	Differences between periods I-III	Differences between periods A-B	Differences between periods A-C	Animal protein Δ=1.0g	Plant protein Δ=1.0g	Animal fat Δ=1.0g	Plant fat Δ=1.0g	Total carbohydrates Δ=1.0g	Pure alcohol Δ=1.0g
BMI	Model No. 1	Δ	0.01	0.56	1.126	-0.49	-1.00	0.0003	-0.006	0.01	-0.002	0.002	0.006
		p	0.85	0.02*	0.01*	0.47	0.36	0.92	0.39	0.41	0.57	0.05*	0.46
	Model No. 2	Δ	0.01	0.53	1.21	-0.49	-0.97					0.001	
		p	0.85	0.02*	0.02*	0.48	0.38					0.03*	

* statistically significant variable

***Table 4*. The influence of nutrients of the diet of men on body mass index. Linear regression analysis included age, period of study and cohort were included additionally**

Dependent variable		Independent variables	Age Δ=1.0 year	Differences between periods I-II	Differences between periods I-III	Differences between cohorts A-B	Differences between cohorts A-C	Animal protein Δ=1.0g	Plant protein Δ=1.0g	Animal fat Δ=1.0g	Plant fat Δ=1.0g	Carbohydrates without saccharosis Δ=1.0g	Saccharosis Δ=1.0g	Pure alcohol Δ=1.0g
BMI	Model No. 1	Δ	0.01	0.56	1.26	-0.48	-1.00	0.0002	-0.007	0.001	-0.002	0.002	0.001	0.006
		p	0.85	0.02*	0.01*	0.47	0.36	0.93	0.49	0.41	0.57	0.25	0.17	0.45
	Model No. 2	Δ	0.01	0.55	1.24	-0.48	-0.96			0.002			0.002	
		p	0.85	0.02*	0.01*	0.49	0.38			0.11			0.10	
	Model No. 3	Δ	0.06	0.54	1.23	-0.51	-1.03						0.002	
		p	0.91	0.02	0.01*	0.46	0.36						0.06	

* statistically significant variable

carbohydrates consumed by men. Explaining, whether saccharides with differentiate structure influence the body mass index to the same extent we excluded disaccharide saccharosis (sugar) from the group "total carbohydrates", and remaining saccharides were called "carbohydrates without saccharosis". Performed regression analysis, including the differences between the structure of the saccharides (*Tab. 4*), revealed in a model using elimination of the variables with step-by-step method (in model no. 3 variables remained with the value of p=0.06) that the body mass index may be influenced mainly by saccharosis (sugar) and other saccharides (saccharides without saccharosis) may not. The presuming mood arises from the value of p=0.06.

Among analysed sociological, economic and psychological factors only shift work caused an increase of the body mass index, while smoking significantly decreased its value – *Tab. 5*.

Discussion

Based on conducted research of body mass index changes in men we can ascertain that the nourishment of examined men in the years 1987-98 was improper. The evaluation showed overweight in 63-73% of examined men and obesity in 15-23% with the tendency to increase of those two states during 9 years of observation. Therefore feeding of examined men, in an observed period of time, did not act as it basically should, because it was providing too much calories according to body needs.

Observed values of BMI in examined men are comparable with the data collected in other studies in the last two decades, conducted in Poland. Szponar [8] examining men hired in big industrial work in the years 1991-94, observed overweight in 59% of men and obesity in 11% of men. On the contrary, in Pol-MONICA study (conducted in 1993) overweight was observed in 68% and obesity alone in 22% of men aged 35-64 years old, inhabitants of Warsaw [9]. Among men, inhabitants of a large Łódź agglomeration and small town area next to it, overweight was observed in 52-58% of examined [10].

The analysis of influence of nutrients in the diet of examined men on the value of their BMI shows that we can only say about an influence of an amount of total carbohydrates consumed, eventually including saccharosis, on BMI. Therefore the more total carbohydrates were consumed by men, including saccharosis, the greater values of BMI were observed in these men and contrariwise. The influence of feeding on health and the age of

Table 5. **Social, economic and psychological determinants of body mass index of 556 men, examined 3 times in the years 1987-1998. Linear regression analysis included age, period of study and cohort were included additionally**

Dependent variable / Independent variables		BMI (kg/m²)			
		Model No. 1		Model No. 2	
		Δ	p	Δ	p
Age (Δ=1.0 year)		0.004	0.94	0.01	0.85
Differences between periods	I-II	0.46	0.06	0.50	0.03*
	I-III	1.02	0.05*	1.18	0.02*
Differences between cohorts	A-B	-0.14	0.84	-0.20	0.76
	A-C	-0.70	0.52	-0.82	0.45
Physical activity according to FAO/WHO (Δ=1.0)		-0.39	0.55		
Character of work (physical/intellectual)		-0.31	0.42		
Education (elementary/secondary, university)		-0.05	0.89		
Shift work (one shift/more shifts)		0.47	0.04*	0.52	0.02*
Health status (healthy/ill)		0.14	0.42		
Marital status (single/married)		0.50	0.19		
Number of people in a family (Δ=1.0)		-0.14	0.22		
Income per person in a family (Δ=1000 PLN)		0.02	0.18		
Smoking (no/yes)		-0.62	0.003*	-0.62	0.003*
Leisure time (passive/active)		-0.14	0.68		
Skilled to evaluate own consumption (no/yes)		-0.03	0.82		
Behaviour model A – subscales (Δ=1.0)	the need of achievements	0.01	0.55		
	domination tendency	0.04	0.20		
	aggressiveness	-0.004	0.85		
	behaviour dynamics	-0.02	0.37		
	hurry and impatience	-0.002	0.93		

* statistically significant variable

survival was showed in the experimental studies on animals, who received fewer saccharides, mainly saccharosis, what was significantly slowing down the biological process of aging and elongated life [11,12].

The comparison of BMI with caloric value of the diet required additional including of several factors. Simple set of trends of those two features could lead to false results, especially in a prospective study. Prentice [13], presenting trends concerning with the frequency of obesity occurrence and the energy value of the diet in the years 1950-90 in England, showed the need of consideration of environmental and interpersonal determinants, and especially the lifestyle. Otherwise we may observe that both energy value of the diet and the amount of consumed fat does not relate to an increase of obesity occurrence. These factors influencing BMI may arise from the environmental conditions and lifestyle elements, for example: working in management, regular physical activity, driving a car instead of walking, leisure time connected with watching television for many hours [13-16], which problems were not identified as detailed in own study, but which are believed to cause an increase of obesity in England [13] and in United States of America [15]. In our own study, when age, environmental factors connected with the period of study and the affiliation to the particular birth cohort were included in multidimensional analysis of the connection between BMI and the caloric value of the diet, we then observed significant influence of the caloric value of the diet on BMI, that is with decreasing caloric value of the diet the BMI value was also decreasing.

The change of shift work into one shift work in examined group of men caused the decrease of BMI value, probably because of elimination of many physiological abnormalities in daily rhythms, arising during night work. Shift work was connected with long pauses between meals and lower number of meals eaten and it was accompanied by significant increase of obesity [17]. Much higher concentration of insulin is observed after meals with such feeding habits and it may also lead to the development of diabetes mellitus [18].

Non-smoking or breaking the habit of smoking caused higher BMI values in examined men in comparison to smoking ones. Other researchers also showed greater values of body weight measurements, body fat weight, BMI or higher frequency of obesity occurrence in non-smoking men in comparison to smoking ones [17,19-22]. In American studies on a group of 7000 men, there were less men with overweight among smoking – 52,8% than among non-smokers who never started smoking – 63,3% [21]. Also in Pol-MONICA study, the study of 2600 men showed lower content of body fat weight in active smokers in comparison to non-smokers and ex-smokers [20]. The influence of cigarette smoking on the decrease of body weight or body fat weight is connected by authors with an increase of total metabolism, preceded by activation by nicotine of sympathic system, what leads, as Hofsteter [23] showed, just after one day of cigarette smoking total metabolism was increasing by about 10%, with an increase of noradrenalin secretion with the urine at the same time.

Conclusions

- Body mass index in the group of 556 men improved significantly after 9 years of study from 26.2 kg/m^2 to 27.6 kg/m^2.
- In examined group of men the percent of people with overweight (BMI≥25) increased after 9 years from 62.8% to 73.2% and the percent of obese men (BMI≥30) increased from 14.6% to 22.5%.
- Among evaluated psychological, social and economic factors we showed that cigarette smoking influenced the decrease of body mass index, while shift work was increasing its value.
- The evaluation of the influence of diet on the body mass index shows that increasing caloric value of the diet and increased consumption of total carbohydrates caused significant increase of that index. Considering two subclasses within consumed carbohydrates, saccharosis consumption itself caused more significant increase of the body mass index than other carbohydrates.
- Resolving the obesity problem in an individual and social dimension requires using behaviour therapy, including health behaviour holistically, with the behaviour connected with nutrition in prevention of contemporary diseases.

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