ORIGINAL ARTICLE

Secondary prevention of coronary heart disease in Poland: does sex matter? Results from the POLASPIRE survey

Małgorzata Setny[1], Piotr Jankowski[2,3], Karol Kamiński[4], Zbigniew Gąsior[5], Maciej Haberka[5], Danuta Czarnecka[6], Andrzej Pająk[7], Paweł Kozieł[6], Karolina Szóstak-Janiak[5], Emilia Sawicka[4], Zofia Stachurska[4], Dariusz A. Kosior[8,9]

1 Clinical Cardiology Center, Central Clinical Hospital of the Ministry of Interior and Administration, Warsaw, Poland
2 Department of Internal Medicine and Geriatric Cardiology, Center of Postgraduate Medical Education, Warsaw, Poland
3 Department of Epidemiology and Health Promotion, School of Public Health, Center of Postgraduate Medical Education, Warsaw, Poland
4 Department of Population Medicine and Lifestyle Diseases Prevention, Medical University of Bialystok, Białystok, Poland
5 Department of Cardiology, Medical University of Silesia, Katowice, Poland
6 First Department of Cardiology, Interventional Electrocardiology and Hypertension, Institute of Cardiology, Jagiellonian University Medical College, Kraków, Poland
7 Department of Epidemiology and Population Studies, Institute of Public Health, Jagiellonian University Medical College, Kraków, Poland
8 Department of Cardiology and Hypertension with the Electrophysiological Lab, Central Clinical Hospital of the Ministry of Interior and Administration, Warsaw, Poland
9 Mossakowski Medical Research Institute, Polish Academy of Sciences, Warsaw, Poland

KEY WORDS

coronary heart disease, goal attainment, risk factors, secondary prevention

ABSTRACT

INTRODUCTION Adherence to health-promoting behaviors intended to mitigate modifiable risk factors plays an important role in secondary cardiovascular prevention.

OBJECTIVES We aimed to evaluate sex differences in the prevalence and control of risk factors in patients with coronary heart disease (CHD).

PATIENTS AND METHODS The study included 1236 patients who experienced acute coronary syndrome or coronary revascularization within the last 6 to 24 months. Definitions of risk factors and treatment goals were based on the 2016 European Society of Cardiology guidelines on cardiovascular prevention.

RESULTS The prevalence of modifiable risk factors in both sexes was high, and their control inadequate. Women were older (P <0.001) and had a higher accumulation of multiple cardiovascular risk factors than men (P = 0.036). They more frequently had central obesity (P <0.001) and reduced values of glomerular filtration rate (P <0.001). Women more often experienced anxiety (P <0.001), reported lower levels of education (P <0.001) and lower income (P = 0.001), and those in the youngest age group were more likely to be exposed to second-hand smoking (P = 0.01). A large fraction of the study patients, men and women alike, did not meet the recommended therapeutic goals. For both sexes, participation in cardiac rehabilitation programs was associated with more frequent attainment of the recommended level of physical activity (P = 0.046) and smoking cessation (P = 0.01).

CONCLUSIONS The prevalence of cardiovascular risk factors in patients with CHD is high, especially in women. Therapeutic goals are met infrequently in both sexes. This situation calls for widening the access to educational programs and paying greater attention to their proper implementation.

Correspondence to:
Małgorzata Setny, MD, Clinical Cardiology Center, Central Clinical Hospital of the Ministry of Interior and Administration, ul. Woloska 137, 02-507 Warszawa, Poland, phone: +48 477 221 834, email: malgorzata.setny@cskmswia.gov.pl
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INTRODUCTION Cardiovascular diseases (CVDs) are not only the leading cause of death of men and women but also the most important cause of premature deaths. Both can be mitigated by the introduction of proper pro-health behaviors and adequate access to treatment.[1] A growing number of studies confirm the effectiveness of both pharmacotherapy and nonpharmacological interventions, such as physical activity or smoking cessation, in the prevention of cardiovascular incidents.[2-8]

WHAT'S NEW?

The study showed, firstly, that a great proportion of patients after acute coronary syndrome or elective coronary revascularization had a high prevalence of modifiable cardiovascular risk factors and, secondly, that many of them did not achieve the therapeutic goals recommended in the European Society of Cardiology guidelines for cardiovascular prevention. These observations were especially true for women, in whom the accumulation of multiple cardiovascular risk factors was significantly higher than in men. In addition to that, 3 or more out of 5 therapeutic goals were achieved only by 20% of women and 28% of men. In both sexes, participation in cardiac rehabilitation programs was associated with a higher frequency of positive, health-promoting behaviors.

Health-promoting behaviors primarily involve reducing the prevalence of modifiable cardiovascular risk factors. As demonstrated in the INTERHEART study,[9] simple lifestyle changes such as smoking cessation, daily fruit and vegetable consumption, and regular physical activity reduced the risk of myocardial infarction by more than 80%. According to the World Health Organization expert analysis conducted in 2009,[10] 8 modifiable risk factors, namely excessive alcohol consumption, smoking, hypertension, obesity, hypercholesterolemia, diabetes mellitus (DM), low fruit and vegetable intake, and low physical inactivity, account for about 61% of cardiovascular deaths and for more than three-quarters of the causes of coronary heart disease (CHD).

Unfortunately, subsequent editions of the EUROASPIRE studies consistently indicated that the prevalence of the aforementioned risk factors is still very high, especially in women.[11,12] One of possible reasons may be that CVD occurs at an older age in women than in men,[9] which likely entails the accumulation of accompanying disorders. Moreover, women are additionally burdened with other, sex-specific conditions—premature menopause or pregnancy complications such as preeclampsia, pregnancy-induced hypertension and gestational diabetes—all of which additionally increase the risk of CVD in older age.[13-16] On top of that, numerous reports indicate that some modifiable risk factors have a stronger effect in women.[17,18]

The most recent survey concerning the implementation of the 2016 European Society of Cardiology (ESC) gudelines on secondary CVD prevention[19] in Poland was carried out in the framework of the POLASPIRE study.[20] The aim of our analysis was to evaluate differences in the prevalence and management of cardiovascular risk factors in patients with CHD, with a focus on the achievement of treatment goals and lifestyle changes in secondary prevention in women and men.

PATIENTS AND METHODS The present study was conducted on a group of patients enrolled in the multicenter, cross-sectional POLASPIRE study,[20] which was a parallel development of the EUROASPIRE V study.[21] It was performed by centrally trained staff in 4 geographical regions of Poland (Kraków, Katowice, Białystok, and Warsaw), in 14 cardiology departments, including university and district hospitals. Regional coordinators were responsible for obtaining approvals from local Bioethics Committees. All participants signed an informed consent form. The study was conducted according to the guidelines of the Declaration of Helsinki.

The study included patients aged 18 to 79 years hospitalized for acute coronary syndrome, that is, ST-segment elevation myocardial infarction (STEMI), non-STEMI (NSTEMI) or unstable angina (UA), or underwent elective percutaneous coronary intervention (PCI) or elective coronary artery bypass grafting (CABG) within the last 6 to 24 months. The protocol consisted of 2 independent parts conducted in 2017–2018. The first part involved reviewing the patient's medical records from the time of hospitalization for the qualifying incident. The aim was to obtain information on cardiovascular risk factors, anthropometric measurements, blood pressure values, and biochemical test results, as well as on the procedures performed during hospitalization and pharmacological treatment prescribed on the day of discharge. Patients who met the inclusion criteria were invited to visit the regional coordinating center. During the visit, each patient was interviewed using detailed EUROASPIRE V questionnaires, which covered the following: medical history, cardiovascular risk factors, education, socioeconomic status, participation in cardiac rehabilitation programs, and used medications. The patients also completed self-administered questionnaires such as the disease perception questionnaire, self-reported depression and anxiety questionnaire (Hospital Anxiety and Depression Scale), and quality of life assessment (EQ-5D-5L). During the visit, measurements of blood pressure (average of at least 2 measurements) and heart rate were taken, anthropometric parameters such as waist circumference, weight, and height were measured, and carbon monoxide concentration in exhaled air was determined. A blood sample was drawn for laboratory tests such as lipidogram, glucose, creatinine (glomerular filtration rate was calculated using the Modification Of Diet In Renal Disease formula), transaminases, creatine phosphokinase, C-reactive protein, N-terminal pro–B-type natriuretic peptide, hemoglobin A_{1c} (HbA_{1c}), and a urine sample was collected for determination of albumin to creatinine ratio. In addition, an oral glucose tolerance test was performed in patients without diagnosed diabetes.

In all centers, the measurements were performed using similar instruments. Height and weight were measured in light clothing without shoes using a SECA 701 scale and a model 220 height gauge. Waist circumference was assessed using a tape, halfway between the lowest ribs and the upper iliac crest at the mid axillary line, in a standing position. Blood pressure (BP) was measured using an Omron M6 automatic

sphygmomanometer. Systolic and diastolic blood pressure values (SBP and DBP, respectively) were measured twice in a sitting position after at least 5 minutes of rest. If the difference between the first and the second SBP or DBP measurements exceeded 10 mm Hg, the procedure was repeated after another 5 minutes of rest.

Blood was collected in the morning after overnight fasting. Total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were analyzed in serum, and HbA_{1c}, in venous blood. The level of low-density lipoprotein cholesterol (LDL-C) was calculated according to the Friedewald formula. The level of non–HDL-C was calculated based on the following formula: TC – HDL-C.

The presence of hypertension, dyslipidemia, and kidney disease was determined based on previous diagnosis included in medical records or the information card from initial hospitalization. The presence of DM or glucose intolerance was determined either based on prior diagnosis or current glucose metabolism assessed at the follow-up visit after an oral glucose tolerance test, according to standard criteria. Smoking status was evaluated based on the interview taken during the follow-up visit and confirmed by the measurement of carbon oxide concentration in exhaled air. Obesity and overweight were defined as a body mass index (BMI) of ≥30 kg/m^2 or ≥25 kg/m^2 and <30 kg/m^2, respectively, based on measurements taken during the follow-up visit. Self-assessment of income was based on responses to the question: "In your opinion, is your family income very low, low, medium, or high?" with answers "very low" and "low" assigned to a single group. The extent of information concerning the recommended lifestyle changes received during hospitalization as well as changes actually implemented in the postdischarge period were assessed based on a questionnaire completed during the follow-up visit.

Definitions of risk factors and treatment targets were based on the 2016 ESC guidelines for the prevention of CVD in clinical practice.[19] According to these guidelines, the following targets were defined: controlled DM (HbA_{1c} <7%, LDL-C <70 mg/dl or its reduction by ≥50% if baseline levels were 70–135 mg/dl, non–HDL-C <100 mg/dl), normal blood pressure (SBP <140 mm Hg and DBP <90 mm Hg for all except diabetic patients, for whom the target DPB was <85 mm Hg), normal BMI (20.0–25.0 kg/m^2), normal waist circumference (<80 cm in women, <94 cm in men), not smoking, and regular physical activity (moderate-intensity exercise ≥150 min/week or vigorous exercise ≥75 min/week).

The treatment goal related to the body mass was defined as maintaining normal BMI or its reduction to less than 30 kg/m^2 in individuals with an initial BMI between 30 and 35 kg/m^2, or target BMI below 35 kg/m^2 in individuals with an initial BMI of 35 kg/m^2 or higher.

The following lipid levels were considered normal: TC, below 190 mg/dl, TG, below 150 mg/dl, HDL-C, equal to or greater than 40 mg/dl in men and equal to or greater than 45 mg/dl in women. Given that the study group at baseline included patients at high cardiovascular risk, we adopted a baseline LDL-C level below 70 mg/dl as a normal value.

The prevalence of abnormal LDL-C, non–HDL-C, HbA_{1c}, and BP, active smoking, and obesity during hospitalization and at the follow-up visit in men and women was compared based on cases for which baseline and follow-up data were both available. Changes in each parameter (in percentage) in either sex group were evaluated based on the difference in the number of patients with undesired outcome at baseline and follow-up in relation to the group size.

Statistical analysis In the case of descriptive statistics, the significance of results was inferred based on the 2-sided *t* test for normally distributed variables (P >0.05 in the Shapiro–Wilk test) or the Wilcoxon test for variables with nonnormal distribution. For categorical variables and the comparison of changes in the prevalence of abnormal outcomes at baseline and follow-up, the χ^2 test was used. Multivariable logistic regression was used to assess the relationship between observable and dependent variables. Reported P values were adjusted using the Benjamini–Hochberg method. All analyses were performed with the "stats" package of the R program, version 3.6.3 (the R Foundation for Statistical Computing, Vienna, Austria).

RESULTS General characteristics and prevalence of risk factors The study included 1236 participants, 354 women (29%) and 882 men (71%). Of these, a total of 1025 individuals, that is, 289 women (28%) and 736 men (72%), attended the follow-up visit (FIGURE 1). General characteristics of the study group are summarized in TABLES 1 and 2.

Women were older than men (mean age at enrollment, 66 vs 64 years, respectively; P <0.001). There was a greater proportion of men in the subgroup of patients aged under 60 years, and women in the subgroup aged over 70 years (P <0.001). There was a significant difference in the distribution of the qualifying incident type (P = 0.007). Women were more likely to have UA and NSTEMI, whereas men more often underwent elective PCI and CABG, and more often had STEMI (TABLE 1).

Among the patients whose complete data from the time of hospitalization and the follow-up visit were available, at baseline, both women and men had high rates of elevated LDL-C (81% vs 76%; P = 0.48), non–HDL-C (70% vs 64%; P = 0.48), and HbA_{1c} levels (42% vs 40%; P = 0.93), as well as a high prevalence of elevated BP values (53% vs 50%; P = 0.86), active smoking (38% vs 39%; P = 0.93), and obesity (47% vs 38%; P = 0.9). For most of those parameters, an improvement was observed during

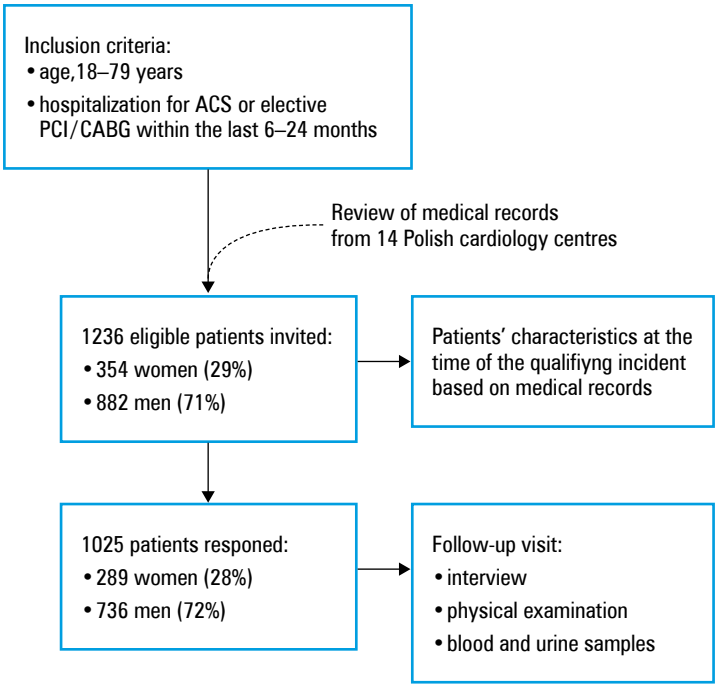

FIGURE 1 Study flow chart
Abbreviations: ACS, acute coronary syndrome; CABG, coronary artery bypass grafting; PCI, percutaneous coronary intervention

the follow-up visit (FIGURE 2), with no significant differences between women and men: LDL-C (–12% vs –14%; *P* = 0.67), non–HDL-C (–16% vs –18%; *P* = 0.67), BP (–10% vs –7%; *P* = 0.67), and smoking (–17% vs –16%; *P* = 0.73). There was no definite change with regard to abnormal HbA_{1c} levels (0% vs –2%; *P* = 0.67), while the prevalence of obesity actually increased (3% vs 1%; *P* = 0.13).

At the time of hospitalization, a similar rate of kidney diseases was observed in both groups; however, at the follow-up visit, reduced glomerular filtration rate (<60 ml/min) was more often observed in women (*P* <0.001), which was most evident in the oldest age subgroup. At the follow-up visit, central obesity was more common in women (*P* <0.001), while overweight in men (*P* = 0.01) (TABLE 2). In both sexes, excess body weight was present more often in individuals with diabetes. In men, obesity was found in 52% of diabetic and 32% of nondiabetic patients (*P* <0.001), while in women these ratios where 56% and 43%, respectively (*P* = 0.065). Similarly, central obesity was more frequently observed in patients with coexisting diabetes than in those without diabetes, with a significant association in men (88% vs 82%; *P* = 0.019) and a borderline insignificant association in women (98% vs 92%, *P* = 0.051).

Of the 5 cardiovascular risk factors including smoking, obesity, hypertension, dyslipidemia, and diabetes, the vast majority of patients had more than 1 (FIGURE 3), and in the particularly burdened group (with ≥3 risk factors), women were significantly more prevalent than men (59% vs 51%; *P* = 0.036).

Men more often had higher education (*P* <0.001), were more often professionally active (*P* <0.001), and more frequently described their income level as medium or high (*P* = 0.001). The groups differed in terms of marital status, with more men being married and more women widowed (*P* <0.001). In addition, women were more likely to report that they lived alone (*P* <0.001). Anxiety levels were higher in the female group (*P* <0.001), while depression levels did not differ between the study groups (*P* = 0.13) (TABLE 1).

There was no sex-related difference in the frequency of referral to cardiac rehabilitation programs or their completion, with 33% of women and 37% of men having been directed to such programs (*P* = 0.24). Of this group, 86% of women and 82% of men completed the programs (*P* = 0.36).

Therapeutic goal achievement With regard to non–HDL-C, BP, and recommended HbA_{1c} levels in diabetic patients, the assessment of goal achievement was possible based on the data gathered during the follow-up visit. In turn, the evaluation of the LDL-C and BMI goals required a comparison with baseline values from the time of hospitalization. LDL-C levels from the time of hospitalization and follow-up visit were available for 813 patients: 227 women (28%) and 586 men (72%). The assessment of BMI goal achievement was possible in 865 patients, of whom 249 (29%) were women and 616 (71%) were men (in 824 patients, the data were available both from the time of hospitalization and the follow-up visit; in the remaining 41 patients, a normal BMI value at the follow-up visit was considered as goal attainment regardless of the baseline status).

According to *P* values adjusted to account for concomitant assessment of all 7 considered therapeutic goals (TABLE 3), sex-related differences did not reach statistical significance in any of the therapeutic goals, at least not until the study groups were further subdivided according to age or other factors.

Considering hypercholesterolemia, target levels for LDL-C were met by 20% of women and 25% of men (*P* = 0.3), and for non–HDL-C, by 46% of women and 55% of men (*P* = 0.06). In both cases, the most pronounced disproportions were observed in the oldest age subgroups, where 21% of women and 33% of men achieved the LDL-C goal (*P* = 0.28), and 47% of women and 67% of men achieved the non–HDL-C goal (*P* = 0.012) (TABLE 3).

There was no sex-related difference in the frequency of maintaining the target BP. Target values (ie, SBP <140 mm Hg and DBP <90 mm Hg or <85 mm Hg in nondiabetic and diabetic patients, respectively) were found in 57% of individuals, and this result was identical in both study groups. Notably though, the BP goal was achieved less frequently in patients with concomitant diabetes: in women it was reached by only 48% of diabetic patients and 61% of nondiabetic patients (*P* = 0.047), while in men, the respective proportion was 46% vs 61% (*P* = 0.002).

TABLE 1 General characteristics of the study group according to age, type of the qualifying incident, and psychosocial factors

Parameter		Women	Men	*P* value
Patients[a]		354 (29)	882 (71)	–
Age, mean (SD)[a]		66 (9)	64 (8)	<0.001
Age group[a]	<60 years	71 (20)	263 (30)	<0.001
	60–70 years	157 (45)	403 (46)	
	≥70 years	125 (35)	214 (24)	
Incident[a]	CABG	8 (2)	46 (5)	0.007
	PCI	120 (34)	323 (37)	
	STEMI	46 (13)	150 (17)	
	NSTEMI	91 (26)	194 (22)	
	UA	89 (25)	169 (19)	
Level of education[b]	High	40 (14)	181 (25)	<0.001
	Secondary	165 (57)	378 (52)	
	Below secondary	82 (29)	172 (24)	
Professionally active[b]		54 (19)	291 (40)	<0.001
Living alone[b]		74 (26)	86 (12)	<0.001
Income[b]	Low	112 (40)	201 (28)	0.001
	Medium	165 (58)	479 (66)	
	High	6 (2)	41 (6)	
Anxiety level[b]	Low	135 (55)	428 (72)	<0.001
	Borderline	55 (23)	107 (18)	
	High	53 (22)	58 (10)	
Depression[b]	No	164 (67)	431 (73)	0.13
	Borderline	51 (21)	118 (20)	
	Yes	28 (12)	44 (7)	
Marital status[b]	Married	158 (55)	587 (80)	<0.001
	Divorced	21 (7)	64 (9)	
	Widowed	98 (34)	53 (7)	
	Single	11 (4)	26 (4)	

Data are presented as number (percentage) of patients unless indicated otherwise.

a Results from the time of hospitalization

b Results from the follow-up visit

P values were adjusted according to the Benjamini–Hochberg method.

Abbreviations: NSTEMI, non–ST-segment elevation myocardial infarction; STEMI, ST-segment elevation myocardial infarction; UA, unstable angina; others, see **FIGURE 1**

There was no sex-related difference in terms of the HbA_{1c} or BMI goal attainment, with 61% of women and 63% of men (P >0.99) achieving the HbA_{1c} goal, and 27% of women and 23% of men (P = 0.35) achieving the BMI goal.

Smoking was quit by 46% of women and 44% of men (P >0.99) who had been smoking a month before hospitalization. Of the remaining smokers, as many as 62% of women and 47% of men had not thought seriously about quitting (P = 0.26). Of note, according to a logistic regression model relating smoking cessation as a dependent variable to sex, age, and participation in a rehabilitation program as explanatory variables, smoking cessation was positively associated with completion of the cardiac rehabilitation program (P = 0.01).

In general, men smoked for a longer period than women (median [interquartile range, IQR] duration of smoking, 30 [20–40] vs 25 [15–40] years, respectively; P = 0.012); however, women quit at an older age than men (median [IQR], 55 [45–65] vs 52 [41–60] years, respectively; P = 0.03). In addition, 21% of women and 15% of men reported sharing a room with a cigarette smoker at home (P = 0.21), and a greater exposure of women to passive smoking was particularly evident in the youngest age subgroup, where the proportion of affected individuals reached 38% in women and 17% in men (P = 0.01).

Finally, only 14% of women and 21% of men (P = 0.067) reported that they engaged in physical activity at the recommended level. Again, according to a logistic regression model in which achievement of the recommended level of physical activity as a dependent variable was assessed relative to sex, age, and participation in a rehabilitation program as explanatory variables, a positive correlation was found for the last parameter (P = 0.046).

On the contrary, logistic regression models based on the same set of explanatory variables as above did not indicate an association between participation in a cardiac rehabilitation program and the LDL-C, BP, or BMI goal attainment.

With respect to the association between age and therapeutic goal achievement, a tendency for better control of LDL-C and non–HDL-C levels in the older and the youngest subgroups was observed in both sexes; however, statistical significance was only reached in the oldest subgroup of male patients. No clear age-related dependence was observed with regard to the remaining goals (**TABLE 3**).

The distribution of the number of concomitantly achieved goals that included attainment of the recommended LDL-C and non–HDL-C levels, target BP values, and the BMI goal, as well as undertaking recommended levels of physical activity, is presented in **FIGURE 4**. Overall, 3 or more out of these 5 goals were achieved by 20% of women and 28% of men (P = 0.051). Due to the moderate size of the study groups, the correlation between the level of education and goal achievement did not reach statistical significance neither in women nor in men (**TABLE 4**).

There were no significant differences between sexes with respect to the reported frequency of being provided with information about the recommended lifestyle changes concerning diet, physical activity, and body mass goal. With respect to the implementation of the above recommendations, as assessed during the follow-up visit, women more often than men reported a reduction of dietary fat intake (79% vs 68%; P = 0.028), while men more often declared that they engaged in physical activity (29% vs 41%, P = 0.020). Otherwise, there were no significant differences between sexes in terms of the introduced lifestyle changes.

TABLE 2 Clinical characteristics of the study groups according to age subgroups

Accompanying condition	Women (n = 354)	Men (n = 882)	*P* value
Hypertension[a]			
Overall	313 (95)	722 (93)	0.30
<60 years	50 (88)	179 (87)	>0.99
60–70 years	140 (97)	349 (95)	0.80
≥70 years	123 (97)	195 (94)	0.56
Diabetes mellitus[b]			
Overall	120 (41)	286 (39)	0.68
<60 years	16 (28)	65 (31)	>0.99
60–70 years	51 (39)	143 (42)	0.80
≥70 years	53 (51)	78 (42)	0.38
Glucose intolerance[b]			
Overall	45 (20)	76 (14)	0.09
<60 years	8 (19)	21 (14)	>0.99
60–70 years	22 (22)	32 (13)	0.13
≥70 years	15 (18)	23 (16)	0.85
Kidney disease[a]			
Overall	38 (13)	70 (10)	0.18
<60 years	2 (4)	9 (5)	>0.99
60–70 years	11 (9)	29 (8)	0.97
≥70 years	25 (22)	32 (16)	0.48
Glomerular filtration rate <60 ml/min[b]			
Overall	68 (31)	81 (15)	<0.001
<60 years	3 (8)	8 (6)	>0.99
60–70 years	21 (23)	33 (13)	0.13
≥70 years	44 (48)	40 (27)	0.014
Dyslipidemia[a]			
Overall	234 (81)	599 (81)	0.95
<60 years	40 (78)	152 (77)	>0.99
60–70 years	98 (79)	279 (81)	0.80
≥70 years	96 (84)	168 (86)	0.84
Active smoking[b]			
Overall	38 (21)	132 (23)	0.77
<60 years	17 (41)	62 (35)	>0.99
60–70 years	15 (17)	60 (22)	0.80
≥70 years	6 (11)	10 (8)	0.84
Obesity[b]			
Overall	141 (48)	293 (40)	0.085
<60 years	28 (49)	84 (40)	>0.99
60–70 years	64 (49)	150 (44)	0.80
≥70 years	49 (47)	59 (32)	0.20
Overweight[b]			
Overall	98 (38)	335 (45)	0.01
<60 years	18 (32)	96 (46)	>0.99
60–70 years	43 (33)	151 (44)	0.43
≥70 years	37 (36)	88 (48)	0.33
Central obesity[b]			
Overall	277 (95)	620 (84)	<0.001
<60 years	54 (95)	171 (81)	0.20
60–70 years	125 (95)	297 (87)	0.10
≥70 years	98 (94)	152 (87)	0.05

Data are presented as number (percentage) of patients.

a Results from the time of hospitalization

b Results from the follow-up visit

P values were adjusted according to the Benjamini–Hochberg method.

Therapeutic goal achievement according to relevant guidelines The 2018 ESC/European Society of Hypertension (ESH) guidelines for the management of arterial hypertension[22] and the subsequent 2021 ESC guidelines on CVD prevention[23] have both changed the therapeutic BP goals in patients with arterial hypertension. In the 2018 guidelines, the target SBP was in the range of 120 to 130 mm Hg in patients younger than 65 years or 130 to 140 mm Hg in older individuals, while the target DBP was below 80 mm Hg, irrespective of age or comorbidities. These target BP values were maintained in the 2021 ESC guidelines on CVD prevention; however, the age threshold determining the desired SBP level was shifted from 65 to 70 years. Considering our results in light of the above guidelines, the BP goal (ie, achieving both the recommended SBP and DBP values) would not be reached by 91% of women and 89% of men ($P = 0.21$) according to the 2018 ESC/ESH criteria, and by 89% of women and 88% of men ($P = 0.75$) according to the 2021 ESC CVD prevention guidelines.

The 2019 ESC/European Atherosclerosis Society guidelines on dyslipidemias[24] and the 2021 ESC guidelines on CVD prevention introduced stricter goals for lipid profile management. In very–high cardiovascular risk patients, at least a 50% reduction from baseline LDL-C levels and a target concentration below 55 mg/dl are recommended, whereas the non–HDL-C goal has been lowered to less than 85 mg/dl. If such criteria were applied to our study patients, the LDL-C goal at follow-up would be achieved by only 7% of women and 8% of men ($P = 0.96$), and the non–HDL-C goal would be met by 23% of women and 35% of men ($P < 0.001$).[25]

DISCUSSION

The results of our analysis conducted within the framework of the POLASPIRE study indicated that a large percentage of patients at high cardiovascular risk did not achieve the recommended therapeutic goals concerning lipid management, BP control, or BMI, neither did they undertake the recommended level of physical activity or quit smoking in the period of 6 to 24 months following hospitalization for acute coronary syndrome or elective coronary revascularization. During the follow-up visit, an improvement relative to the hospitalization period was indeed observed in both women and men for most of the analyzed variables, particularly for BP control, lipid management, and smoking cessation, but they were still not optimally controlled in a considerable group of patients. No improvement was observed in terms of obesity, whose prevalence actually increased slightly. These findings are consistent with earlier data obtained in a group of Polish patients with CHD,[26] as well as with subsequent reports from the EUROASPIRE studies,[27,28] which invariably demonstrated high prevalence of unhealthy lifestyle and persistence of modifiable CVD risk factors. The latest, fifth edition of that study[21] showed that as many as

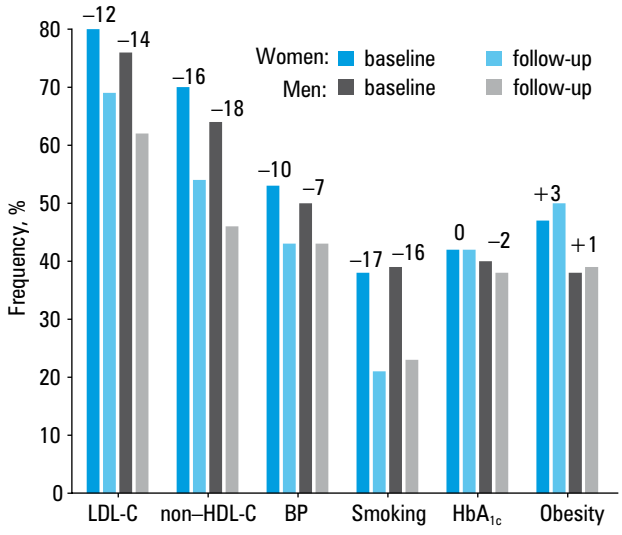

FIGURE 2 Prevalence of cardiovascular risk factors during hospitalization and the follow-up visit in women and men. Only patients with available baseline and follow-up data were included in the analysis: LDL-C, 813 patients (28% women); non–HDL-C, 819 patients (28% women); BP, 979 patients (28% women); smoking status, 762 (24% women); HbA_{1c}, 117 patients (28% women); BMI, 824 patients (29% women). Abbreviations: BP, blood pressure; HbA_{1c}, hemoglobin A_{1c}, others, see TABLE 3

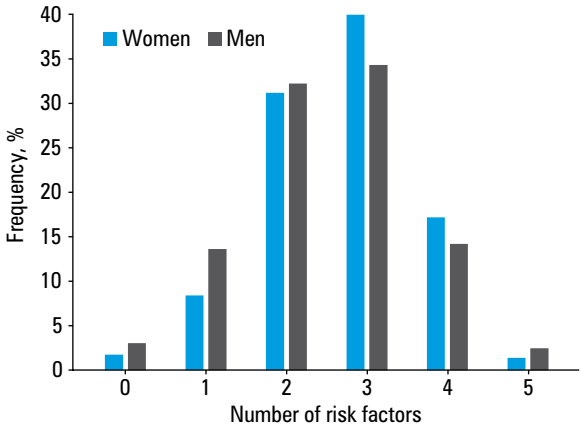

FIGURE 3 Accumulation of risk factors (smoking, obesity, hypertension, dyslipidemia, and diabetes) in women (n = 285) and men (n = 725) at the time of the follow-up visit

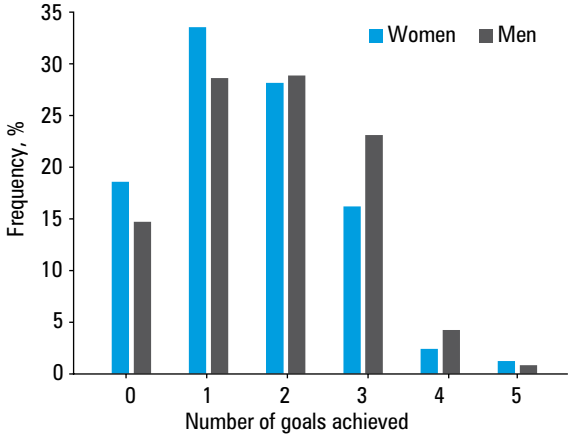

FIGURE 4 The number of therapeutic goals (LDL-C level, non–HDL-C level, target BP, BMI value, and recommended level of physical activity) achieved by women (n = 167) and men (n = 381) at the time of the follow-up visit

19% of participants smoked cigarettes, of which 55% had smoked before the qualifying incident, 38% were obese, 59% had central obesity, 66% were physically active for less than 30 minutes 5 times per week, 42% had blood pressure equal to or greater than 140/90 mm Hg (≥140/85 mm Hg if diabetic), 71% had LDL-C levels equal to or greater than 1.8 mmol/l (≥70 mg/dl), and 29% had diabetes. Compared with previous editions, there was a further increase in the number of new cases of diabetes and obesity, as well as in terms of improved BP control and lipid management.

Aside from confirming the overall poor adherence to secondary CVD prevention guidelines, our analysis highlighted notable sex-related differences, with generally less favorable outcomes for women. Compared with men, women were more likely to have central obesity, were more prone to renal insufficiency, and reported higher levels of anxiety. Additionally, they less frequently achieved the secondary hypercholesterolemia treatment goal (ie, the desired non–HDL-C level), especially in the oldest age subgroup. Women were also more often exposed to harmful effects of passive smoking, particularly in the youngest age subgroup.

Clinical importance of the above differences is further compounded by the fact that diabetes, cigarette smoking, depression, and other psychosocial cardiovascular risk factors exert stronger effects in women and result in a higher risk of CVD-related morbidity and mortality in women than in men.[17,29-32] In particular, several studies have shown that smoking in women, especially in younger women, is associated with a higher risk of cardiovascular complications than in men.[33-37] In a study by Huxley et al,[18] smoking women had a higher risk of CHD than men. In the Copenhagan City Heart Study,[38] the risk of myocardial infarction and death from any cause associated with smoking was significantly higher in women. These observations were applicable to both active and passive smoking, which was also confirmed in other studies.[39] Psychological factors and emotional stress were also shown to impact the manifestation and clinical outcome of CHD in women to a greater extent than in men.[9] Moreover, these factors were found to hamper the efforts towards lifestyle modification and health promotion.[40-42] Indeed, while numerous studies have shown that regular physical activity is associated with a reduced CVD incidence and reduced all-cause mortality,[43-45] according to our results, only 14% of women and 21% of men reported the recommended level of exercise. It is worth emphasizing that our results clearly indicate that participation in cardiac rehabilitation programs positively influences the decision to quit smoking and to undertake the desired level of physical activity. Unfortunately, we noted that only less than 40% of patients were referred to such programs. The above findings are consistent with a recent report showing that participation in rehabilitation programs increases the

TABLE 3 Goal achievement in particular age subgroups of women and men during the follow-up visit

Goal	Women	Men	*P* value	Women		Men	
				OR (95% CI)	*P* value	OR (95% CI)	*P* value
LDL-C							
Overall	45 (20)	147 (25)	0.30	–	–	–	–
<60 years	5 (10)	33 (19)	0.56	1	–	1	–
60–70 years	24 (24)	68 (25)	0.98	2.84 (1.01–7.97)	0.16	1.42 (0.8–2.44)	0.49
≥70 years	16 (21)	46 (33)	0.28	2.39 (0.82–7.02)	0.30	2.09 (1.17–3.76)	0.042
Non–HDL-C							
Overall	133 (46)	403 (55)	0.06	–	–	–	–
<60 years	18 (32)	101 (48)	0.25	1	–	1	–
60–70 years	67 (51)	179 (52)	0.98	2.21 (1.15–4.26)	0.12	1.17 (0.83–1.65)	0.49
≥70 years	48 (47)	123 (67)	0.012	1.88 (0.95–3.72)	0.30	2.19 (1.46–3.31)	0.001
Blood pressure							
Overall	168 (57)	423 (57)	>0.99	–	–	–	–
<60 years	36 (63)	126 (60)	0.26	1	–	1	–
60–70 years	78 (59)	189 (55)	0.98	0.84 (0.44–1.60)	0.61	0.81 (0.57–1.15)	0.49
≥70 years	54 (52)	108 (58)	0.82	0.63 (0.33–1.23)	0.31	0.92 (0.61–1.37)	0.80
Smoking cessation							
Overall	32 (46)	98 (44)	>0.99	–	–	–	–
<60 years	10 (37)	38 (39)	>0.99	1	–	1	–
60–70 years	14 (48)	49 (46)	0.98	1.57 (0.54–4.56)	0.61	1.33 (0.76–2.33)	0.49
≥70 years	8 (57)	11 (55)	>0.99	2.26 (0.60–8.39)	0.31	1.91 (0.72–5.04)	0.27
Diabetes mellitus							
Overall	66 (61)	160 (63)	>0.99	–	–	–	–
<60 years	9 (56)	41 (68)	0.91	1	–	1	–
60–70 years	30 (64)	71 (59)	0.98	1.39 (0.44–4.42)	0.61	0.68 (0.35–1.29)	0.49
≥70 years	27 (60)	48 (67)	0.94	1.17 (0.37–3.72)	0.91	0.95 (0.46–1.98)	0.90
BMI							
Overall	67 (27)	139 (23)	0.35	–	–	–	–
<60 years	13 (25)	37 (21)	0.91	1	–	1	–
60–70 years	32 (29)	56 (20)	0.25	1.22 (0.58–2.59)	0.61	0.94 (0.59–1.49)	0.80
≥70 years	22 (25)	46 (28)	0.94	1 (0.45–2.21)	1	1.46 (0.89–2.40)	0.23
Physical activity							
Overall	41 (14)	149 (21)	0.09	–	–	–	–
<60 years	11 (20)	44 (21)	>0.99	1	–	1	–
60–70 years	19 (15)	82 (24)	0.20	0.70 (0.31–1.60)	0.61	1.19 (0.78–1.79)	0.49
≥70 years	11 (11)	23 (13)	0.95	0.49 (0.19–1.22)	0.30	0.56 (0.32–0.97)	0.09

Data are presented as number (percentage) of patients unless indicated otherwise.

P values were adjusted according to the Benjamini–Hochberg method.

Abbreviations: BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; non–HDL-C, non–high-density lipoprotein cholesterol; OR, crude odds ratio

chance of introducing health-promoting behaviors, leads to improved glycemic control, and results in better quality of life.[46]

In the EUROASPIRE III study,[47] a significantly higher prevalence of depression and anxiety among women coincided with less frequent lifestyle modifications, less frequent physical activity, more unhealthy diet, higher BMI, greater waist circumference, abnormal fasting glucose levels, and more frequently reported diabetes. In the VIRGO study,[48,49] young and middle-aged women with myocardial infarction experienced higher levels of stress than men, which was associated with slower recovery. Of importance are also socioeconomic aspects. In this respect, our analysis showed that women were more likely to describe their income as low, and less often completed higher education. Meanwhile, it has been found that lower socioeconomic status and lower level of education are associated with a higher risk of CHD in women than in men.[50]

The study has several limitations. Firstly, it was restricted to a selected group of patients with CHD, namely individuals with a history of acute

TABLE 4 Odds ratios for achievement of treatment goals at follow-up depending on the level of education in women and men

Level of education	Women			Men		
	n (%)	OR (95% CI)	*P* value	n (%)	OR (95% CI)	*P* value
LDL-C						
Below secondary	15 (24)	1.00	–	37 (29)	1.00	–
Secondary	22 (17)	0.66 (0.32–1.39)	0.35	73 (24)	0.76 (0.48–1.21)	0.56
High	6 (20)	0.80 (0.28–2.32)	0.84	36 (25)	0.82 (0.48–1.40)	0.58
Non–HDL-C						
Below secondary	42 (52)	1.00	–	87 (51)	1.00	–
Secondary	68 (41)	0.65 (0.38–1.11)	0.19	203 (54)	1.13 (0.79–1.63)	0.62
High	19 (49)	0.88 (0.41–1.89)	0.84	109 (62)	1.55 (1.01–2.37)	0.11
BMI						
Below secondary	11 (17)	1.00	–	29 (21)	1.00	–
Secondary	47 (32)	2.22 (1.06–4.64)	0.08	65 (21)	0.99 (0.60–1.61)	0.95
High	8 (24)	1.45 (0.52–4.05)	0.84	42 (27)	1.37 (0.80–2.36)	0.42
Blood pressure						
Below secondary	40 (56)	1.00	–	88 (61)	1.00	–
Secondary	82 (55)	0.98 (0.56–1.72)	0.94	153 (51)	0.67 (0.45–1.00)	0.25
High	16 (53)	0.91 (0.39–2.15)	0.84	86 (58)	0.90 (0.56–1.43)	0.65
Physical activity						
Below secondary	5 (6)	1.00	–	28 (16)	1.00	–
Secondary	28 (17)	3.19 (1.18–8.61)	0.08	73 (20)	1.26 (0.78–2.04)	0.56
High	8 (20)	3.85 (1.17–12.67)	0.13	48 (27)	1.87 (1.11–3.15)	0.09

P values were adjusted according to the Benjamini–Hochberg method.

Abbreviations: see **TABLE 3**

coronary syndrome or elective coronary revascularization within the previous 6 to 24 months. Secondly, it did not cover all regions of Poland. Furthermore, the analysis of the LDL-C and BMI goal attainment depended on the availability of baseline data on LDL-C levels and BMI values, which were unavailable in approximately 20% of the participants. In addition, the medical records contained no information regarding the level of physical activity preceding the hospitalization period.

In conclusion, our study showed a high prevalence of modifiable CVD risk factors in patients at high cardiovascular risk, especially in women. The results indicate a need for targeted educational programs and wider access to cardiac rehabilitation.

ARTICLE INFORMATION

CONTRIBUTION STATEMENT MS and DAK conceived the concept of the study. MS, PJ, KK, ZG, MH, DCz, AP, PK, KSzJ, ES, ZS, and DAK were involved in data collection. MS analyzed the data and wrote the first version of the manuscript. PJ, KK, ZG, and DAK edited the manuscript. All authors approved the final version of the manuscript.

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