EVALUATION OF SELECTED BIOCHEMICAL AND ANTHROPOMETRIC INDICES AND EATING HABITS OF 40-YEAR-OLD WOMEN FROM WROCŁAW

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Eating habits of 40-year-old women (n=592) were evaluated in the study. The women were participants of the programme "Prophylaxis of cardiovascular diseases in the population of 40-year-old citizens of Wrocław" carried out under the auspices of the Health Department of the City Office of Wrocław. In the study, use was made of a 24-h recall method and history of nutrition that included, among other things, average daily number of meals, frequency of meal consumption and food preferences. The examined women were also subjected to analyses of concentrations of total cholesterol, HDL cholesterol fraction and blood glucose as well as measurements of blood pressure and calculations of Body Mass Index (BMI).

The study demonstrated the presence of overweight in 27% of the women examined, obesity in 10% of the women, elevated blood level of total cholesterol in 51.7% of the women, elevated blood glucose level in 17% of the women, and elevated systolic blood pressure in 15% of the women. The statistical analysis indicated a significant, unfavourable effect of BMI index on blood pressure and some lipid indices.

In the group of women examined (n=592), the risk of cardiovascular disease was estimated in a 10-year period of observations based on Framingham Heart Study criteria. A high risk, *i.e.* 11–30%, was demonstrated for 25 women.

INTRODUCTION

Contemporary man living in economically developed, highly industrialized countries, and taking advantage of scientific and technical advances, is more and more exposed to their negative effects. They include degenerative metabolic diseases, also referred to as civilization diseases. Those diseases may be characterized as chronic, long-term processes (preceded by an asymptomatic phase) that impair the organism's efficiency in a progressive manner [Duda, 2000]. Induction and development of those diseases are determined by a variety of endo- and exogenous factors widely described in literature.

Based on literature data as well as investigations of the National Institute of Food and Nutrition, it was estimated that in 2000 approximately 20% of the Polish population suffered from metabolic diseases [Szponar, 2000]. In that population, about 1–3 million people were diabetics and patients with glucose tolerance disturbances. Those suffering from hypertension constitute over 3 million Poles, whereas approximately 200 thousand Poles suffer from diseases of the circulatory system. Overweight has been reported in 1.5 million men and in as many as 2.1 million women. About 2 million people over 45 years of age are at risk of osteoporosis development.

Due to such an unfavourable situation, the health status of the Polish population is a source of anxiety. It therefore seems important and advisable to implement any health-promoting and prophylactic actions aimed at improving health condition as well as nutritional education of the Polish population.

The reported study was aimed at evaluating selected biochemical and anthropometric indices as well as eating habits of 40-year-old women from Wrocław.

MATERIAL AND METHODS

Nutritional investigations covered women participating in the programme "Prophylaxis of cardiovascular diseases in the population of 40-year-old citizens of Wrocław" in the years 1999–2001, which was coordinated by the Health Department of the Municipal Office in Wrocław. The women examined were selected based on personal identification number (PESEL) and invited by letter to free-of-charge prophylactic examinations. Out of responding women, 592 agreed additionally to take part in the nutritional assays.

Nutritional patterns of the women were investigated with the 24-h recall method (nutritional interview 24 h before the examination) and history of nutrition, taking into account the intake of food products and dishes in a period of 2–3 months.

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In the quantitative evaluation use was made of the "Album of photographs of food products and dishes [2000] elaborated by the National Institute of Food and Nutrition. Using "Dietetyk 2000" software for Windows 95 coupled with a database generated on the basis of "Tables of nutritive value of food products" [Kunachowicz *et al*., 1998] and "Dishes – composition and nutritive value" [Nadolna *et al*., 1994], the food rations of women were examined for energy value and contents of 19 nutrients.

The women participating in the programme "Prophylaxis of cardiovascular diseases in the population of 40-year-old citizens of Wrocław" (n=592) were subjected to the following analyses: (1) biochemical: concentration of total cholesterol in blood plasma with the enzymatic method with esterase and oxidase using a test by Pointe Scientific company, concentration of HDL cholesterol in blood plasma with the method with a polyethylene glycol precipitating reagent using a test by Pointe Scientific company, concentration of glucose in blood plasma with the enzymatic method with oxidase and peroxidase using a test by Human company; (2) anthropometric: Body Mass Index – BMI (according to the formula: body mass (kg)/body height (m^2)); and (3) measurement of blood pressure (single measurement) with the use of a mercuric sphygmomanometer.

Results obtained were compared with European Recommendations for Prophylaxis of Cardiovascular Disease in reference to the situation of the Polish population [Szostak *et al*., 2004]. The presented study is a continuation of earlier published investigations into a population of 40-year-old women from Wrocław [Bronkowska & Żechałko-Czajkowska, 2006a,b].

In the group of women examined, also the risk of cardiovascular diseases was estimated based on an algorithm of the Framingham Heart Study in a 10-year observation period [Grundy *et al*., 2001; Wilson *et al*., 1998]. The number of points obtained was linked with the occurrence of risk factors, including: age, smoking total cholesterols and HDL cholesterol concentrations, as well as systolic blood pressure.

Results of nutritional, anthropometric and biochemical assays were subjected to a statistical analysis. All variables examined were characterised by normal distribution (Shapiro–Wilk's test). Statistical calculations were carried out with Statistica PL v. 6.1 software.

A canonical analysis was conducted as well that enabled a relationship to be determined between nutritional factors and biochemical parameters [Stanisz, 2000]. Logistic regression analysis [Stanisz, 2000] was carried out additionally to evaluate the likelihood of the occurrence of improper biochemical indices in the group of subjects with increasing BMI.

RESULTS AND DISCUSSION

Results obtained in analyses are presented in Table 1. In the investigated group of women (n=592), the anthropometric and biochemical analyses as well as blood pressure measurements demonstrated the occurrence of the following metabolic disorders: overweight, obesity, elevated total blood cholesterol, elevated blood concentration of glucose as well as a tendency for elevated systolic pressure.

The occurrence of overweight and obesity always results from a positive energetic balance, *i.e.* an excess of energy

TABLE 1. Division of the examined group of women in terms of BMI, biochemical blood parameters and blood pressure (n=592).

Parameter	Range	% of the group examined (n=592)
BMI	24.9	63.0
	24.9 – 29.9	27.0
	29.9	10.0
Total cholesterol (mmol/L)	5.2	59.3
	5.3 – 6.5	32.6
	6.6	8.1
HDL – cholesterol (mmol/L)	0.9	2.5
	0.91 – 1.15	25.7
	1.16	71.8
Glucose (mmol/L)	5.5	83.1
	5.6 – 6.9	15.7
	7.0	1.2
Systolic blood pressure (mm Hg)	130	85.0
	131 – 139	1.3
	140	13.7
Diastolic blood pressure (mm Hg)	80	68.9
	81 – 89	11.0
	90	21.1
Total chol./HDL-chol. index*	4	62.0
	4.1 – 7.9	35.5
	8	2.5

* Total cholesterol/HDL-cholesterol index

supplied to a body over its consumption that is sustained over a sufficient period of time [Pardo *et al*., 2001; Szponar *et al*., 1999]. Currently there is an epidemic of obesity that has wide-ranging effects and affects hundreds of millions of inhabitants of our globe.

In the present study, overweight-indicating BMI ranging from 24.9 to 29.9 was reported in 27% of the women, whereas obesity-indicating BMI reaching >29.9 was reported in 10% of the 40-year-old women under scrutiny. Results obtained within the Pol–MONICA BIS programme (Warsaw and the former Tarnobrzeskie Province) demonstrate an incidence of overweight of 27.9% and 32.3%, and that of obesity of 13.9% and 13%, in women aged 35–44, respectively [Rywik & Broda, 2002a, b]. Assays carried out among women inhabitants of Lublin City (n=1214) showed that overweight affected 37.3% and overweight 25.6% of women aged 35–64 [Kozak-Szkopek *et al*., 2003]. In a study carried out within the CINDI – WHO programme among citizens of Łódź, overweight was reported in 30.5% of women aged 35–44, and obesity in 9% of the subjects [Kaczmarczyk-Chałas & Drygas, 2003].

Metabolic disorders of the women examined were evaluated using the European Recommendations for Prophylaxis of Cardiovascular Disease in reference to the situation of the Polish population [Szostak *et al*., 2004]. According to those recommendations, in women the concentration of total cholesterol in blood serum should be lower than 5 mmol/L, that

of its HDL fraction should be ≥1.2 mmol/L, that of glucose should be ≤5.5 mmol/L, whereas arterial blood pressure should be 130/80. In the present study, approximately 41.5% of the women were shown to have an improper level of total cholesterol (5.0–6.3 mmol/L) requiring normalization. Considerable hypercholesterolaemia (>6.3 mmol/L), a key risk factor of atherosclerosis, was observed in 10.2% of those examined. In approximately 18.3% of the women, the level of HDL cholesterol was below the recommended values (<1.2 mmol/L). A moderate level (0.9–1.2 mmol/L) of HDL cholesterol was observed in approximately 17.2% of those examined, and a low level (<0.9 mmol/L) in about 1% of the women. The results obtained in the reported study correspond to those obtained in the study carried out within the Pol–MONICA BIS programme [Rywik & Broda, 2002a, b; Rywik *et al.*, 2003]. In the population of women from Warsaw aged 35–44, mild hypercholesterolemia was demonstrated for 36.4% of the examined, whereas considerable hypercholesterolemia was shown for 7.4% of the women. In approximately 2.% of the subjects, the level of HDL-cholesterol was below 1.16 mmol/L [Rywik & Broda, 2002b; Rywik *et al.*, 2003]. Similar investigations were carried out for a population of women originating from the former Tarnobrzeskie Province. In that population, elevated blood concentration of total cholesterol was observed in 28.7% of those examined. Hypercholesterolaemia was reported for 3.1%, whereas low levels of HDL-cholesterol were reported for 3.8% of the women [Rywik & Broda, 2002a; Rywik *et al.*, 2003].

A study aimed at evaluating indices of lipid metabolism among patients (n=152) of the Warszawa–Ochota Outpatient Clinic demonstrated proper levels of total cholesterol (<5.2 mmol/L) in 47% of the examined group of women aged 36–50, and higher values of that index (>5.2 mmol/L) in 53% of the subjects [Hamułka *et al.*, 2002].

A cohort study carried out on a population of women (n=14077) aged 30–64 inhabiting the UK included an evaluation of lipid metabolism. It demonstrated that in subjects with BMI<25 the blood concentration of total cholesterol was 5.2 mmol/L and in those with BMI 25–30 and BMI>30 it was 5.4 mmol/L and 5.6 mmol/L, respectively [Ashton *et al.*, 2001].

Hyperglycaemia (≥7.0 mmol/L) was demonstrated in 1.2% of the analysed 40-year-old women from Wrocław. Those disorders point to improper carbohydrate metabolism or diabetes. Corresponding results were obtained for women originating from the former Tarnobrzeskie Province, in the case of whom hyperglycaemia was reported in 2.3% of the subjects [Rywik & Broda, 2002b; Rywik *et al.*, 2003]. An elevated concentration of glucose in blood was found in 9.9% of the 35–44-year-old women participating in the Pol–MONICA BIS Warszawa study [Rywik & Broda, 2002a; Rywik *et al.*, 2003]. Diabetes is a metabolic disease with various aetiology and characterised by chronic hyperglycaemia with disorders in metabolism of carbohydrates, lipids and proteins as a result of a defect in secretion and/or action of insulin. Its most frequent complication is vascular lesions leading to atherosclerosis of peripheral and cerebral arteries. The frequency of diabetes occurrence increases with age. According to estimates of the World Health Organization, the number of people suffering from diabetes worldwide will double from 143 million in 1997 to 300 million in 2025. In Poland, that number will approach 1.5 million. The real number of patients affected by diabetes will probably be higher since in a number of people that ailment remains latent for many years [Szostak & Cybulska, 2003; WHO, 2003].

Hypertension is one of the plagues of contemporary civilization. That disease is estimated to affect nearly one-fourth of the adult population in our country. Elevated arterial blood pressure often leads to intensified development of atherosclerosis, the appearance of complications of coronary heart disease and myocardial infarction, circulatory failure and arterial occlusion of limbs [Januszewicz, 2002].

According to results of most investigations, the incidence of arterial hypertension is very similar in various countries and increases from 5% in young persons to nearly 50% in the middle-aged [WHO, 2003].

In the reported study, an elevated systolic pressure (>140 mmHg), indicating hypertension according to European Recommendations for the Prophylaxis of Cardiovascular Diseases in Poland, was observed in 13.7% of the 40-year-old women examined. Those analyses were based on a single

TABLE 2. Canonical masses and factorial structure between variables linked with eating habits *vs.* biochemical blood parameters of the examined group of women (n = 592).

	Variables	Criterion 1		Criterion 2	
		Canonical weights	Criterion structure	Canonical weights	Criterion structure
Parameters linked with eating habits	Energy value	0.0597	-0.0164	0.0170	0.0748
	% of energy from fats	-0.2305	0.0142	2.4985	0.3172
	Dietary cholesterol	0.2610	0.0493	-1.3865	-0.2289
	% of energy from saturated fatty acids	0.4184	-0.0171	-3.7589	-0.0918
	Keys` index	-0.4275	-0.0222	2.3641	-0.1937
	BMI	1.003	0.9887	0.0214	0.0839
Biochemical parameters	Systolic blood pressure	0.3333	0.7360	0.2613	0.1002
	Diastolic blood pressure	0.4499	0.7471	-0.2098	-0.2676
	Total cholesterol	-0.1553	0.2853	0.1026	0.5184
	Glucose	0.4014	0.5511	-0.7473	-0.6269
	Total chol./chol-HDL index[*]	0.4742	0.5095	0.6811	0.6554

r = 0.37; p< 0.02; * Total cholesterol/HDL-cholesterol index

screening measurement of arterial blood pressure. A single measurement is not enough to draw conclusions on the range of the problem, but it may signal the occurrence of potential complications in the future. Epidemiological assays point to the existence of a strong relationship between high systolic and diastolic pressure and the risk of ischaemic heart disease in women [Januszewicz, 2002].

In the evaluation of the risk of ischaemic heart disease use was made of the index: total cholesterol/HDL cholesterol. A proper index (≤4) pointing to a low risk of ischaemic heart disease was observed in 62% of those examined. A mild risk (index value of 4.1–7.9) was reported in 35.5% of the women, whereas a high risk of development of atherosclerotic lesions (≥7.9) was reported in 2.5% of the women (Table 1).

In order to determine a relationship between nutritional parameters and biochemical ones and blood pressure, a canonical analysis was carried out in the study. A correlation (p≤0.02) was demonstrated between nutritional parameters and biochemical ones and blood pressure, yet the correlation was not strong (r=0.37). Table 2 presents the criterion structure that characterised the significance of variables in determining criteria of the canonical analysis. That significance was expressed by coefficients of a correlation between a criterion and variables. The most important parameter for criterion 1 appeared to be the BMI value (r=0.9887). When it comes to parameters of health status, the most significant appeared to be systolic pressure (r=0.760), diastolic pressure (r=0.7471), glucose (r=0.5511) and, to a lesser extent, an index calculated from the ratio total cholesterol:HDL cholesterol (r=0.5095). Since canonical correlations of criterion 1 did not cover the highest number of variations, the contribution of criterion 2 was presented as well. Canonical weights and criterion structure were computed for that criterion. The most important component of criterion 2 was percent of energy originating from fats in a daily food ration (r=0.3172). Amongst biochemical parameters, the most important appeared to be the total cholesterol:HDL cholesterol ratio (r=0.6554), concentration of total cholesterol (r=0.5184) as well as negatively correlated concentration of glucose (r=-0.6269).

A logistic regression analysis was carried out as well, which enabled the likelihood of the occurrence of elevated values of biochemical indices and blood pressure to be evaluated (Table 3). In the women examined, increasing BMI (25–27.5) was accompanied by a higher likelihood of elevated systolic pressure (2.08 times) (p≤0.02) and glucose concentration (2.95 times) (p≤0.01). In subjects with BMI >30, as compared to those with BMI ≤24.9, the likelihood of high systolic pressure increased by 5.64 times (p≤0.02), that of high glucose concentration by 7.44 times (p≤0.01), and that of high total blood cholesterol by 2.04 times (p≤0.01).

In a study conducted in 2001 in a population of Warsaw citizens (Praga Północ and Praga Południe), the likelihood of developing ischaemic heart diseases was also evaluated with the use of logistic regression. It was estimated that the risk of ischaemic heart disease development is 2-fold higher in persons with BMI >25, as compared to individuals with correct BMI [Polakowska & Piotrowski, 2003].

The reported study demonstrated the occurrence of incorrect biochemical parameters (elevated concentration of total cholesterol, diminished concentration of HDL cholesterol, increased concentration of glucose in blood serum as well as increased systolic and diastolic pressure) with increasing BMI values, yet those correlations were not statistically significant.

Branca *et al*. [2001] observed also that the risk of civilization diseases was affected to the greatest extent by BMI values. The PROCAM study demonstrated a significant effect of overweight and obesity (increasing BMI) on the occurrence of improper concentrations of total cholesterol and its LDL fraction as well as arterial blood pressure [Schulte *et al*., 1999]. Hecker *et al*. [1999], in a cross study of women and men aged 30–50 years, emphasized the impact of high BMI on enhanced synthesis of endogenous cholesterol, which was observed to increase from 12 mg/kg in persons with correct BMI to 20 mg/kg of body mass in obese individuals.

The investigated group of women (n=592) was divided based on the risk of cardiovascular diseases estimated over the period of 10-year observation according to Framingham Point Scores [Grundy *et al*., 2001]. Table 4 depicts point division obtained by the women under scrutiny.

The reference group included 409 subjects characterised by the lowest risk of developing cardiovascular diseases within 10 years – estimated at about 1% (number of points: 0–12). A low risk of cardiovascular diseases, i.e. 2–3%, was reported in 102 women (number of points: 13–15). Women (n=56) with the number of points 16–19 were classified in a group of moderate risk of 5–8%. Finally, 25 women obtained >19 points and were classified in a high risk group of ischaemic heart disease (10–30% risk).

In the INTERSALT assay [acc. to Januszewicz, 2002], to reduce the effect of nutritional factors on the development of hypertension, a decrease in sodium intake from 170 mmol/day (10 g NaCl) to 70 mmol/day (4 g NaCl) and an increase in potassium intake from 50 mmol/day (3.7 g KCl) to 70 mmol/day (5.2 g KCl) were suggested. It was estimated that a decrease in body mass index from 25.0 to 23.0 and reduction of alcohol intake to 20-30 g ethanol/day was likely to cause a decline in arterial blood pressure by 5 mmHg. It is worth emphasizing that those changes in the nutritional pattern may lead to a decrease in total death rate of various causes in

TABLE 3. Likelihood of the occurrence of elevated indices of the circulatory system status and biochemical blood parameters in subjects with BMI in the following ranges: 24.9–27.5, and 27.5–30.0 and > 30 as compared with subjects with BMI ≤25 (n=592).

Parameter	Systolic blood pressure	Diastolic blood pressure	Total cholesterol	Total chol./chol.-HDL index**	Glucose
BMI >30	5.64* (p≤0.02)	1.45 (p≤0.11)	2.04* (p≤0.01)	1.07 (p≤0.71)	7.44* (p≤0.01)
BMI 27.5-30.0	1.35 (p≤0.55)	1.71* (p≤0.03)	1.26 (p≤0.42)	1.03 (p≤0.99)	1.81 (p≤0.40)
BMI 24.9–27.5	2.08* (p≤0.02)	1.36 (p≤0.09)	1.01 (p≤0.93)	1.66* (p≤0.03)	2.95* (p≤0.03)
BMI <24.9	1.0	1.0	1.0	1.0	1.0

p – significance level; * statistically significant; ** Total cholesterol/HDL-cholesterol index

TABLE 4. Estimated risk of the occurrence in a 10-year period of ischaemic heart disease in 40-year-old women (n=592) considering 5 risk factors (age, total cholesterol, nicotinism, HDL–cholesterol, systolic blood pressure).

Risk degree	No. of points acc. to Framingham Point Scores	No. of subjects	% of population	Risk in 10-year period (%)
Reference group	<9	231	39.10	< 1
	9	55	9.29	1
	10	47	7.94	1
	11	39	6.59	1
	12	37	6.25	1
Low risk	13	26	4.39	2
	14	48	8.11	2
	15	28	4.73	3
Mild risk	16	20	3.38	5
	17	17	2.87	5
	18	10	1.69	6
	19	9	1.52	8
High risk	20	11	1.86	11
	21	3	0.51	14
	22	5	0.84	17
	23	3	0.51	22
	24	1	0.17	27
	25	2	0.34	30

Poland by 7%, that of only cerebral stroke by 14%, and that of ischaemic heart disease by 9% [acc. to Cybulska, 2000].

Investigations carried out under the project Dietary Approaches to Stop Hypertension (DASH) demonstrated lower systolic blood pressure (by 7.11 to 11.5 mmHg on average) in subjects without hypertension and with a diet rich in fruits and vegetables, as compared to patients suffering from hypertension and with a lower intake of those products [Lin *et al*., 2003; Sacks *et al*., 2001].

The vast majority of the 40-year-old women examined have not demonstrated any distinct ailments of the cardiovascular system yet. Still, anthropometric analyses, measurements of blood pressure and biochemical blood analyses point only to the onset of metabolic disorders in a number of persons, which constitute the basis for development of cardiovascular diseases. Thus it is of utmost importance to elaborate and implement a prophylactic programme aimed, most of all, at rationalization of diet and change of lifestyle of the women examined, followed by appropriate medical care in the case of subjects with a distinct degree of risk.

CONCLUSIONS

1. Body Mass Index (BMI), determined biochemical parameters as well as blood pressure indicated the occurrence of numerous metabolic disorders in the group of women analysed (among others, overweight, obesity, hypercholesterolaemia, hyperglycaemia, inclination to arterial hypertension).

2. The strongest determinant, having a statistically signif-

icant impact on lipid parameters, glucose concentration and blood pressure, appeared to be BMI.

3. The likelihood of the occurrence of elevated systolic blood pressure, total cholesterol concentration and glucose level in blood serum was observed to increase several times with BMI values increasing from 20 to >30.

4. The risk of ischaemic heart disease estimated according to Framingham Point Scores over 10 years of observations was as high as 11-30% for 25 women, and 5-8% for 56 subjects.

5. The selection of individuals with elevated health risk out of the population of 40-year-old women examined should lead to prophylactic and educational actions aimed at that population.

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OCENA WYBRANYCH WSKAŹNIKÓW BIOCHEMICZNYCH, ANTROPOMETRYCZNYCH ORAZ SPOSOBU ŻYWIENIA 40-LETNICH KOBIET Z WROCŁAWIA

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Oceniono sposób żywienia 40-letnich kobiet (n=592), uczestniczek programu „Profilaktyka chorób sercowo-naczyniowych populacji 40--letnich mieszkańców Wrocławia" realizowanego pod patronatem Wydziału Zdrowia Urzędu Miejskiego we Wrocławiu. Zastosowano metodę wywiadu o spożyciu w ciągu 24 godzin oraz historię żywienia, obejmującą m.in. zwyczajową dzienną liczbę posiłków, częstotliwość spożywania produktów, upodobania żywieniowe. Badanym osobom wykonano także oznaczenia stężenia cholesterolu całkowitego, cholesterolu frakcji HDL oraz glukozy we krwi, mierzono ciśnienie krwi, a także obliczono wskaźnik masy ciała BMI.

Wykazano występowanie nadwagi u 27% badanych kobiet, otyłości u 10%, podwyższonego stężenia cholesterolu całkowitego we krwi u 51,7%, podwyższonego poziomu glukozy we krwi u 17% oraz podwyższonego ciśnienia skurczowego u 15%. W ocenie statystycznej wykazano istotny, niekorzystny wpływ wskaźnika BMI na ciśnienie krwi oraz niektóre wskaźniki lipidowe.

Dla badanej grupy kobiet (n=592) oszacowano również, według kryteriów Framingham Heart Study ryzyko zachorowania na choroby układu krążenia w ciągu 10 lat obserwacji; wysokie ryzyko – 11 – 30% wykazano u 25 kobiet.