ORIGINAL ARTICLE

Changes over time in the prevention of recurrent coronary artery disease in everyday practice

Jan W. Pęksa[1], Piotr Jankowski[1], Paweł Kozieł[1], Piotr Bogacki[2], Piotr Gomuła[3], Ewa Mirek-Bryniarska[4], Jadwiga Nessler[5], Piotr Podolec[6], Andrzej Wiśniewski[7], Marek Rajzer[1], Danuta Czarnecka[1], Andrzej Pająk[8]

1 1st Department of Cardiology, Interventional Electrocardiology and Hypertension, Institute of Cardiology, Jagiellonian University Medical College, Kraków, Poland
2 Department of Cardiology, Ludwik Rydygier District Hospital, Kraków, Poland
3 Department of Cardiology, Gabriel Narutowicz Memorial General Hospital, Kraków, Poland
4 Department of Cardiology, Józef Dietl Hospital, Kraków, Poland
5 Department of Coronary Disease, Institute of Cardiology, Jagiellonian University Medical College, Kraków, Poland
6 Department of Cardiac and Vascular Diseases, Institute of Cardiology, Jagiellonian University Medical College, Kraków, Poland
7 Department of Internal Medicine and Cardiology, Stefan Żeromski Hospital, Kraków, Poland
9 Department of Clinical Epidemiology and Population Studies, Institute of Public Health, Jagiellonian University Medical College, Kraków, Poland

KEY WORDS

cardiovascular risk, coronary artery disease, high blood pressure, high cholesterol, prevention of coronary artery disease

ABSTRACT

INTRODUCTION Patients with coronary artery disease (CAD) are at high risk of recurrent cardiovascular events, and risk factor control is crucial in this population.

OBJECTIVES The aim of the study was to compare the implementation of the European Society of Cardiology guidelines regarding prevention of recurrent CAD in 2011 to 2013 with 2016 to 2017.

PATIENTS AND METHODS The study included 5 hospitals with cardiology departments serving the city of Kraków and its surrounding districts. Consecutive patients with established CAD were interviewed 6 to 18 months after hospitalization in the years 2011 to 2013 and 2016 to 2017.

RESULTS We examined 616 patients in 2011 to 2013 and 388 in 2016 to 2017 (mean [SD] age, 64.7 [8.8] years vs 66.4 [8.4] years; $P < 0.01$). After adjusting for covariates, the proportion of patients with high blood pressure decreased by 8.9% (95% CI, –15.6% to –2.1%) and the proportion of patients with high level of low-density lipoprotein cholesterol declined by 9.5% (95% CI, –16.7% to –2.2%) in 2016 to 2017 compared with 2011 to 2013, whereas the proportion of smoking patients (–0.2% [95% CI, –6% to 5.5%]) and those with high glucose levels (3.9% [95% CI, –2.2% to 10%]) and a body mass index of 25 kg/m^2 or greater (3.8% [95% CI, –3.9% to 11.6%]) did not change. More patients were prescribed antiplatelets, β-blockers, angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers, calcium antagonists, and anticoagulants in the second period.

CONCLUSIONS We observed an increase in the proportion of patients with CAD who were prescribed cardiovascular drugs, and consequently a slight improvement in the control of their blood pressure and low-density lipoprotein cholesterol. No changes were found regarding other main risk factors.

Correspondence to:
Piotr Jankowski, MD, PhD, Department of Cardiology, Interventional Electrocardiology and Hypertension, Institute of Cardiology, Jagiellonian University Medical College, ul. Jakubowskiego 2, 30-688 Kraków, Poland, phone: +48 12 400 21 00, email: piotrjankowski@interia.pl
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INTRODUCTION Cardiovascular diseases are the leading cause of deaths in most developed countries.[1-3] Numerous scientific societies, including the European Society of Cardiology (ESC), and national medical associations emphasize the importance of cardiovascular prevention.[4-7]

The control of cardiovascular risk factors in patients with coronary artery disease (CAD) improved only slightly in Poland between 1997 to 1998 and 2011 to 2013.[8] There is potential for more effective implementation of the ESC guidelines on CAD prevention.[8] Indeed, one of the suggested major causes of high mortality

WHAT'S NEW?

We found an increase in the proportion of patients with blood pressure and low-density lipoprotein cholesterol levels at goal between 2011 to 2013 and 2016 to 2017 in patients 80 years old or younger. On the other hand, there was no change in the control of other risk factors (smoking, glycemia, body mass index). Despite an increase in the uptake of blood-pressure lowering drugs, a considerable proportion of patients with coronary artery disease still have uncontrolled blood pressure. In addition, the high proportion of both patients with elevated low-density lipoprotein cholesterol despite the wide use of lipid-lowering drugs and those who are overweight or obese suggests there is a great potential for lifestyle modification and adherence improvement. Our results likewise point to the need for further reduction in cardiovascular risk in patients with coronary artery disease and that a revision of state-funded programs for cardiac prevention is justified.

rates following hospitalization for CAD is insufficient quality of medical care regarding the prevention of recurrent CAD.[9-11] The implementation of guidelines on preventing recurrent CAD in day-to-day clinical practice was assessed every few years beginning from 1997 to 1998.[8] The aim of the present analysis was to compare the implementation of the ESC guidelines regarding recurrent CAD prevention in 2016 to 2017 with their implementation in 2011 to 2013.

PATIENTS AND METHODS We analyzed data of participants from 2 surveys appraising cardiovascular prevention in patients with established CAD in 2011 to 2013 and 2016 to 2017.[12-14] The same 5 hospitals providing cardiac care in the city and surrounding districts participated in each survey. The participating hospitals serve a population of approximately 1 200 000 inhabitants. The methods used in the surveys had been published previously and were similar on each occasion.[12-14] Briefly, patients aged 80 years or younger and hospitalized for acute coronary syndrome or a myocardial revascularization procedure were interviewed 6 to 18 months following their discharge from hospital. Centrally trained research staff collected data using standardized methods and the same instruments.

A patient's personal medical history, lifestyle, and medication regimen were evaluated using a standard data collection form. Smoking status was verified by assessing the concentration of breath carbon monoxide with a smokerlyzer (Bedfont Scientific, Ltd, Maidstone, United Kingdom). Height and weight were measured in a standing position without shoes and heavy outwear on standard scales with a vertical ruler (SECA). Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Blood pressure was measured twice, on the right arm in a sitting position after at least 5 minutes of rest using an automatic device. The mean of 2 readings was used for the present analysis. A fasting venous blood sample was taken to measure plasma lipid and glucose levels. The blood samples were analyzed in the central laboratory, which was the same in both surveys. The present report included the results of analyses performed no later than 12 hours after blood collection.

We analyzed the proportions of patients with risk factors not meeting the recommended goals: current smoking, low-density lipoprotein (LDL) cholesterol level of 1.8 mmol/l or greater, fasting glucose level of 7 mmol/l or greater, BMI of 25 kg/m^2 or greater. In the case of blood pressure, 2 approaches were adopted. First, we analyzed the proportions of patients achieving the goals recommended at the time of each survey.[6,15] Second, we also analyzed the proportions of patients with blood pressure of 140/90 mm Hg or greater.

The prevention index was calculated as follows: one point was given for each controlled risk factor (nonsmoking, blood pressure at goal, LDL cholesterol at goal, glucose <7.0 mmol/l, BMI <25 kg/m^2) during the follow-up examination. The target values for blood pressure and LDL cholesterol were based on the ESC guidelines, which were valid at the time each survey was carried out. Additionally, one point was awarded to a patient for taking an antiplatelet agent and an angiotensin-converting inhibitor (ACEI) or an angiotensin II receptor blocker (ARB). Thus, a patient's prevention index could vary from 0 to 7.[8,12]

The survey protocol was approved by the bioethics committee of the Jagiellonian University. All participants provided signed informed consent.

Statistical analysis Categorical variables were reported as percentages and continuous variables as means (SD). The Pearson χ^2 test was applied to all categorical variables. Normally distributed continuous variables were compared using the *t* test. Variables without normal distributions were evaluated by means of the Mann–Whitney test.[16,17] Multivariable analyses were performed on the basis of the generalized linear model as implemented in the Statistica 13 software (TIBCO Software Inc, Palo Alto, California, United States). A 2-tailed *P* value of less than 0.05 was regarded as statistically significant.

RESULTS Overall, the present analysis included data of 1005 patients (616 examined in 2011–2013 and 389 in 2016–2017). Participants of the second survey were older and there were more men (TABLE 1). More participants of the second survey underwent percutaneous coronary intervention. On the other hand, the proportion of those with a diagnosis of unstable angina was higher in the first survey.

The temporal changes in mean blood pressure as well as levels of lipids and glucose are presented in TABLE 2. We found significant differences in concentrations of carbon monoxide in exhaled air, systolic blood pressure as well as levels of LDL cholesterol, triglycerides, and glucose. When we limited the analysis to smokers, the difference in concentrations of carbon monoxide

TABLE 1 Demographic and clinical characteristics of the study groups

Variable		2011–2013 (n = 616)	2016–2017 (n = 389)	*P* value
Age, y, mean (SD)		64.7 (8.8)	66.4 (8.4)	0.003
Sex	Male	399 (64.7)	277 (71.2)	0.03
	Female	217 (35.2)	112 (28.8)	
Duration of education, y, mean (SD)		11.9 (3.2)	12.6 (3.2)	<0.001
Professionally active		131 (21.3)	123 (31.7)	<0.001
Index diagnosis	Myocardial infarction	213 (34.6)	133 (34.2)	0.90
	Unstable angina	203 (33)	66 (17)	<0.001
	PCI	141 (22.9)	171 (44)	<0.001
	CABG	59 (9.6)	19 (4.9)	0.007

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

Abbreviations: CABG, coronary artery bypass grafting; PCI, percutaneous coronary intervention

in exhaled air was no longer significant (mean [SD], 10.7 [5] ppm vs 9.9 [6] ppm; *P* = 0.37). Proportions of patients with uncontrolled main risk factors are presented in **TABLE 3**. The proportion of patients who failed to achieve treatment targets for blood pressure and LDL cholesterol levels decreased. We did not find any differences in the control of the other main risk factors. The proportions of patients who were prescribed antiplatelets, β-blockers, ACEIs/ARBs, calcium antagonists, and anticoagulants were higher in 2016 to 2017 compared with 2011 to 2013 (**TABLE 4**).

The mean (SD) number of well-controlled main risk factors (smoking, blood pressure, LDL cholesterol, glucose, and BMI) were 2.98 (0.99) in 2011 to 2013 and 3.07 (1.0) in 2016 to 2017 (*P* = 0.19). The difference remained significant after multivariable adjustment (*P* = 0.14). In 2011 to 2013, 0.4%, 5.7%, 20.8%, 39.1%, 27.6%, and 6.4% of the patients had 0, 1, 2, 3, 4, and 5 risk factors well controlled, respectively. The corresponding proportions in 2016 to 2017 were 0%, 7.1%, 23.5%, 38.2%, 26.1%, and 5.1%, respectively. The mean (SD) value of the prevention index increased from 4.40 (1.18) to 4.62 (1.05) (*P* <0.004; **FIGURE 1**). However, the difference was not significant when adjusted for covariates (*P* = 0.07).

DISCUSSION The presented data allows for comparison of implementation of the ESC guidelines in everyday clinical practice. Although we observed an increase in the proportion of patients who achieved their treatment targets for blood pressure and LDL cholesterol levels, the control of the other risk factors did not change significantly. In addition, although the value of the prevention index increased, the difference did not persist after multivariable adjustment. Our results suggest that the potential for a further reduction in cardiovascular risk in patients with CAD has not decreased and that revision of state-funded cardiac prevention programs would be justified. Indeed, several studies describing initiatives aimed at improving cardiovascular risk in

TABLE 2 Temporal changes in risk factors 6 to 18 months after discharge

Survey	CO in exhaled air, ppm	SBP, mm Hg	DBP, mm Hg	Total cholesterol, mmol/l	HDL cholesterol, mmol/l	LDL cholesterol, mmol/l	Triglycerides, mmol/l	Fasting glucose, mmol/l	HbA_{1c}, %[a]	BMI, kg/m²
2011–2013	3 (2–4)	135.3 (22.1)	81 (12.5)	4.55 (1.27)	1.35 (0.42)	2.49 (1.07)	1.3 (1–1.8)	6.10 (2.03)	6.22 (0.97)	28.7 (4.4)
2016–2017	2 (1–3)	134.1 (18.4)	79.7 (10.6)	4.09 (1.09)	1.30 (0.37)	2.12 (0.92)	1.25 (0.96–1.73)	6.41 (2.07)	6.18 (0.95)	29.0 (4.4)
P value	0.001	0.36	0.55	<0.001	0.05	<0.001	0.04	0.02	0.59	0.33
Differences adjusted for age, sex, index diagnosis, duration of education, and professional activity (95% CIs)										
2016–2017 vs 2011–2013	−0.68 (−1.26 to −0.09)	−3.4 (−6.4 to −0.3)	0.1 (−1.6 to 1.8)	−0.31 (−0.49 to −0.12)	0 (−0.05 to 0.06)	−0.29 (−0.44 to −0.13)	−0.09 (−0.25 to −0.07)	0.34 (0.01–0.67)	0.38 (−14.19 to 14.95)	0.28 (−0.41 to 0.96)

Data are presented as mean (SD) or median (interquartile range) unless otherwise indicated.

[a] Available for 362 patients in 2011–2013 and 383 patients in 2016–2017

Abbreviations: BMI, body mass index; CO, carbon monoxide; DBP, diastolic blood pressure; HbA_{1c}, glycosylated hemoglobin; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SBP, systolic blood pressure

TABLE 3 Temporal changes in proportions of patients who did not reach treatment goals 6 to 18 months after discharge

Survey	Smoking	BP not at goal[a]	BP ≥140/90 mm Hg	LDL cholesterol ≥1.8 mmol/l	HbA_{1c} ≥7%[b]	Fasting glucose ≥7 mmol/l	BMI ≥25 kg/m²	BMI ≥30 kg/m²
2011–2013	117 (19)	310 (50.3)	265 (43)	443 (71.9)	87 (14.1)	98 (15.9)	500 (81.2)	208 (33.8)
2016–2017	63 (16.2)	158 (40.6)	152 (39.1)	235 (60.4)	58 (14.9)	79 (20.3)	324 (83.3)	149 (38.3)
P value	0.26	0.003	0.24	<0.001	0.76	0.09	0.37	0.14
Differences adjusted for age, sex, index diagnosis, duration of education, and professional activity (95% CIs)								
2016–2017 vs 2011–2013	–0.2 (–6 to 5.5)	–8.9 (–15.6 to –2.1)	–6.7 (–14.3 to 1)	–9.5 (–16.7 to –2.2)	2 (–3.4 to 7.4)	3.9 (–2.2 to 10)	3.8 (–3.9 to 11.6)	1.6 (–5.8 to 9)

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

a BP goal of <140/90 mm Hg (<130/80 mm Hg in diabetics) in 2011–2013 and <140/90 mm Hg (<140/85 mm Hg in diabetics) in 2016–2017

b Available for 362 patients in 2011–2013 and 383 patients in 2016–2017

Abbreviations: BP, blood pressure; others, see TABLE 2

TABLE 4 Temporal changes in proportion of patients receiving cardioprotective drugs 6 to 18 months after discharge from hospital

Survey	Antiplatelets	β-Blockers	ACEIs/ARBs	Calcium antagonists	Diuretics	Lipid-lowering drugs	Antidiabetic agents	Anticoagulants
2011–2013	556 (90.3)	498 (80.8)	473 (76.8)	147 (23.9)	262 (42.5)	518 (84.1)	164 (26.6)	42 (6.8)
2016–2017	374 (96.1)	352 (90.5)	343 (88.2)	125 (32.1)	186 (47.8)	353 (90.7)	147 (37.8)	57 (14.7)
P value	<0.001	<0.001	<0.001	0.004	0.1	0.002	<0.001	<0.001
Differences adjusted for age, sex, index diagnosis, duration of education, and professional activity (95% CIs)								
2016–2017 vs 2011–2013	6.5 (2.6–10.3)	7.4 (2.2–12.6)	8.6 (2.9–14.3)	8.1 (1.3–15)	6.2 (–1.2 to 13.6)	3.9 (–1.2 to 9.1)	6.3 (–0.9 to 13.6)	5.5 (0.7–10.2)

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

Abbreviations: ACEIs, angiotensin-converting enzyme inhibitors; ARBs, angiotensin II receptor blockers

patients with CAD have been published recently,[10,11,18,19] including the concept of managed care for survivors of myocardial infarction, which was introduced in 2017.[11]

The increase in the uptake of blood pressure–lowering drugs might be related to a significantly higher proportion of patients with blood pressure at target level in 2016 to 2017. Nevertheless, a considerable proportion of patients with CAD still have uncontrolled blood pressure. Furthermore, the high proportion of patients with elevated LDL cholesterol levels despite a wide use of lipid-lowering drugs as well as the high proportion of overweight or obese patients suggest a considerable potential for lifestyle modification.[6,10,20,21]

Our data allow for a comparison of risk factor control in Kraków and other European centers participating in the EUROASPIRE survey.[22] In 2016–2017, in our study, 16% of patients were smokers, and in the EUROASPIRE survey centers, 19%.[22]

The proportions of patients with high blood pressure (41% vs 42%) and obesity (38% vs 38%) were similar between the studies, and more patients had high LDL cholesterol levels in the EUROASPIRE (60% vs 71%). Generally, more patients were prescribed cardioprotective drugs in Polish centers compared with the EUROASPIRE centers (antiplatelets, 96% vs 93%; β-blockers, 91% vs 81%; ACEIs/ARBs, 88% vs 75%; lipid-lowering drugs, 91% vs 84%, respectively). Similar conclusions could be drawn when comparing data of Polish patients with stable CAD with those from other European countries participating in the CLARIFY registry.[23]

The present analysis has several limitations, which are similar to previously published comparable analyses.[8,14,24] Firstly, we were unable to assess the impact of the implementation of cardiovascular prevention guidelines on the risk of cardiovascular complications.[8,14,24] Secondly, participants in the present study were not representative of all patients with CAD: they were limited to those after an acute CAD event or after a revascularization procedure. As a consequence, the present results should not be directly addressed to other groups of patients with CAD. Thirdly, we only studied patients aged 80 years or younger, and hence our results should not be applied directly to older patients. Fourth, examined factors might have not been stable over one year period in some patients. Finally, we did not analyze the doses of cardioprotective drugs taken by patients, and it is possible that blood pressure as well as levels of lipids and glucose were not controlled in some cases due to insufficient dosage. It should also be noted that we had no information on patient compliance with instructions regarding prescriptions. It is reasonable to suspect that some patients had taken their medications irregularly.[25-27] According to a previously published study, patient self-reported drug intake is often misleading.[26] However, an important advantage

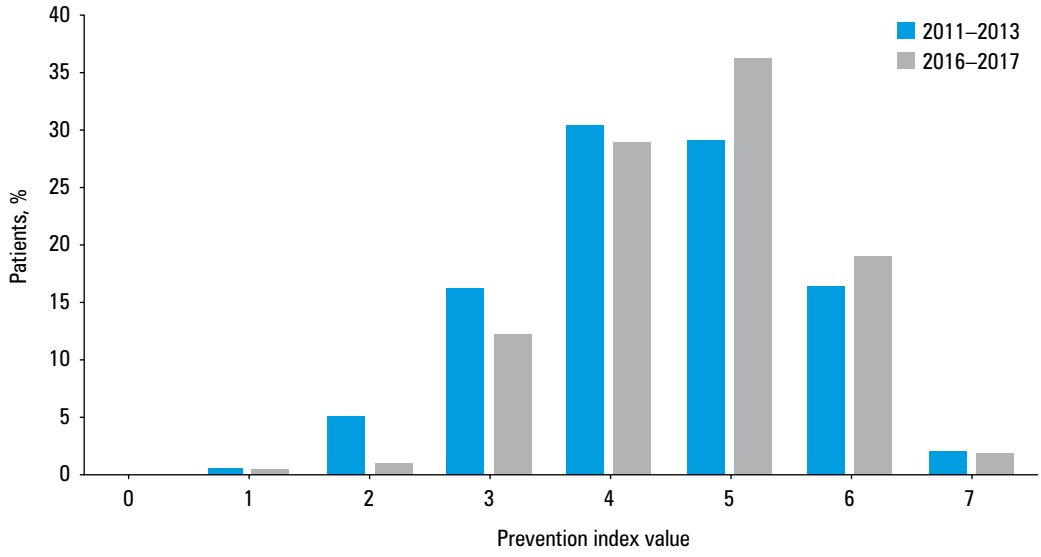

FIGURE 1 Distribution of the prevention index values by survey ($P = 0.007$)

of our analysis is that our results are not based on abstracted medical record data but on face-to--face interviews and examinations using the same protocol and standardized methods and instruments.[8,14,24] Therefore, the present analysis provides reliable information on lifestyle, risk factors, and therapeutic management for prevention of recurrent CAD.

Conclusions We found that more patients were prescribed several classes of cardiovascular drugs and consequently had a slight improvement in the control of blood pressure and LDL cholesterol levels in 2016 to 2017 as compared with 2011 to 2013. However, no major changes occurred in the prevalence of other main cardiovascular risk factors.

ARTICLE INFORMATION

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CONTRIBUTION STATEMENT PJ, PK, PB, PG, EM-B, JN, PP, AW, DC, and AP were involved in organizing the study and managing data collection. PJ designed the analysis and performed the statistical analyses. JWP and PJ drafted the manuscript and contributed to analyses and interpretation. All authors revised the manuscript. All authors gave final approval and agreed to be accountable for all aspects of the work ensuring integrity and accuracy.

CONFLICT OF INTEREST None declared.

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