

ORIGINAL ARTICLE

Blood pressure and cholesterol control in patients with hypertension and hypercholesterolemia: the results from the Polish multicenter national health survey WOBASZ II

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ABSTRACT

INTRODUCTION Persons with multiple risk factors of cardiovascular disease (CVD) are at a greater risk than persons exposed to a single risk factor. Control of specific risk factors of CVD in Poland is rather poor. Effective control of comorbid hypertension and hypercholesterolemia seems especially challenging. **OBJECTIVES** The aim of the study was to assess the control of hypertension and hypercholesterolemia in patients with both hypertension and hypercholesterolemia; data from the Polish multicenter national health survey, WOBASZ II, were analyzed.

PATIENTS AND METHODS The WOBASZ II study was a cross-sectional survey conducted from 2013 to 2014 in 6170 people (3410 women and 2760 men) from all 16 Polish voivodships.

RESULTS Age-standardized prevalence of coexisting hypertension and hypercholesterolemia in WOBASZ II sample was 34.6%. The prevalence of hypercholesterolemia in participants with hypertension was 69.7%. Age-standardized rates of control of hypertension, hypercholesterolemia, and both hypertension and hypercholesterolemia in the entire analyzed age range of 19 to 99 years was 24.3%, 11.2%, and 5.4%, respectively. In multivariable logistic regression models, control of both hypertension and hypercholesterolemia was associated with smoking (odds ratio [OR], 0.5; 95% CI, 0.34–0.76), cardiovascular disease (OR, 2.25; 95% CI, 1.70–2.97), frequent medical visits (OR, 1.76; 95% CI, 1.33–2.32), and high education level (OR, 1.37; 95% CI, 1.03–1.80).

CONCLUSIONS Comorbid hypertension and hypercholesterolemia were observed in one-third of the Polish population (included in WOBASZ II study). Only 5.4% have both risk factors controlled. After adjustment for covariates, female sex, nonsmoking, comorbid CVD or diabetes, the frequency of medical visits, and high level of education appeared to increase the proportion of controlled hypertension or hypercholesterolemia.

WHAT'S NEW?

This is the first study based on the latest and largest Polish epidemiological WOBASZ II survey regarding the prevalence of hypercholesterolemia and hypertension in the Polish population, the prevalence of hypercholesterolemia in patients with hypertension, control of blood pressure and cholesterol levels, and factors affecting this control.

INTRODUCTION In the Polish population, according to the WOBASZ II (Multicenter National Population Health Examination Survey; Polish, Wieloośrodkowe Ogólnopolskie Badanie Stanu Zdrowia Ludności), the prevalence of hypertension in adults above 20 years of age is 46% and 40% and the prevalence of dyslipidemia is 70% and 64.3% in men and women, respectively.^{1,2}

In the 2011 Polish NATPOL (Arterial hypertension and other CVD risk factors in Poland; Polish, Nadciśnienie Tętnicze oraz inne czynniki ryzyka chorób serca i naczyń w Polsce) study, in the general population aged 18 to 79 years, the prevalence of hypercholesterolemia was estimated at 61.1% and the efficacy of treatment (achieving total cholesterol [TC] <4.9 mmol/l) at 10.9%.³ In POLFOKUS, another Polish study, elevated level of low-density lipoprotein cholesterol (LDL-C) was observed in 49.2%, 61.6%, and 61.5% patients with controlled, uncontrolled, and resistant hypertension, respectively.⁴ The prevalence of other modifiable risk factors for cardiovascular disease in the WOBASZ II study population was described elsewhere.⁵⁻⁸

The Framingham study showed that the incidence of CVD increases 2- to 3-fold in patients with hypertension—with the highest risk of stroke, heart failure, and all forms of coronary heart disease (CHD): angina pectoris, myocardial infarction, sudden cardiac death. In patients aged 40 to 69 years, mortality due to stroke or CHD doubled with each increase in systolic blood pressure (SBP) of 20 mm Hg and diastolic blood pressure (DBP) of 10 mm Hg.⁹ A relationship with CVD risk was seen in a wide range of TC and LDL-C concentrations. This applies to men and women, both with and without diagnosed CVD.¹⁰ It has been proved that changes in SBP in the range of 110 to 170 mm Hg are associated with an approximately 6-fold increase in CHD risk. Similarly, an increase in TC level in the range of 4.0 to 8.0 mmol/l results in an approximately 8-fold increase in the risk of CHD. And an increase in the range of 110 to 170 mm Hg SBP and 70 to 105 mm Hg DBP also increases the risk of stroke nearly 8-fold.¹¹ The implementation of antihypertensive treatment reduces the risk of CHD by approximately 25%.¹² The inclusion of lipid-lowering treatment in patients with hypertension reduces the residual risk of CHD by more than 35%,¹³ as confirmed by the AFCAPS/TexCAPS (Air Force/Texas Coronary Atherosclerosis Prevention Study)¹⁴ and the ASCOTLLA (AngloScandinavian Cardiac Outcomes Trial-Lipid Lowering Arm) study.¹⁵

Patients with multiple CVD risk factors are at higher risk of incident CVD than persons exposed to only 1 risk factor. The CVD risk resulting from concomitant hypertension and hypercholesterolemia is typically greater than the sum of risk from individual exposure to hypertension or hypercholesterolemia alone.^{16,17} It was found that in patients with hypertension and concomitant hyperlipidemia, the risk of CVD doubles, and in patients with normal cholesterol levels, the coexistence of hypertension results in a 3-fold increase in the risk of CVD.¹⁴ In people with SBP of 195 mm Hg and TC level of 8.5 mmol/l, the risk of CVD increases as much as 9-fold.¹⁸ Data on men aged 35 to 64 years from the POL-MONICA (Polish part of the Monitoring of Trends and Determinants in Cardiovascular Disease) study showed that the coexistence of hypertension and hypercholesterolemia increases the risk of death caused by CHD over 4.5-fold.¹⁹ The assessment of the overall cardiac risk can be made using the Systematic Coronary Risk Evaluation (SCORE) tables. For example, in the Polish population, a nonsmoking 70-year-old man with SBP of 180 mm Hg and TC of 8 mmol/l has a 50% risk of cardiovascular death within 10 years, and, respectively, with SBP of 120 mm Hg and TC of 4 mmol/l, only 10%.²⁰

Results of the analyses in the Polish population published so far do not indicate to what extent exposure to hypertension and hypercholesterolemia occurs in the same person.

The objectives of the study were: 1) to assess the prevalence of comorbid hypertension and hypercholesterolemia in participants of the nationwide WOBASZ II study; 2) to assess the prevalence of hypercholesterolemia in the Polish hypertensive population; 3) to evaluate the control of blood pressure and cholesterol levels in patients with hypertension and hypercholesterolemia; and 4) to assess the factors related to the control.

PATIENTS AND METHODS The WOBASZ II study was a cross-sectional survey conducted from 2013 to 2014 in 6170 people (3410 women and 2760 men) from all 16 voivodships (108 communes) in Poland. The reporting rate was 45.5%. The sampling method used a 3-stage scheme, stratified by voivodship, commune category, and sex. The study was approved by the Ethics Committee at the Institute of Cardiology in Warsaw, Poland (no. 1344). Each respondent was informed in writing about the purpose of the study and the range of activities (including blood pressure measurements and blood collection for laboratory tests). All participants signed informed consent form. The study methods have been presented in detail elsewhere.²¹ Blood pressure was measured 3 times in 1 visit in a sitting position in accordance with the 2013 European Society of Cardiology/European Society of Hypertension guidelines²² and the 2015 Polish Society of Hypertension²³ guidelines. An UA631(AND Co., Tokyo, Japan) automatic device was used. The mean

of the second and third measurements was used for analysis. Clinical chemistry tests were performed at the Central Laboratory “Diagnostyka” at the Institute of Cardiology in Warsaw, which has been certified by the Centre for Disease Control – Lipid Standardization Program in Atlanta, United States, and has the European quality certificate, Random International Quality Assessment Scheme. The sequence of procedures was as follows: first, blood pressure measurements were performed, then the survey was taken, and finally, blood was collected for laboratory tests. Details of the methodology for measuring blood pressure, blood collection, and clinical chemistry tests have been described elsewhere.^{1,2}

Hypertension was defined as SBP of 140 mm Hg or higher, or DBP of 90 mm Hg or higher, or use of blood pressure-lowering medication (regularly for the last 2 weeks). Hypercholesterolemia was diagnosed if TC levels were 5 mmol/l or higher, or LDL-C levels were 3 mmol/l or higher, or the participant was taking a lipid-lowering medication (regularly for the last 2 weeks). Treated hypertension was defined as patients with hypertension who reported taking medication for high BP (affirmative response to the question, “Have you taken these medicines regularly during the last 2 weeks?”). Treated hypercholesterolemia was defined as patients who reported taking medication for high cholesterol level (affirmative response to the question, “Have you taken these medicines regularly during the last 2 weeks?”). Controlled hypercholesterolemia was defined as patients with hypercholesterolemia who had TC of less than 5 mmol/l and LDL-C of less than 3 mmol/l for people with intermediate or low cardiovascular risk; LDL-C of less than 2.5 mmol/l for people with high CVD risk; LDL-C of less than 1.8 mmol/l for people with very high CVD risk. The target treatment thresholds have been adopted according to risk categories based on the 2016 European guidelines for CVD prevention in clinical practice.²⁴ Controlled hypertension was defined as patients with hypertension who had SBP of less than 140 mm Hg and DBP of less than 90 mm Hg. CVD risk was assessed according to the SCORE risk charts as follows: less than 1%, low risk; from 1% up to 5%, intermediate risk; from 5% up to 10%, high score; 10% and higher, very high risk. Diabetes was defined as patients who gave an affirmative response to the question, “Have you ever been diagnosed with diabetes?” or those taking a hypoglycemic medication (regularly for the last 2 weeks). Smoking was defined as at least 1 cigarette per day. Comorbid CVD was defined as previously diagnosed coronary artery disease, past myocardial infarction, myocardial revascularization, previous stroke, peripheral atherosclerosis. Physical activity was defined as at least 30 minutes of uninterrupted activity, for example, a walk, gymnastic exercises at least 4 d/wk. Alcohol drinkers were defined as patients who gave an affirmative response to the question, “Have you drunk any vodka, wine

or beer in the last 12 months at least once?” High education was defined as more than vocational education. Obesity was defined as body mass index (BMI) of 30 kg/m² or higher; overweight, as BMI of 25 to 30 kg/m²; and normal weight, as BMI of less than 25 kg/m². High income per person in the household of more than 1000 PLN (>250 EUR).

Statistical analyses Continuous variables such as blood pressure values and age were presented as arithmetic mean (95% CI). Concentrations of TC, LDL-C, HDLC, and TG were presented as median and (95% CI). Qualitative variables were presented as percentages (95% CI). Crude prevalence of hypertension and hypercholesterolemia, and the prevalence of both hypertension and hypercholesterolemia control were described as percentages (95% CI) for the following age ranges 20 to 49, 50 to 59, 60 to 69, 70 to 79, and 80 years and older. The results were standardized²⁵ for age of the Polish population based on data from the Central Statistical Office report of December 31, 2014. The standardization method has been described in detail earlier.²¹ The prevalence of the analyzed features was compared using the χ^2 test for trend. The influence of various parameters (age, sex, BMI, diabetes, HDL-C concentration, TG concentration, smoking, alcohol consumption, education, physical activity, coexisting CVD, marital status, the SCORE, number of visits and income) on the control of blood pressure, hypercholesterolemia, and simultaneous control of both blood pressure and hypercholesterolemia was evaluated by univariate logistic regression. The influence of selected parameters on the control of hypertension, hypercholesterolemia, and simultaneous control of both hypertension and hypercholesterolemia was evaluated by multivariable logistic regression with adjusted odds ratios. The logistic regression model took into account the simultaneous influence of age (increase by 10 years), HDL-C and TG concentrations (increase by 1mmol/l) as well as sex, diabetes, obesity, smoking, coexistence of other cardiovascular diseases, frequency of visits (<4 visits a year vs \geq 4 visits a year), level of education (vocational education vs secondary and higher), and income (above 1000 PLN vs below 1000 PLN). All statistical tests were 2-tailed, and significance was accepted for *P* values of less than 0.05. The statistical analysis was performed with Statistica 12.5 (StatSoft Inc., Tulsa, Oklahoma, United States), Excel (Microsoft Corp., Seattle, Washington, United States), and PQStat (PQStat Software, Poznań, Poland).

RESULTS The analysis included 5939 participants aged 19 to 99 years (2647 men and 3292 women). A total of 231 people with no measurements of blood pressure or cholesterol levels were excluded from the analysis. Mean (SD) age was 49.5 (16.3) years (men, 48.9 [16.3] years; women, 50.0 [16.3] years).

TABLE 1 Descriptive characteristics of participants with hypertension and hypercholesterolemia in WOBASZ II Study

Variable	Hypertension and hypercholesterolemia	
Age, y, mean (95% CI); n	58.8 (58.2–59.3); 2037	
Male sex, mean (95% CI); n	48.3 (45.1–51.4); 982	
BMI kg/m ² , % (95% CI); n	17.3 (13.4–21.3); 353	
SBP, mm Hg, mean (95% CI); n	144.7 (143.8–145.5); 2037	
DBP, mm Hg, mean (95% CI); n	86.2 (85.7–86.7); 2037	
TC, mmol/l, median (95% CI); n	5.6 (5.5–5.6); 2012	
LDL-C, mmol/l, median (95% CI); n	3.5 (3.4–3.6); 2008	
HDL-C, mmol/l, median (95% CI); n	1.4 (1.3–1.4); 2009	
TG, mmol/l, median (95% CI); n	1.5 (1.4–1.6); 2010	
Hypertension treatment, % (95% CI); n	59 (56.2–61.7); 1201	
Hypercholesterolemia treatment, % (95% CI); n	31.3 (27.7–34.9); 637	
Diabetes, % (95% CI); n	14 (10.0–18.0); 286	
Smoking, % (95% CI); n	21.7 (17.9–25.6); 443	
Alcohol drinkers, % (95% CI); n	80.3 (78.4–82.2); 1636	
Education, % (95% CI); n	75.2 (73–77.4); 15,32	
Physical activity, % (95% CI); n	56.9 (54–59.7); 1159	
Coexisting CVD, % (95% CI); n	27.6 (23.9–31.3); 562	
Married, % (95% CI); n	23.7 (19.9–27.5); 483	
SCORE, % (95% CI); n	<5%	54.6 (51.7–57.5); 1112
	≥5% and <10%	26.9(23.1–30.6); 547
	≥10%	18.6(14.6–22.5); 378
Visits, number/year, % (95% CI); n	0	11.3 (7.2–15.4); 230
	1	25.6 (21.8–29.3); 521
	2–4	25.9 (22.2–29.7); 528
	5–6	7 (2.8–11.2); 143
	>7	30.2 (26.6–33.8); 615
Income, % (95% CI); n	<1000 PLN (<250 EUR)	43 (39.5–46.5); 453
	>1000 PLN (>250 EUR)	57 (53.9–60.1); 998

Abbreviations: BMI, body mass index; CVD, cardiovascular disease; DBP, diastolic blood pressure; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; SCORE, Systematic Coronary Risk Evaluation; TC, total cholesterol; TG, triglycerides

In the whole WOBASZ II population, hypertension was found in 2784 (crude data 46.9%) persons (1365 men and 1419 women). Mean (SD) age was 58.4 (13.9) years (men, 55.8 [14.4] years; women, 60.9 [13.0]).

Comorbid hypertension and hypercholesterolemia was found in 2037 patients (982 men and 1055 women). Mean age was 58.8 (12.9) years (men, 56.1 [13.4] years; women, 60.5 [11.8] years). Descriptive statistics of the study group are summarized in **TABLES 1** and **2**.

Age-standardized prevalence of coexisting hypertension and hypercholesterolemia in WOBASZ II population was 32.2% (95% CI, 30.8–33.7); in men, 34.5% (95% CI, 32.3–36.7); and in women, 31% (95% CI, 29.1–32.9) (**TABLE 3**).

Age-standardized prevalence of hypercholesterolemia in patients diagnosed with hypertension in the entire study sample was 69.7% (95% CI, 65.9–73.4); in men, 70% (95% CI, 64.9–75.2); and in women, 68.6% (95% CI, 63.1–74.2). The highest prevalence (crude data) was observed in women aged 50 to 59 years (83.3% [95% CI, 79.6–87.1])

and in men aged 60 to 69 years (76.2% [95% CI, 71.9–80.6]) (**TABLE 4**).

Among patients with coexisting hypertension and hypercholesterolemia, the highest control rate of hypertension, hypercholesterolemia, and both hypertension and hypercholesterolemia (crude data) was observed in patients older than 80 years of age (37.7%, 29.2%, and 17%, respectively). Age-standardized control of hypertension, hypercholesterolemia, and both hypertension and hypercholesterolemia in the entire sample (age range, 19–99 years) was 24.3%, 11.2%, and 5.4%, respectively (**TABLE 5**).

Age, comorbid diabetes, comorbid CVD, frequent medical visits, and CVD risk according to the SCORE of less than 5% were positively associated with controlled hypertension, hypercholesterolemia, and both. Female sex, obesity, income above 250 EUR per person in the household were not associated with controlled hypercholesterolemia, but related with controlled hypertension and a controlled both hypertension and hypercholesterolemia. Education higher than vocational

TABLE 2 Descriptive characteristics of patients with hypertension and hypercholesterolemia in WOBASZ II Study

Variable	Controlled hypertension and hypercholesterolemia	Controlled hypertension; uncontrolled hypercholesterolemia	Controlled hypercholesterolemia; uncontrolled hypertension	Uncontrolled hypertension and hypercholesterolemia
Age, y, mean (95% CI); n	64.1 (62.4–65.7); 151	57.3 (56–58.5); 411	46 (45.4–46.6); 171	58 (48–66); 1275
Male sex, % (95% CI); n	39.1 (26.6–51.5); 59	38 (30.3–45.6); 156	44.4 (33.3–55.6); 76	53.4 (49.7–57.2); 681
BMI kg/m ² , % (95% CI); n	<25	13.9 (–0.9 to 28.7); 21	15.1 (6.2–24); 62	9.4 (0–23.6); 16
	25–30	41.7 (29.5–53.9); 63	44 (36.8–51.2); 181	42.7 (31.3–54); 73
	>30	44.4 (32.5–56.3); 67	40.9 (33.4–48.3); 168	48 (37.1–58.8); 82
SBP, mm Hg, mean (95% CI); n	124.3 (122.7–125.9); 151	144.2 (142.8–145.6); 411	120.2 (119.7–120.6); 171	149 (141.5–161.5); 1275
DBP, mm Hg, mean (95% CI); n	75.8 (74.4–77.1); 151	85.9 (85.1–86.7); 411	76.1 (75.7–76.4); 171	90.5 (84.5–96.5); 1275
TC, mmol/l, median, (95% CI); n	4.1 (3.9–4.2); 151	5.7 (5.5–5.8); 411	4.1 (3.8–4.4); 171	5.9 (5.8–5.9); 1275
LDL-C, mmol/l, median, (95% CI); n	2.1 (2–2.2); 151	3.6 (3.5–3.7); 411	2.1 (2–2.2); 171	3.7 (3.7–3.8); 1274
HDL-C, mmol/l, median, (95% CI); n	1.2 (1.2–1.3); 151	1.3 (1.3–1.4); 411	1.3 (1.1–1.4); 171	1.4 (1.4–1.4); 1275
TG, mmol/l, median, (95% CI); n	1.3 (1.1–1.4); 150	1.6 (1.5–1.7); 411	1.3 (1–1.5); 171	1.6 (1.5–1.6); 1274
Hypertension treatment, % (95% CI); n	100 (100–100); 151	100 (100–100); 411	77.2 (70–84.4); 132	37.7 (33.4–42.1); 481
Hypercholesterolemia treatment, % (95% CI); n	100 (100–100); 151	27.3 (19–35.5); 112	95.9 (92.9–98.9); 164	14.3 (9.2–19.4); 182
Diabetes, % (95% CI); n	23.8 (9.9–37.8); 36	14.6 (5.7–23.5); 60	26.9 (14.1–39.7); 46	10.7 (5.6–15.9); 137
Smoking, % (95% CI); n	9.9 (0–25.1); 15	19.2 (10.5–27.9); 79	12.3 (0–26.3); 21	25.5 (20.8–30.2); 352
Alcohol drinkers, % (95% CI); n	81.5 (74.6–88.3); 123	74 (69–78.9); 304	80.1 (73.4–86.8); 137	82.7 (80.5–85); 1055
Education, % (95% CI); n	68.9 (60–77.8); 104	75.7 (70.9–80.4); 311	68.4 (60–76.8); 117	77 (74.4–79.7); 982
Physical activity, % (95% CI); n	55 (44.3–65.7); 83	55.7 (49.3–62.2); 229	58.5 (48.8–68.1); 100	57.3 (53.7–60.9); 731
Coexisting CVD, % (95% CI); n	55.6 (45–66.3); 84	33.6 (25.7–41.5); 138	50.9 (40.4–61.4); 874	18.8 (13.9–23.8); 240
Married, % (95% CI); n	30.5 (17.2–43.8); 46	23.1 (14.6–31.6); 95	31 (18.5–43.4); 53	21.9 (17–26.7); 279
SCORE, % (95% CI); n	SCORE ≥5	72.8 (64.5–81.2); 110	71.8 (66.2–77.3); 254	55 (43.9–66.1); 77
	SCORE ≥5% and <10	9.9 (0–25.1); 15	27.1 (18.2–36); 96	43.6 (31.1–56); 61
	SCORE ≥10%	17.2 (2.7–31.7); 26	1.10–11.5); 4	1.4 (0–17.9); 2
Visits, number/year, % (95% CI); n	0	16.6 (2–31.1); 25	14.6 (5.7–23.5); 60	34.5 (22.4–46.6); 59
	1	2.6 (0–18.4); 4	8.3 (0–17.5); 34	9.9 (0–24.2); 17
	2–4	24.5 (10.6–38.4); 37	27 (18.7–35.3); 111	4.7 (0–19.3); 8
	5–6	14.6 (0–29.3); 22	8.5 (0–17.8); 35	4.7 (0–19.3); 8
	>7	41.7 (29.5–53.9); 63	41.6 (34.2–49); 171	46.2 (35.2–57.2); 79
Income, % (95% CI); n	<PLN 1000 (< EUR 250)	42.6 (29.9–55.4); 58	41.3 (33.5–49.1); 152	35.1 (22.2–48.1); 52
	> PLN 1000 (> EUR 250)	57.4 (46.4–68.3); 78	58.7 (52.1–65.3); 216	64.9 (55.3–74.4); 96

Abbreviations: see [TABLE 1](#)

was associated only with improvement in hypertension. Conversely, smoking was associated with worse control of hypertension, hypercholesterolemia, and both. Alcohol consumption was inversely associated with controlled hypertension ([TABLE 6](#)).

After adjustment for covariates, female sex, comorbid CVD, frequent medical visits, and high education increased the odds of controlled hypertension. The strongest effect was observed for comorbid CVD (odds ratio, 2.35; 95% CI, 1.93–2.86). Hypercholesterolemia control was positively related with comorbid diabetes, CVD, and with controlled hypertension. Hypercholesterolemia control was inversely related with smoking (odds ratio, 0.57; 95% CI, 0.45–0.71). The good control of both hypertension and hypercholesterolemia was more frequent in participants with

comorbid CVD, frequent medical visits, and high education. Smoking decreased the odds of controlled of both hypertension and hypercholesterolemia 2-fold ([FIGURE 1](#); Supplementary material, [Tables S1](#) and [S2](#)).

DISCUSSION Our results suggest that about one-third of the adult population have comorbid hypertension and hypercholesterolemia. Control of hypertension in this group appeared similar to the control in the general population, but control of hypercholesterolemia was better than in the general population.^{1,2} Nevertheless, proportion of patients with good control of both conditions was only about 5%.

Considering the more stringent thresholds of antihypertensive treatment in accordance

TABLE 3 Crude and age-standardized prevalence of hypertension and hypercholesterolemia in the Polish population aged 19–99

Age group, y	Total	Men	Women
19–49	15 (13.7–16.3); 432	20.9 (18.8–23.1); 278	9.9 (8.4–11.4); 154
50–59	46.7 (44–49.5); 596	50.9 (46.7–55.1); 278	43.7 (40.1–47.2); 320
60–69	58.2 (55.2–61.2); 613	58.3 (53.9–62.7); 280	58.1 (54.1–62.2); 333
70–79	60.4 (56–64.8); 290	56.6 (49.8–63.4); 116	63.3 (57.6–69); 174
≥80	52 (45.1–58.8); 106	41.6 (30.6–52.6); 32	58.3 (49.7–66.8); 74
Age standardized	32.2 (30.8–33.7); 2037	34.5 (32.3–36.7); 982	31 (29.1–32.9); 1055

Data are presented as percentage (95% CI); number of patients.

TABLE 4 Crude and age-standardized prevalence of hypercholesterolemia in the Polish hypertensive population aged 19–99

Age group, y	Total	Men	Women
19–49	64.9 (61.2–68.5); 666	67.3 (62.8–71.8); 413	60.9 (54.9–66.9); 253
50–59	79.9 (77–82.8); 746	76.2 (71.9–80.6); 362	83.3 (79.6–87.1); 384
60–69	77.6 (74.7–80.5); 790	77.3 (73–81.7); 362	77.8 (73.9–81.7); 428
70–79	71.3 (66.9–75.7); 407	69.5 (62.5–76.4); 167	72.5 (66.9–78.1); 240
≥80	60.9 (53.7–68.2); 174	53.3 (40.7–66); 60	64.9 (56.2–73.7); 114
Age standardized	69.7 (65.9–73.4); 2037	70 (64.9–75.2); 982	68.6 (63.1–74.2); 1055

Data are presented as percentage (95% CI); number of patients.

TABLE 5 Crude and age-standardized prevalence of controlled blood pressure, hypercholesterolemia, or both in the Polish population with hypertension and hypercholesterolemia aged 19–99

Population	Age group, y					Age standardized	P value for trend
	19–49	50–59	60–69	70–79	≥80		
Controlled hypertension							
Total	18.8 (15.1–22.4); 81	30.5 (26.8–34.2); 182	31.6 (28–35.3); 194	27.6 (22.4–32.7); 80	37.7 (28.5–47); 40	24.3 (21.7–26.9); 557	<0.001
Men	16.2 (11.9–20.5); 45	25 (19.9–30.1); 69	26.1 (20.9–31.2); 73	20.7 (13.3–28.1); 24	25 (10–40); 8	19.7 (16.5–22.9) ^a ; 219	0.01
Women	23.4 (16.7–30.1); 36	35.3 (30.1–40.5); 113	36.3 (31.2–41.5); 121	32.2 (25.2–39.1); 56	43.2 (32–54.5); 32	29.5 (25.1–33.9); 358	<0.001
Controlled hypercholesterolemia							
Total	4.9 (2.8–6.9); 21	14.1 (11.3–16.9); 84	20.9 (17.7–24.1); 128	20 (15.4–24.6); 58	29.2 (20.6–37.9); 31	11.2 (9.7–12.7); 322	<0.001
Men	6.5 (3.6–9.4); 18	15.6 (11.3–19.9); 43	15.7 (11.5–20); 44	19 (11.8–26.1); 22	25 (10–40); 8	10.8 (8.6–13) ^b ; 135	<0.001
Women	1.9 (0–4.1); 3	12.8 (9.2–16.5); 41	25.2 (20.6–29.9); 84	20.7 (14.7–26.7); 36	31.1 (20.5–41.6); 23	11 (9.1–12.8); 187	<0.001
Controlled hypertension and hypercholesterolemia							
Total	2.3 (0.9–3.7); 10	7.4 (5.3–9.5); 44	9.3 (7–11.6); 56	7.6 (4.5–10.6); 22	17 (9.8–24.1); 18	5.4 (4.3–6.4); 151	<0.001
Men	2.9 (0.9–4.8); 8	6.5 (3.6–9.4); 18	6.8 (3.8–9.7); 19	9.5 (4.2–14.8); 11	9.4 (–0.7 to 19.5); 3	4.7 (3.3–6.1) ^c ; 59	0.09
Women	1.3 (0–3.1); 2	8.1 (5.1–11.1); 26	11.4 (8–14.8); 38	6.3 (2.7–9.9); 11	20.3 (11.1–29.4); 15	5.7 (4.3–7.1); 92	<0.001

Data are presented as percentage (95% CI); number of patients.

a Men vs women ($P < 0.001$); **b** Men vs women ($P = 0.95$); **c** Men vs women ($P = 0.79$)

with the 2018 European Society of Hypertension guidelines²⁶ and the 2019 Polish Society of Hypertension guidelines²⁷ (for patients below 65 years of age, the target pressure below 130/80 mm Hg; for those between 65 and 85

years of age, below 140/80 mm Hg; and for those over 80 years of age, below 150/80 mm Hg), blood pressure control in the WOBASZ II population would decrease from 23% to approximately 14%, and simultaneous control of

TABLE 6 Univariate odds ratios and 95% CI of factors associated with control of hypertension, hypercholesterolemia, or both in patients with hypertension and hypercholesterolemia in the WOBASZ II study

Variable	Controlled hypertension	Controlled hypercholesterolemia	Controlled hypertension and hypercholesterolemia
Age, per 10 years	1.22 (1.15–1.3)	1.06 (1–1.13)	1.31 (1.2–1.43)
Sex (female)	1.72 (1.45–2.04)	1.17 (1–1.38)	1.48 (1.16–1.88)
BMI (> 30 kg/m ²)	1.31 (1.1–1.55)	1.17 (0.99–1.38)	1.36 (1.07–1.74)
Diabetes	1.39 (1.1–1.74)	1.75 (1.4–2.18)	1.73 (1.28–2.33)
HDL-C, per 1.0 mmol/l	0.94 (0.48–1.84)	1.62 (0.9–2.93)	1.44 (0.67–3.1)
TG, per 1.0 mmol/l	0.87 (0.54–1.4)	0.63 (0.33–1.18)	0.73 (0.29–1.83)
Smokers	0.61 (0.49–0.76)	0.56 (0.45–0.69)	0.41 (0.28–0.6)
Alcohol drinkers	0.98 (0.96–0.99)	0.99 (0.99–1)	0.98 (0.96–1)
Education	1.2 (1.01–1.42)	1.01 (0.86–1.19)	1.1 (0.86–1.39)
Physical activity	1.02 (0.87–1.21)	0.89 (0.75–1.04)	1.04 (0.82–1.33)
Coexisting CVD	2.33 (1.95–2.78)	2.15 (1.81–2.56)	3.01 (2.36–3.83)
Married	1.06 (0.88–1.29)	1.19 (0.99–1.44)	1.16 (0.88–1.52)
SCORE (<5%)	1.72 (1.45–2.04)	1.62 (1.37–1.91)	2.08 (1.61–2.69)

Data are presented as odds ratio (95% CI).

Abbreviations: see [TABLE 1](#)

hypercholesterolemia and blood pressure would only be achieved in 3.5% of patients.

Treatment targets for hypertension or hypercholesterolemia were more frequently achieved in women, participants with high education, non-smokers, persons with comorbid CVD or diabetes, and in those who had more medical visits.

Some caution is recommended in the interpretation of the results of the present study due to relatively low (approximately 45.5%) participation rate which could have affected the representativeness of the sample. In previous WOBASZ II analysis, it was found that regional differences in the prevalence of hypercholesterolemia were related to the participation rate (0.4% increase in the percentage of people with hypercholesterolemia per 1% increase in reporting rate).² Such relationship was not observed in case of hypertension prevalence.¹ Moreover, our participation rates were similar to that recorded in other European studies, for example, the EHES (European Health Examination Survey) conducted from 2009 to 2012, in which the reporting rate ranged from 16% to 57% in men and from 31% to 74% in women.²⁸ However, it is likely that low response rate might have contributed to some underestimation in the prevalence rates.^{29,30}

Moreover, cross-sectional study design does not allow to address the problem of causality. Although multivariate models allow to control the effect of important covariates, residual confounding is still possible.

Nevertheless, the study has strengths. In contrast to most of the evidence collected in patients from the clinics, our study involved a large nationwide sample. Moreover, the research team applied standardized research procedures to ensure highest possible data quality.

Comparing our results with a large epidemiological study conducted in the United States from 2005 to 2010, NHANES (National Health and Nutrition Examination Survey), we found that the participants from the United States achieved the goal of lipid-lowering therapy more than 4-fold more often (11.2% vs 45.4%, respectively). Moreover, control of both hypertension and hypercholesterolemia was 6-fold more common than in our study (30.7% vs. 5.4%, respectively).³¹ These comparisons might indicate the gap in the effectiveness of risk factors control between Poland and the United States. However, the observed difference could also be explained by larger prevalence of obesity, diabetes, and lower prevalence of smoking in the NHANES sample. Our results indicate that these factors seem to improve hypertension and hypercholesterolemia control. The iSEARCH (Cardiovascular Risk Factors and Microalbuminuria in Hypertensive Individuals) study, which included over 17 000 patients from 26 countries with treated hypertension, found lower prevalence of hypercholesterolemia (average 49%) than observed in our study. However, there was a large variation in hypercholesterolemia prevalence in different regions—the lowest prevalence was observed in Southern Europe (43.3%) and Asia (43.1%), and the highest, in North America (64.4%), the Middle East (56.1%), and Northern Europe (53%).³² In the Polish POSTER (Therapeutic Strategies in Poorly Controlled Hypertension in Outpatient Setting in Poland) study, which enrolled 8766 patients with poorly controlled hypertension, the prevalence of hypercholesterolemia was estimated at 64.8%.³³

Our results are in accordance with findings from Polish part of the EUROASPIRE IV (European Society of Cardiology study of lifestyle, risk factors, and treatment approaches in patients with coronary

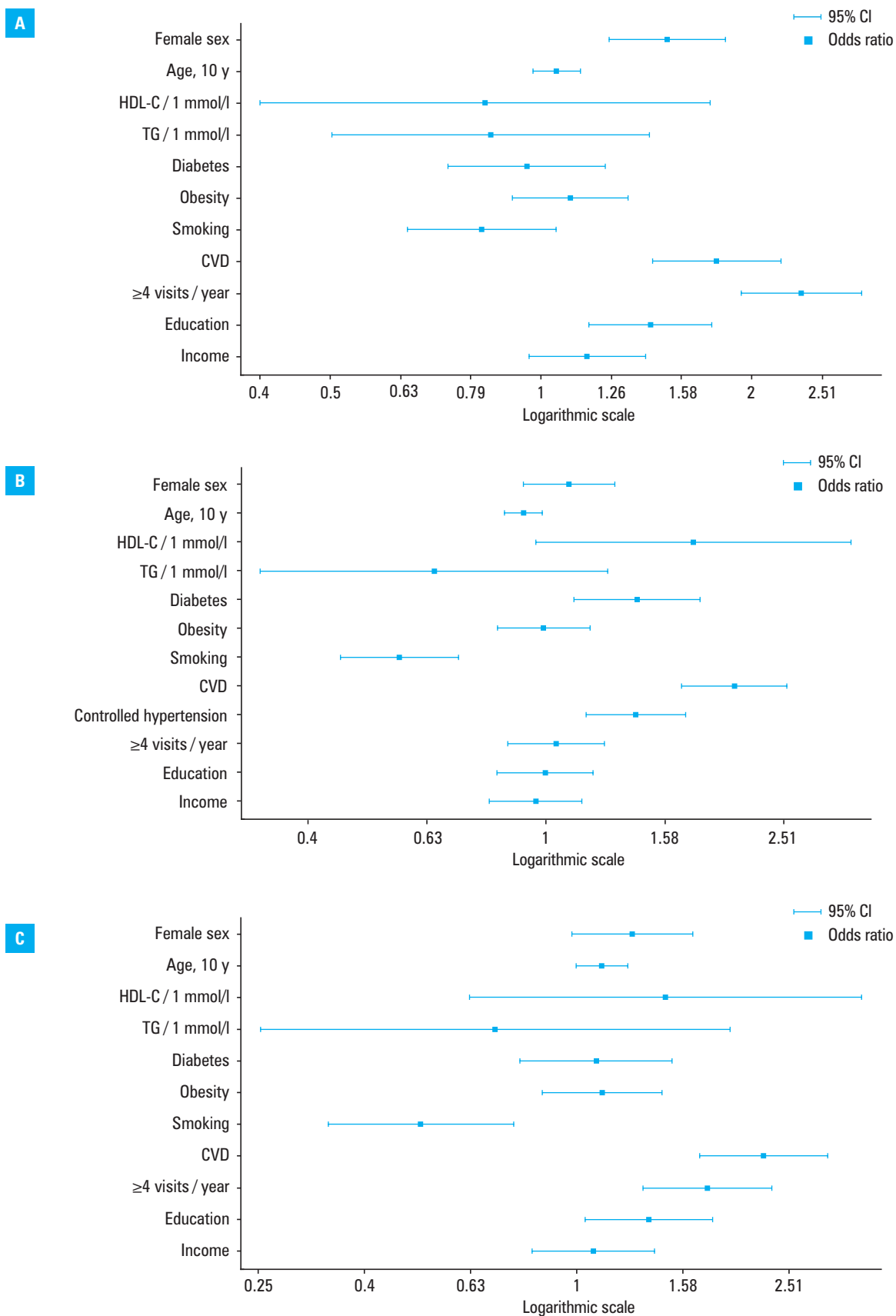


FIGURE 1 Multivariable odds ratios and 95% CI for clinical variables associated with control of hypertension (A), hypercholesterolemia (B), or both (C). Abbreviations: see TABLE 1

artery disease) study, which showed better control of hypertension and hypercholesterolemia in patients after hospitalization due to CHD³⁴ compared with the findings from the general population.^{1,2}

In our study, in participants with comorbid hypertension and hypercholesterolemia, we found that blood pressure control was low and comparable to the general population (23% vs 24.3%),

whereas hypercholesterolemia control was nearly twice higher than in the general population (11.2% vs 6%).¹ Many patients with hypertension and hypercholesterolemia present low compliance and adherence to medical advising and do not achieve the therapeutic goals, which has significant clinical and economic consequences.³⁵⁻³⁷ Recently, a promoted way of improving blood pressure and hypercholesterolemia control could be use of a polypill—a single tablet containing a combination of several drugs (including antihypertensive and lipid-lowering agents) with proved efficacy and cardioprotective effect. It is suggested that in the population above 55 years of age such a combination product could prevent as many as 80% of cardiovascular events.³⁸⁻⁴² Although combination pills containing both antihypertensive and lipid-lowering drugs exist, they are not often used in clinical practice. Their use on a larger scale could contribute to improved blood pressure control, as well as to the achievement of cholesterol targets; for this reason, the position of combination products has recently been strengthened in the European guidelines for the treatment of hypertension and hypercholesterolemia.^{43,44}

It seems that introduction of polypill could contribute to solve the problem of not undertaking or discontinuing treatment (13% of patients with hypertension and 17% of patients with hypercholesterolemia) or the problem of ineffective doses (23% of patients with hypertension and 23% of patients with hypercholesterolemia).^{1,2} Still the final effect would be related largely to the level of motivation of patients to change their lifestyle (diet, physical activity) and adhere to the long-term treatment regime. However, the largest public health problem in Poland is poor detection of risk factors. Over 60% of people with hypercholesterolemia and about 40% with hypertension are not aware of the condition,^{1,2} which substantially limits the potentials of the available treatments.

In conclusion, hypertension and hypercholesterolemia were observed in one-third of the Polish population (included in WOBASZ II study). Only 5.4% have both risk factors controlled. After adjustment for covariates, female sex, non-smoking, comorbid CVD or diabetes, frequency of medical visits and high education, appeared to increase the proportion of controlled hypertension or hypercholesterolemia.

SUPPLEMENTARY MATERIAL

Supplementary material is available at www.mp.pl/paim.

ARTICLE INFORMATION

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CONTRIBUTION STATEMENT AN conceived the idea for the manuscript, contributed to the study design, analyzed the data, interpreted the results, and wrote the paper. JM, MK, AP, TZ, WD, AP, MK, KK, and AT provided the data of WOBASZ II study and contributed to the writing of the paper. AN and JM performed the statistical analysis. MK and AP critically revised the manuscript. All authors read and approved the final manuscript.

CONFLICT OF INTEREST AP received honoraria for consultations from Amgen (not directly related to the present paper).

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