

# Metabolic syndrome in peri- and postmenopausal women performing intellectual work

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## Abstract

**Introduction.** Metabolic Syndrome is a set of interrelated risk factors for the emergence and progression of cardiovascular disease and diabetes, such as central obesity (abdominal), elevated blood pressure and disorders of carbohydrate and lipid metabolism.

Peri- and postmenopausal women are particularly at risk for developing MS by the aging and loss of the protective effect of estrogen on the body, additionally by intellectual work associated with a sedentary lifestyle and job stress.

**Objective.** The aim of the study was to analyze the frequency of MS and its criteria in perimenopausal and postmenopausal women performing intellectual work, as well as selected factors on which the metabolic syndrome depends.

**Materials and method.** The study group consist of 300 women aged 44–66 working intellectually. Research methods used: metabolic syndrome's criteria, Greene Climacteric Scale, body fat accumulation, medical interview. Statistical methods used: logistic regression analysis, analysis of variance,  $\chi^2$  test of stochastic independence.

**Results.** The MS was diagnosed in about ¼ of the women in perimenopausal and postmenopausal period working intellectually; in most of them, abdominal obesity (¾), in more than a half hypertension, in every sixth hypertriglyceridaemia, in every seventh hyperglycaemia and in every tenth low HDL-C. Prevalence of MS and its criteria was correlated with BMI, body fat accumulation and parity. Prevalence of arterial hypertension was associated with the severity of menopausal symptoms and lack of physical activity.

**Conclusions.** Prevalence of MS and some of its criteria depended on BMI, body fat accumulation, parity, severity of menopausal symptoms and lack of physical activity, whereas it did not depend on: age between 44–66, educational level, marital status or HRT taking.

## Key words

menopause, metabolic syndrome, intellectual work

## INTRODUCTION

Metabolic Syndrome (MS, X Syndrome, Raeven Syndrome, Insulin Resistance Syndrome) is a set of interrelated risk factors for the emergence and progression of cardiovascular disease and diabetes, such as central obesity (abdominal), elevated blood pressure and disorders of carbohydrate and lipid metabolism.

Etiopathogenesis of metabolic syndrome is complex and not fully understood. Its inception may result from: aging, too little physical activity, unhealthy diet or foetal programming [1]. However, according to the latest scientific data, the most important role in the pathogenesis of MS is played by insulin resistance and obesity (especially abdominal obesity). A somewhat lower, but also important role is played by oxidative stress and inflammatory factor [2, 3].

MS predisposes to early organ damage, such as left ventricular hypertrophy, microalbuminuria, increased

stiffness of arteries, thickening of the intima-media carotid arteries and impaired endothelial function. It also enhances the prothrombotic state, which increases the risk of venous thrombosis and/or pulmonary embolism [1]. MS increases the risk of developing diabetes (3–6-fold), as well as cardiovascular events and death, regardless of the cause (approximately 2-fold). The risk of sudden cardiovascular events is increased in people with MS, cardiovascular disease or type 2 diabetes, compared to healthy subjects. It is currently believed that one metabolic disorder in MS increases the severity of one or more associated disorders [4].

Metabolic disorders: arterial hypertension, dyslipidaemia, obesity and diabetes, as well as improper diet, smoking and low physical activity, are major risk factors for cardiovascular disease. There are, however, differences in the frequency of occurrence of individual risk factors, dependent on the gender. In women, for example, abdominal obesity is more common (on average 41% vs. 28%), but cigarette smoking less (approximately 25% vs 42%).

The strength of association between the occurrence of a specific risk factor and development of cardiovascular disease also differs in the two genders. An example is diabetes, which increases the risk of coronary heart disease more commonly

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in women than in men [5]. Several risk factors cited above are common to the development of cardiovascular disease and type 2 diabetes. These are: obesity, hypertension, low HDL, elevated levels of TG, impaired glucose tolerance. They are also components of the Metabolic Syndrome (MS) [6]

Peri- and postmenopausal women are particularly at risk of developing MS, first by aging and secondly, by loss of the protective effect of estrogen on the body. Moreover, the risk of MS may grow due to environmental factors, such as intellectual work usually associated with a sedentary lifestyle and job stress.

## OBJECTIVES

The aim of this study was to analyze the frequency of MS and its criteria in perimenopausal and postmenopausal women performing intellectual work, as well as selected factors on which metabolic syndrome depends.

## MATERIALS AND METHOD

**Study group.** The study was conducted among women aged 44–66 at the Institute of Rural Health in Lublin, and covered 300 women who performed intellectual work in various institutions. The criteria of exclusion were: education lower than secondary, chronic diseases, addictions, diagnosed mental disease in medical history.

The medical examination for the presence and treatment of arterial hypertension, type 2 diabetes, dyslipidaemia, as well as body weight and height measurements, were conducted in the studied women. In addition, the respondents were asked about age, educational level, place of residence, marital status, parity, HRT application, age at the last menstrual period and physical activity level. Blood pressure and waist circumference were measured and blood collected to measure FSH and glucose concentration in the serum and lipid profiles.

The examined women were divided into 3 groups according to their reproductive status:

- 1) women at the early peri-menopausal period: menstruating, with FSH below 20 mIU/ml;
- 2) women at the late peri-menopausal period: menstruating, with FSH 20 mIU/ml and over;
- 3) women at the postmenopausal period: not menstruating for at least 12 months.

**Body fat accumulation.** Measurements of adipose tissue were performed using electronic Body Fat Gauge equipment 'Take it easy' of the 'Finesse' company. The deposits were measured at 3 places of the body: thigh, biceps and abdominal fold. The percentage of body fat was compared to the set standard [7].

**Greene Climacteric Scale.** In all the women, the degree of intensity of menopausal symptoms was assessed using the Greene Climacteric Scale [8]. The respondents provided answers according to the scale from 0–3 to 20 questions concerning the occurrence of the following:

- 1) heart palpitations;
- 2) feeling of tension or nervousness;
- 3) sleep disorders;
- 4) irritation;

- 5) episodes of panic;
- 6) difficulties with concentration;
- 7) feeling of fatigue or lack of energy;
- 8) loss of interests;
- 9) feeling of sadness, depression;
- 10) episodes of spasms;
- 11) irritability;
- 12) dizziness and syncope episodes;
- 13) feeling of tension, pressure in the head;
- 14) numbness and tingling;
- 15) headaches;
- 16) sensory loss in the palms and feet;
- 17) osteoarticular pain;
- 18) breathing difficulties;
- 19) hot flushes and 20) night sweats.

Subsequently, the scores were calculated for 3 subscales:

- subscale of psychological symptoms; results summed-up from questions 1–11;
- subscale of somatic symptoms; results summed-up from questions 12–18;
- subscale of vasomotor symptoms; results summed-up from questions 19–20.

**Definition of Metabolic Syndrome (MS).** In order to diagnose MS, defined according to the International Diabetes Federation in 2005, it is necessary to find 3 of 5 abnormalities:

- 1) abdominal obesity (waist circumference  $\geq 80$  cm in women);
- 2) hypertriglyceridaemia (triglyceride  $\geq 150$  mg/dl or current use of medication treatment for dyslipidaemia);
- 3) low HDL-C (HDL-C  $< 50$  mg/dl in women or current use of medication treatment for dyslipidaemia);
- 4) arterial hypertension (systolic blood pressure  $\geq 130$  mm Hg or diastolic blood pressure  $\geq 85$  mm Hg or current use of antihypertensive medication);
- 5) hyperglycaemia (blood glucose level with empty stomach  $\geq 100$  mg/dl or current use of medication for type 2 diabetes).

**Statistical analysis.** The results were statistically analysed by SAS System software. Mean values ( $M$ ) were calculated, with standard deviations ( $SD$ ) estimated for continuous variables, and absolute ( $n$ ) and relative numbers (%) of occurrence of items for categorical variables.  $F$  test analysis of variance was used to compare continuous variables, and  $\chi^2$  test to compare categorical variables between women in the 3 periods of reproductive life.

Logistic regression and estimated odds ratios (OR) were used to compare the prevalence of MS and its criteria between the women exposed and unexposed to selected risk factors.

The value of  $p < 0.05$  was considered as a significant difference.

Informed consent for participation in the study was obtained from the women. The study was approved by the Ethics Committee in the Institute of Rural Medicine in Lublin, Poland.

## RESULTS

**Characteristics of the study group.** A total of 300 women were examined, including 100 (i.e. 33.33% of respondents) in

**Table 1.** Characteristics of the examined women

Characteristics	Total women (N=300)	Early peri-menopausal women (N=100)	Late peri-menopausal women (N=43)	Post-menopausal women (N=157)	p
Age (years), M±SD	53.1±4.8	48.6±2.7	51.6±3.3	56.4±3.4	
44–49, n (%)	89 (29.7)	69 (69.0)	13 (30.2)	7 (4.5)	<0.001
50–54	86 (28.7)	26 (26.0)	23 (53.5)	37 (23.6)	
55–59	94 (31.3)	5 (5.0)	6 (14.0)	83 (52.8)	
60–66	31 (10.3)	0 (0.0)	1 (2.3)	30 (19.1)	
Educational level, n (%)					
secondary	106 (35.3)	24 (24.0)	11 (25.6)	71 (45.2)	0.001
tertiary	194 (64.7)	76 (76.0)	32 (74.4)	86 (54.8)	
Place of residence, n (%)					
city	191 (63.7)	62 (62.0)	30 (69.7)	99 (63.1)	0.920
town	61 (20.3)	22 (22.0)	7 (16.3)	32 (20.4)	
rural area	48 (16.0)	16 (16.0)	6 (14.0)	26 (16.5)	
Marital status, n (%)					
married	232 (77.3)	75 (75.0)	29 (67.4)	128 (81.5)	0.124
never married	22 (7.3)	12 (12.0)	3 (7.0)	7 (4.5)	
divorced	28 (9.3)	8 (8.0)	8 (18.6)	12 (7.6)	
widowed	12 (4.0)	3 (3.0)	3 (7.0)	6 (3.8)	
separated	6 (2.0)	2 (2.0)	0 (0.0)	4 (2.6)	
BMI (kg/m <sup>2</sup> ), M±SD	26.2±4.6	26.4±5.2	25.5±4.3	26.4±4.4	
underweight, n (%)	1 (0.3)	1 (1.0)	0 (0.0)	0 (0.0)	0.493
normal	131 (43.7)	44 (44.0)	22 (51.2)	65 (41.4)	
overweight	118 (39.3)	41 (41.0)	13 (30.2)	64 (40.8)	
obese	50 (16.7)	14 (14.0)	8 (18.6)	28 (17.8)	
Fat accumulation in the body (%), M±SD	30.1±6.1	29.3±6.3	30.3±5.8	30.5±6.1	
very low	6 (2.0)	3 (3.0)	1 (2.3)	2 (1.3)	0.342
low	19 (6.3)	7 (7.0)	2 (4.7)	10 (6.4)	
optimal	153 (51.0)	48 (48.0)	21 (48.8)	84 (53.5)	
elevated	58 (19.3)	20 (20.0)	8 (18.6)	30 (19.1)	
high	64 (21.3)	22 (22.0)	11 (25.6)	31 (19.8)	
Parity – yes, n (%)	269 (89.7)	88 (88.0)	37 (86.1)	144 (91.7)	
Greene Climacteric Scale, M±SD					
psychological symptoms	9.5±6.7	8.4±6.3	9.7±7.3	10.2±6.7	0.114
somatic symptoms	4.9±3.8	4.5±3.6	5.0±3.9	5.1±4.0	0.452
vasomotor symptoms	1.7±1.9	0.9±1.4	2.0±1.8	2.1±1.9	<0.001
HRT- yes, n (%)	8 (8.0)	4 (9.3)	35 (22.3)	47 (15.6)	0.004
Physical activity, n (%)					
yes	49 (16.3)	11 (11.0)	6 (14.0)	32 (20.4)	0.178
rather yes	117 (39.0)	45 (45.0)	14 (32.6)	58 (36.9)	
rather no	94 (31.3)	33 (33.0)	13 (30.2)	48 (30.6)	
no	40 (13.3)	11 (11.0)	10 (23.3)	19 (12.1)	

p – Student t test for continuous variables or  $\chi^2$  test for categorical variables

the early perimenopausal period, 43 (i.e. 14.33%) in the late perimenopausal and 157 (i.e. 52.33%) in the postmenopausal period.

The examined women in the perimenopausal period were the youngest, in late perimenopausal period – older, and in postmenopausal period – the oldest. About ¾ of the women examined in early and late perimenopausal periods had completed tertiary education, whereas fewer (slightly above half) of those in the postmenopausal period were university graduates.

HRT was taken most commonly by the examined women in late perimenopausal period, less commonly – in the postmenopausal period and the least commonly – in those in the early perimenopausal period.

The women examined in the late perimenopausal and postmenopausal periods had more severe vasomotor menopausal symptoms compared to those in early perimenopausal period.

The place of residence, marital status, BMI, fat accumulation, parity, physical activity level and severity of

psychological and somatic menopausal symptoms, did not differ significantly between the examined women in the 3 periods of reproductive life.

Most of the examined women lived in a city, were married, had BMI above normal and the optimal fat accumulation, bore at least one child and tended to be physically active. Their severity of psychological and somatic menopausal symptoms oscillated between the results for the general population of women and the model for menopausal women.

**Characteristics of MS.** MS was diagnosed in 23.7% of the women examined and most of the women met 3 criteria, fewer – 4 criteria, and the fewest – all 5 criteria (Tab. 2). MS prevalence did not differ significantly between the 3 periods of reproductive life ( $p=0.616$ ). Also, the prevalence of each of the 5 MS criteria did not differ significantly between the 3 periods of reproductive life (Tab. 3). ¾ of the tested women had abdominal obesity, every sixth – hypertriglyceridaemia, every tenth – low HDL-C, over a half – arterial hypertension, every seventh – hyperglycaemia.

**Table 2.** Number of MS criteria in the examined women

No. of MS criteria	Total women (N=300)		Early peri-menopausal women (N=100)		Late peri-menopausal women (N=43)		Post-menopausal women (N=157)	
	n	%	n	%	n	%	n	%
0–2	229	76.3	73	73.0	33	76.7	123	78.3
0	41	13.7	18	18.0	5	11.6	18	11.5
1	86	28.7	24	24.0	15	34.9	47	29.9
2	102	34.0	31	31.0	13	30.2	58	36.9
3–5	71	23.7	27	27.0	10	23.3	34	21.7
3	53	17.7	20	20.0	8	18.6	25	15.9
4	16	5.3	7	7.0	2	4.7	7	4.5
5	2	0.7	0	0.0	0	0.0	2	1.3

**Table 3.** MS characteristics in the examined women

Criteria	Total women (N=300)		Early peri-menopausal women (N=100)		Late peri-menopausal women (N=43)		Post-menopausal women (N=157)		p
	n	%	n	%	n	%	n	%	
Abdominal obesity	225	75.0	72	72.0	28	65.1	125	79.6	0.105
Hypertri-glyceridaemia	50	16.7	19	19.0	8	18.6	23	14.7	0.616
Low HDL-C	34	11.3	17	17.0	3	7.0	14	8.9	0.085
Arterial hypertension	171	57.0	53	53.0	25	58.4	93	59.2	0.608
Hyperglycaemia	43	14.3	13	13.0	9	20.9	21	13.4	0.409

**Prevalence of MS and its criteria acc. to selected risk factors.** MS and all 5 of its criteria occurred more frequently in the examined women with a higher BMI, and greater accumulation of body fat (with the exception of low HDL-C by the accumulation of fat tissue).

MS and hyperglycaemia were present more than twice as frequently in the women who never had given birth, compared to those who had given birth.

Arterial hypertension occurred more often in the examined women with more severe psychological, somatic

and vasomotor menopausal symptoms, as well as in those who were not physically active.

Women living in cities more often had low HDL-C than those living in the country.

The prevalence of MS and its criteria did not depend on: age between 44–66, educational level, marital status and HRT use.

## DISCUSSION

The results obtained confirm a significant prevalence of MS in peri- and postmenopausal women – diagnosed in 23.7% of the examined women.

According to the study by NATPOL PLUS in 2002, the MS criteria were met by 10 million Poles [9]. However, another study by NATPOL in 2011 showed that in the last decade the percentage of obese people and people with diabetes or at risk of diabetes had risen even higher.

The main disturbance in the surveyed peri- and postmenopausal women performing mental work was abdominal obesity – 75% of the women.

According to the study by NATPOL PLUS, 48% of Polish women are overweight or obese [9], and Stachowiak estimated that as many as 2/3 of postmenopausal women are overweight or obese [2]. The presented study highlights an even higher percentage of women with weight above normal.

Abdominal obesity, regardless of the BMI > 30, is the strongest predictor for coronary heart disease and type 2 diabetes [10]. Despres believes that the accumulation of fat in the abdomen is a key factor for diabetic (increased insulin resistance), atherogenic, prothrombotic and inflammatory disorders, thereby increasing the risk of developing type 2 diabetes and cardiovascular disease [11]. Ueno et al. also argue that too high BMI or too large waist circumference leads to insulin resistance and diabetes type 2 [12].

The second in the order of significance metabolic disorders occurring in the surveyed women was hypertension – diagnosed in 57%. Hypertension is a major risk factor for heart attack, heart failure and stroke. According to the study by NATPOL in 2011, hypertension applies to 32% of people in Poland. Considering the gender, hypertensive disease

**Table 4.** Prevalence of MS and its criteria acc. to risk factors in the examined women

Risk factors	MS		abdominal obesity		hypertri-glyceridaemia		low HDL-C		arterial hypertension		hyperglycaemia	
	OR	p	OR	p	OR	p	OR	p	OR	p	OR	p
Age (years)	0.967	0.219	1.027	0.377	0.952	0.135	0.931	0.072	1.019	0.434	1.002	0.935
Educational level, secondary vs. tertiary	1.076	0.795	1.219	0.486	0.932	0.829	1.738	0.132	1.399	0.174	1.234	0.534
Place of residence, urban vs. rural	0.558	0.089	0.757	0.468	1.000	1.000	0.400	0.027	0.937	0.839	0.806	0.615
Marital status, single vs. married	1.627	0.113	0.746	0.340	1.593	0.177	1.494	0.321	1.019	0.947	1.815	0.098
BMI (kg/m <sup>2</sup> )	1.244	<0.001	1.953	<0.001	1.091	0.005	1.109	0.003	1.270	<0.001	1.150	<0.001
Body fat accumulation (%)	1.128	<0.001	1.213	<0.001	1.065	0.014	1.041	0.169	1.107	<0.001	1.069	0.013
Parity, no vs. yes	2.627	0.014	1.437	0.446	1.227	0.672	1.592	0.377	1.421	0.374	2.326	0.050
Greene Climacteric Scale – psychological symptoms	1.011	0.604	1.030	0.158	0.988	0.606	1.036	0.178	1.067	0.001	0.984	0.515
– somatic symptoms	1.054	0.126	1.064	0.095	1.005	0.898	1.041	0.380	1.135	<0.001	1.055	0.193
– vasomotor symptoms	0.995	0.945	1.089	0.257	0.921	0.351	0.952	0.629	1.129	0.050	1.046	0.608
HRT, no vs. yes	0.887	0.743	0.902	0.783	0.516	0.080	2.048	0.253	1.329	0.372	1.485	0.434
Physical activity, no vs. yes	1.022	0.938	1.037	0.893	0.720	0.300	1.115	0.767	1.614	0.044	1.356	0.356

has affected more than 80% of women aged over 60. It is believed that an increase in systolic blood pressure of 20 mm Hg in the age group 40–69 years is associated with a 2-fold increased risk of death from stroke, coronary heart disease and cardiovascular disease [13; 10].

The development of hypertension after menopause is induced by, among others, activation of the renin-angiotensin-aldosterone system, the adrenergic system and increased levels of endothelin, and dominance of the sympathetic nervous system [14; 15]. In the process of developing hypertension, an important role is also played by hyperinsulinaemia which, by enhancing feedback re-absorption of sodium in the renal tubules, leads to stimulation of sympathetic nervous system, proliferation of vascular smooth muscle and an increase in plasma renin activity [13].

Zafirir regards hypertension as the main culprit for most of the circulatory system diseases as it involves 59% of people suffering from various cardiovascular diseases. Next in order, according to the author, are obesity and smoking (33%), while type 2 diabetes only occurs in 24% of patients [16]. On the other hand, according to Oh, hypertension and diabetes are the 2 main risk factors for developing cardiovascular disease. However, hypertension is associated with increased mortality from these diseases more than diabetes [17].

Atherogenic dyslipidaemia is a characteristic set of lipid disorders in the course of MS. Among the respondents, however, dyslipidaemia occurred much less frequently than abdominal obesity and arterial hypertension. Elevated TG affected 16.7% of the women and too low concentrations of HDL were found in 11.3%.

It is recognized that hypercholesterolaemia and low HDL-C, and to a lesser extent, hypertriglyceridaemia, increase the risk of cardiovascular disease. According to the WOBASZ study, respectively in men and women in Poland, elevated total cholesterol (TC) occurs in 67% and 64%, increased levels of LDL-C of 60% and 55%, hypertriglyceridaemia in 32% and 20%, and low HDL – C concentration in 15% and 17% [18]. Stachowiak, based on his own data, indicates that 72% of women in menopause have compared to 2002, but still more than a half of adult Poles have cholesterol levels above 190 mg / dl. Additionally worrying is the increased concentration of TC and 15% increased TG concentration [2].

According to the study by NATPOL in 2011, the percentage of people with high cholesterol has decreased, although more than a half of adult Poles still have a cholesterol level above 190 mg/dl (of approx. 18 million Poles with hypercholesterolaemia up to 10.8 million are unaware of this fact [10].

Impaired fasting glucose or type 2 diabetes took the fourth place among metabolic disorders in the studied peri- and postmenopausal women – found in 14% of the women.

Diabetes is the most common chronic disease in the developed countries and affects 7–8% of women in Europe and North America. The ICZMP (Polish Mother's Memorial Hospital Research Institute) data indicate that the occurrence of glucose intolerance and diabetes in the Polish women aged 45–65 years reaches 8% and 4.8%, respectively [2]. The essence of diabetes disorder is tissue insulin resistance which will promote dyslipidaemia, obesity, hypertension, atherosclerosis, and estrogen dependent tumours [2]. Diabetes type 2 is considered to be an independent risk factor for coronary heart disease, increasing the risk of this disease four-fold [13].

According to Gholi, not only diabetes, but also pre-diabetes (IFG) is associated with an increased risk of cardiovascular disease. Pre-diabetes is defined as a fasting glucose (IFG) 100–125 mg / dl or as impaired glucose tolerance – glucose 2 hours after a meal (IGT) 140–199 mg / dl. It is recognized that IFG is strongly associated with an increased risk of cardiovascular disease and overall mortality [ADA; 2004]. According to the author, obesity, dyslipidaemia, and spikes in blood pressure may contribute to the development of IFG and cardiovascular disease [6].

## CONCLUSIONS

1. In about ¼ of the women in perimenopausal and postmenopausal period working intellectually, MS was diagnosed, in most of them abdominal obesity (¾), in more than a half – hypertension, in every sixth – hypertriglyceridaemia, in every seventh – hyperglycaemia and in every tenth – low HDL-C.
2. Prevalence of MS and its criteria was correlated with BMI, body fat accumulation and parity.
3. Prevalence of arterial hypertension was associated with the severity of menopausal symptoms and lack of physical activity.
4. Prevalence of MS and its criteria did not depend on: age between 44–66, educational level, marital status or HRT taking.
5. Education on MS prevention and how to deal with it are needed, once it occurs, so that the psycho-physical comfort of women is not disturbed.

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