Knowledge and prevalence of risk factors for coronary artery disease in patients after the first and repeated percutaneous coronary intervention

Krzysztof Wójcicki¹, Róża Krycińska¹, Tomasz Tokarek¹, Zbigniew Siudak², Artur Dziewierz⁴, Renata Rajtar-Salwa¹, Rafał Januszek³, Andżelika Siwiec¹, Łukasz Reczek¹, Dariusz Dudek¹,⁴

1 2nd Department of Cardiology and Cardiovascular Interventions, University Hospital, Kraków, Poland
2 Faculty of Medicine and Health Science, Jan Kochanowski University, Kielce, Poland
3 Department of Clinical Rehabilitation, University of Physical Education, Kraków, Poland
4 2nd Department of Cardiology, Jagiellonian University Medical College, Kraków, Poland

KEY WORDS
 coronary artery disease, patient knowledge, secondary prevention

INTRODUCTION  Cardiovascular disease is the main cause of death in most European countries, responsible for 45% of all deaths.¹ Most of its risk factors can be modified and controlled. It has been recently reported that the control of cardiovascular risk factors in Europe is generally poor.² Percutaneous coronary intervention (PCI) is a minimally invasive procedure associated with a short hospital stay lasting even less than 24 hours.¹ Furthermore, PCI immediately relieves symptoms and causes less discomfort after the procedure compared with coronary artery bypass grafting. However, shorter hospitalization reduces the time for in-hospital education as well as the chance to review risk factors for coronary artery disease (CAD) and to initiate treatment of important yet often underappreciated factors...
WHAT’S NEW?
Although the European guidelines on cardiovascular disease prevention are well established, our study demonstrated that patients after percutaneous coronary intervention (PCI) (both first and repeated) are still poorly educated about the role of modifiable risk factors for coronary artery disease and its secondary prevention. It suggests that medical education in hospitals and outpatient departments is insufficient and ineffective. Current models of education implemented immediately after PCI and the timing of the procedure may be inadequate to induce recommended lifestyle changes. Every effort must be made to improve preventive practice so that it can meet the challenge posed by the progress in modern interventional cardiology.

such as obesity.4 The convenient procedure can make patients unaware of the severity of their disease and the impact of the intervention on the function of body systems.5 PCI was demonstrated as an independent predictor of nonattendance at cardiac rehabilitation and a predictor of poor adherence to lifestyle changes after the procedure.6 Despite the rapid development of PCI techniques, patients still lack knowledge and awareness of the necessity to prevent CAD. In recent years, only a slight improvement was observed in the control of risk factors for CAD in Poland.7 Thus, we sought to evaluate the influence of education offered during PCI-related hospitalization on knowledge, awareness, and prevalence of self-reported risk factors for CAD.

METHODS The study group included 200 consecutive patients admitted for elective PCI to the 2nd Department of Cardiology and Cardiovascular Interventions at the University Hospital in Kraków (Poland) from July 2016 to October 2018. We recruited patients with no history of revascularization (the pre-PCI group) and with a history of PCI defined as undergoing revascularization at least 8 weeks prior to the current hospitalization (the prior-PCI group). The data was collected using a self-designed 56-item questionnaire created on the basis of the 2016 European Society of Cardiology guidelines.8 The survey comprised questions about patients’ sociodemographic and clinical profile, knowledge of CAD, and control of cardiovascular risk factors. Ten questions—some with subsections— concerned the level of knowledge and 1 point was given for each correct answer; the maximal score in this part was 31 points (Supplementary material, Figure S1). Risk control was assessed based on data from the survey (Supplementary material, Figure S2) and information obtained from patients’ medical history, including blood pressure, fasting glucose, glycated hemoglobin, low-density lipoprotein, and total cholesterol levels (measurements taken during patients’ current hospitalization). The maximal possible score for risk control was 15 points.

RESULTS All patients (n = 200) enrolled in the study were divided into 2 groups according to the history of PCI. The pre-PCI group included 72 patients (36%) and the prior-PCI group, 128 (64%). The sociodemographic and clinical profiles of the study groups are presented in Tables 1 and 2. The median (IQR) level of knowledge was similar between the pre-PCI and prior-PCI groups (19 [12.5–23] points and 21 [12.5–24] points, respectively; P = 0.35). Also, no difference was observed in the median (IQR) level of risk control between both groups (5 [4.5–7] points and 6 [4–8] points, respectively; P = 0.4). The prevalence of particular risk factors for CAD in both groups is presented in Table 3. Of all patients, 41% attended cardiac rehabilitation, 28% chose stationary rehabilitation in an inpatient unit, 12% ambulatory rehabilitation in an outpatient unit, and 11% rehabilitation at home. Stationary rehabilitation and home rehabilitation were attended more often by the prior-PCI patients and no difference in attendance was observed between the study groups with regard to ambulatory rehabilitation. Two percent of the pre-PCI patients and 13% of the prior-PCI patients attended more than 1 type of rehabilitation (P = 0.01).

In a multiple regression analysis, not attending any rehabilitation had an influence on
### TABLE 1  Sociodemographic profile of the study patients

| Variable                        | All patients (n = 200) | Pre-PCI (n = 72) | Prior-PCI (n = 128) | P value |
|---------------------------------|------------------------|------------------|---------------------|---------|
| Male sex                        | 146 (73)               | 53 (73)          | 92 (72)             | 0.91    |
| Age, y, mean (SD)               | 67.3 (11.5)            | 67 (11.6)        | 67.5 (9.6)          | 0.8     |
| Education                       | Primary, secondary, or vocational | 152 (76) | 49 (68) | 103 (81) | 0.04 |
|                                 | Higher                 | 48 (24)          | 23 (32)             | 25 (19) |
| Current marital status          | Married                | 146 (73)         | 50 (70)             | 96 (75)  | 0.52 |
|                                 | Not married            | 54 (27)          | 22 (30)             | 32 (25)  |
| Place of residence              | Rural area             | 48 (24)          | 17 (24)             | 31 (24)  | 0.98 |
|                                 | City                   | 152 (76)         | 55 (76)             | 97 (76)  |
| Net monthly household income    | <4000 PLN\(^a\)        | 156 (78)         | 52 (72)             | 104 (81) | 0.22 |
|                                 | >4000 PLN\(^a\)        | 44 (22)          | 20 (28)             | 24 (19)  |

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

\(^a\) 1 PLN = 0.23 EUR

Abbreviations: PCI, percutaneous coronary intervention

### TABLE 2  Clinical characteristics of the study patients

| Variable                                         | All patients (n = 200) | Pre-PCI (n = 72) | Prior-PCI (n = 128) | P value |
|--------------------------------------------------|------------------------|------------------|---------------------|---------|
| Duration of CAD, y, median (IQR)                 | 6 (0.6–15)             | 0.5 (0.08–7)     | 10 (3–17)           | 0.001  |
| History of 2 or more cardiac hospitalizations   | 94 (47)                | 10 (15)          | 84 (66)             | 0.001  |
| History of MI                                    | 96 (48)                | 17 (24)          | 79 (62)             | 0.001  |
| Diabetes mellitus                                | 72 (36)                | 19 (26)          | 53 (41)             | 0.049  |
| Hypercholesterolemia                             | 164 (82)               | 51 (71)          | 113 (88)            | 0.02   |
| Arterial hypertension                            | 178 (89)               | 55 (76)          | 123 (95)            | 0.001  |
| Family history of CAD                            | 60 (30)                | 16 (23)          | 44 (34)             | 0.19   |
| Early diagnosis of CAD (below the age of 55 in men and 65 in women) | 102 (51) | 27 (37) | 75 (59) | 0.003 |

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

Abbreviations: CAD, coronary artery disease; IQR, interquartile range; MI, myocardial infarction; others, see TABLE 1

### TABLE 3  Prevalence of risk factors for coronary artery disease in the study patients

| Variable                                           | All Patients (n = 200) | Pre-PCI (n = 72) | Prior-PCI (n = 128) | P value |
|----------------------------------------------------|------------------------|------------------|---------------------|---------|
| Little physical activity (regular activity <150 min a week) | 150 (75)               | 55 (76)          | 95 (74)             | 0.78    |
| No cardiac rehabilitation                          | 118 (59)               | 54 (76)          | 64 (50)             | 0.001   |
| LDL cholesterol >1.8 mmol/l                        | 114 (57)               | 51 (71)          | 63 (49)             | 0.02    |
| Fasting glucose >5.5 mmol/l                        | 86 (43)                | 33 (46)          | 53 (41)             | 0.61    |
| SBP ≥140 mm Hg and / or DBP ≥90 mm Hg              | 84 (42)                | 30 (41)          | 54 (42)             | 0.9     |
| Obesity (BMI ≥30 kg/m\(^2\))                       | 68 (34)                | 19 (26)          | 49 (38)             | 0.07    |
| Current smoking                                    | 40 (20)                | 15 (21)          | 25 (19)             | 0.72    |

Data are presented as number (percentage).

Abbreviations: BMI, body mass index; DBP, diastolic blood pressure; LDL, low-density lipoprotein; SBP, systolic blood pressure; others, see TABLE 1
### TABLE 4 Impact of factors other than a history of percutaneous coronary intervention on the level of knowledge and control of risk factors for coronary artery disease

| Variable                  | Level of knowledge (max. 31) | P value | Level of risk control (max. 15) | P value |
|---------------------------|------------------------------|---------|---------------------------------|---------|
| All patients              | 20 (12.5–24)                 | –       | 6 (4–7)                         | –       |
| Age                       |                              |         |                                 |         |
| <65 y                     | 20 (13–24)                   | 0.87    | 5 (4–6)                         | 0.001   |
| >65 y                     | 21 (12–24)                   |         | 6 (5–8)                         |         |
| Sex                       |                              |         |                                 |         |
| Male                      | 20 (15–24)                   | 0.15    | 6 (4–7)                         | 0.5     |
| Female                    | 19 (8–23)                    |         | 5 (4–7)                         |         |
| Education                 |                              |         |                                 |         |
| Primary, secondary, or vocational | 19 (10–23)       | 0.002   | 5 (4–7.5)                       | 0.58    |
| Higher                    | 22 (19–24)                   |         | 6 (5–7)                         |         |
| Marital status            |                              |         |                                 |         |
| Married                   | 20.5 (13–24)                 | 0.66    | 6 (5–7)                         | 0.1     |
| Not married               | 20 (12.5–23.5)               |         | 5 (4–6.5)                       |         |
| Place of residence        |                              |         |                                 |         |
| Rural area                | 18 (10–22)                   | 0.03    | 6 (5–7)                         | 0.44    |
| City                      | 21 (15–24)                   |         | 5 (4–7)                         |         |
| Net monthly household income |                          |         |                                 |         |
| <4000 PLN a               | 19 (11–24)                   | 0.001   | 6 (4–7)                         | 0.37    |
| >4000 PLN a               | 22 (20–25)                   |         | 5 (5–8)                         |         |
| History of MI             |                              |         |                                 |         |
| Present                   | 21 (15–24)                   | 0.1     | 6 (5–8)                         | 0.03    |
| Absent                    | 19 (10–23)                   |         | 5 (4–7)                         |         |
| History of CABG           |                              |         |                                 |         |
| Present                   | 21 (18–23)                   | 0.13    | 7 (5–8)                         | 0.006   |
| Absent                    | 19 (11–24)                   |         | 5 (4–7)                         |         |
| Cardiac rehabilitation    |                              |         |                                 |         |
| Attended                  | 21 (17–24)                   | 0.06    | 7 (5–8)                         | 0.001   |
| Not attended              | 20 (11–24)                   |         | 5 (4–6)                         |         |
| Hypertension              |                              |         |                                 |         |
| Present                   | 20 (12–24)                   | 0.27    | 6 (4–7)                         | 0.72    |
| Absent                    | 21 (15–24)                   |         | 5 (4–8)                         |         |
| Diabetes                  |                              |         |                                 |         |
| Present                   | 21 (15–24)                   | 0.17    | 5 (4–7)                         | 0.56    |
| Absent                    | 19 (11–24)                   |         | 6 (4–8)                         |         |
| Cardiac consultations     |                              |         |                                 |         |
| Less often than every 6 months | 21 (15–24)     | 0.54    | 5 (4–6)                         | 0.01    |
| At least every 6 months   | 20 (13.5–24)                 |         | 6 (5–8)                         |         |

Data are presented as median (interquartile range) number of points scored in the questionnaire.

---

**Abbreviations:** CABG, coronary artery bypass grafting; others, see TABLE 2.

---

the level of risk control in all patients ($R^2 = 0.15$; $\beta = -2.4$; $P = 0.001$) and in the prior-PCI group ($R^2 = 0.18$; $\beta = -2.8$; $P = 0.001$). No such impact was found for any particular type of rehabilitation. There was no association between the level of knowledge and the type of rehabilitation. The compliance to prescribed treatment was similar in both groups; 18% of patients in the pre-PCI group and 11% in the prior-PCI group admitted forgetting about the treatment more frequently than once a month ($P = 0.17$). However, more patients in the pre-PCI group did not control blood pressure (28% in the pre-PCI group compared with 14% in the prior-PCI group, $P = 0.04$). No difference between the groups was observed in the frequency of visiting a general practitioner: 37% of the pre-PCI and 49% of the prior-PCI patients visited a general practitioner regularly every month ($P = 0.2$). Patients from the prior-PCI group consulted a cardiologist more often: 44% of the pre-PCI and 73% of the prior-PCI patients visited a cardiologist at least once in 6 months ($P = 0.001$). The frequency of visiting a general practitioner had no impact on both the level of knowledge ($P = 0.85$) and the level of risk factor control ($P = 0.11$).

We evaluated the impact of factors other than a history of PCI on the level of knowledge and the level of control of risk factors for CAD. The specific data are presented in TABLE 4. The analysis of Spearman rank correlation coefficient revealed that there was no correlation between the number of hospitalizations and the level of knowledge ($R^2 = 0.07$; $P = 0.38$). However, a weak correlation was found between the duration of CAD and the level of knowledge ($R^2 = 0.2$; $P = 0.03$). In addition, the actual level of patient knowledge correlated with the self-assessed level of knowledge ($R^2 = 0.36$; $P = 0.001$). Weak correlations were confirmed between the number of hospitalizations and the level of CAD risk control ($R^2 = 0.2$; $P = 0.002$) as well as between the duration of CAD and the level of risk control ($R^2 = 0.2$; $P = 0.003$). No association was found between the level of knowledge and that of risk control. However, there was a link between the self-assessed level of self-care and level of risk control ($R^2 = 0.2$; $P = 0.02$). The results of the multiple regression model assessing the impact of sociodemographic and clinical factors on the level of knowledge and risk control are presented in TABLE 5.

Asked about their previous education on CAD, 44% of patients in the pre-PCI group and 53% in the prior-PCI group reported receiving education during every previous hospitalization, whereas 25% of patients in the pre-PCI group and 13% in the prior-PCI group had not received any information before ($P = 0.06$). The median (IQR) quality rate of provided education assessed on a 5-point scale (1—worst quality, 5—best quality) was 3 (2–4) in the pre-PCI group and 4 (3–5) in the prior-PCI group ($P = 0.01$).

### DISCUSSION

The results of our study suggest that a change in patients’ lifestyle and an increase in their knowledge after PCI is insufficient. Furthermore, not attending any form of rehabilitation lowers the level of risk control.
In recent decades, a rapid development in both pharmacological and invasive methods of treating CAD has been observed. Nevertheless, the results of the mortality follow-up in a series of the EUROASPIRE surveys indicate that cardiovascular risk factors remain independent predictors of mortality in patients with CAD. It has been repeatedly demonstrated that the proper management of those risk factors, based on comprehensive secondary prevention programs, directly translates into a significant reduction in cardiac mortality and an improvement in the quality of life.

The EUROASPIRE IV survey, conducted among 7998 patients with CAD, highlighted the excessively high incidence of modifiable cardiovascular risk factors and their insufficient control, with 16% of the patients still smoking, 42.7% having poorly controlled hypertension, 37% being obese, 59.9% not meeting physical activity goals, 80.5% having poorly controlled low-density lipoprotein cholesterol levels, 26.8% having diabetes, and 58.8% not participating in any form of cardiac rehabilitation. Preliminary data from the EUROASPIRE V study are even more worrisome.

At the same time, it has been shown that even the standard education provided during hospitalization significantly improves patient awareness, and longer and more comprehensive education programs and cardiac rehabilitation can increase the effect. Of note, as many as 85% of the respondents in the latest European survey had a history of PCI. The introduction of PCI—with a shorter hospital stay, faster recovery, and frequent immediate relief of symptoms—improves short- to medium-term prognosis compared with coronary artery bypass grafting. However, the disease and its debilitating consequences can be underestimated by the patients.

In the SPICI study (Study of Patient Information after Percutaneous Coronary Intervention), 67% of the prior-PCI patients perceived themselves as

### TABLE 5

Results of the multivariate regression analysis assessing the impact of risk factors for coronary artery disease on the level of knowledge and risk control in study patients

| Dependent variable | Study group | $R^2$ | Independent variable | β  | P value |
|--------------------|-------------|-------|-----------------------|----|---------|
| Level of knowledge | Pre-PCI     | 0.33  | Number of hospitalizations | −1.30 | 0.2   |
|                    |             |       | Duration of CAD       | 0.16 | 0.06   |
|                    |             |       | Self-assessed level of knowledge | 2.39 | 0.001 |
|                    |             |       | Self-assessed level of self-care | −0.71 | 0.34   |
|                    |             |       | Level of risk control  | −0.24 | 0.59   |
| Prior-PCI          |             | 0.05  | Number of hospitalizations | −0.07 | 0.74   |
|                    |             |       | Duration of CAD       | 0.06 | 0.35   |
|                    |             |       | Self-assessed level of knowledge | 0.89 | 0.1    |
|                    |             |       | Self-assessed level of self-care | −0.22 | 0.71   |
|                    |             |       | Level of risk control  | 0.23 | 0.47   |
| Level of risk control | Pre-PCI  | 0.15  | Number of hospitalizations | 0.06 | 0.85   |
|                    |             |       | Duration of CAD       | 0.03 | 0.24   |
|                    |             |       | Self-assessed level of knowledge | 0.29 | 0.18   |
|                    |             |       | Self-assessed level of self-care | 0.39 | 0.1    |
|                    |             |       | Level of knowledge     | −0.03 | 0.59   |
| Prior-PCI          |             | 0.02  | Number of hospitalizations | 0.12 | 0.62   |
|                    |             |       | Duration of CAD       | 0.12 | 0.58   |
|                    |             |       | Self-assessed level of knowledge | 0.11 | 0.37   |
|                    |             |       | Self-assessed level of self-care | 0.1  | 0.51   |
|                    |             |       | Level of knowledge     | 0.1  | 0.47   |

Abbreviations: see TABLES 1 and 2.
the evidence on the quality of secondary pre-
vention or secondary prevention program.
A similar lack of relation between the duration and severity of the disease and its risk factors was also observed in other conditions such as aortic valve stenosis.

**Limitations** Some important limitations of our study should be considered. The main limitation was the unstandardized questionnaire used in the assessment of patient knowledge and risk control levels. However, we still lack standardized methods for such evaluation and experience obtained from every study investigating that issue may help create normalized tools that could be used in further research to provide comparable results. Another important limitation is the heterogeneous patients’ clinical characteristics, also present for factors influencing the level of knowledge and risk control, such as the prevalence of MI or duration of CAD. However, the heterogeneity depicts a comprehensive profile of patients in each group that influences the clinical outcome and it is difficult to assess particular factors in isolation. Furthermore, our study is based on a single-center experience. Therefore, further multi-center trials are still needed to fully assess the complex factors that affect patients’ attitude towards lifestyle modifications in CAD.

**Conclusions** Patients have poor knowledge and awareness of their CAD risk regardless of having a history of revascularization. No difference in the levels of knowledge and risk control was observed between the pre- and prior-PCI groups. There is a considerable need for an in-depth revision of secondary prevention of CAD, especially in the prior-PCI population, aimed to improve patients’ understanding of the disease and compliance to the cardioprotective lifestyle.
Supplementary material is available at www.mp.pl/kardiologiapolska.

ARTICLE INFORMATION

CONFLICT OF INTEREST None declared.

OPEN ACCESS This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0), allowing third parties to download articles and share them with others, provided the original work is properly cited, not changed in any way, distributed under the same license, and used for non-commercial purposes only. For commercial use, please contact the Journal office at kardiologiapolska@ptkardio.pl.

HOW TO CITE Wójcicki K, Kryczkis Ł, Tołkarcz K, et al. Knowledge and prevalence of risk factors for coronary artery disease in patients after the first and repeated percutaneous coronary intervention. Kardiol Pol. 2020; 78: 147-153. doi:10.33963/KP.19070

REFERENCES

1 Wilkins T, Wilson L, Wickramasinghe K, et al. European Cardiovascular Disease Statistics 2017. Brussels, Belgium: European Heart Network; 2017: 11-16.

2 Kotseva K, Wood D, De Bacquer D, et al. EUROASPIRE IV: a European Society of Cardiology survey on the lifestyle, risk factor and therapeutic management of coronary patients from 24 European countries. Eur J Prev Cardiol. 2016; 23: 636-648.

3 Serruys PW, Morice MC, Kappetein AP, et al. Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. N Engl J Med. 2009; 360: 961-972.

4 Hossain M, Amin A, Paul A, et al. Recognizing obesity in adult hospitalized patients: a retrospective cohort study assessing rates of documentation and prevalence of obesity. J Clin Med. 2018; 7: E203.

5 Sabatowski K, Stotek M, Wegrzyń K, et al. Impact of percutaneous invasive coronary procedures using a radial approach on endothelial function of radial artery. Postepy Kardiol Interwencyjnej. 2018; 14: 95-98.

6 Gentz CA. Perceived learning needs of the patient undergoing coronary angioplasty: an integrative review of the literature. Heart Lung. 2000; 29: 161-172.

7 Jankowski P, Czarnecka D, Lysyk R, et al. Secondary prevention in patients after hospitalization due to coronary artery disease: what has changed since 2006? Kardiol Pol. 2014; 72: 355-362.

8 Piepoli MF, Hoes AW, Agewall S, et al. European Guidelines on cardiovascular disease prevention in clinical practice: the Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). Eur Heart J. 2016; 37: 2315-2381.

9 Ford ES, Ajani UA, Croft JB, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980-2000. N Engl J Med. 2007; 356: 2388-2398.

10 Brown JP, Clark AM, Dalal H, et al. Effect of patient education in the management of coronary heart disease: a systematic review and meta-analysis of randomized controlled trials. Eur J Prev Cardiol. 2013; 20: 701-714.

11 Clark AM, Hartling L, Vandermeer B, McAlister FA. Meta-analysis: secondary prevention programs for patients with coronary artery disease. Ann Intern Med. 2005; 143: 659-672.

12 De Bacquer D, De Bacquier D, Ryhlé J, et al. EUROASPIRE investigators. Lifestyle and risk factor management in people at high cardiovascular risk from Bulgaria, Croatia, Poland, Romania and the United Kingdom who participated in both the EUROASPIRE III and IV primary care surveys. Eur J Prev Cardiol. 2016; 23: 1618-1627.

13 Kotseva K. EUROASPIRE — time trends in lifestyle, cardiovascular risk factors, and therapeutic management in patients with coronary disease in Europe: a comparison of EUROASPIRE IV and V surveys over 5 years in 21 countries. Paper presented at: ESC Congress 2018; August 27, 2018; Munich, Germany.

14 Griffo R, Ambrosi M, Tramarin R, et al. Effective secondary prevention through cardiac rehabilitation after coronary revascularization and predictors of poor adherence to lifestyle modification and medication. Results of the ECAROS Survey. Int J Cardiol. 2013; 167: 1390-1395.

15 Reddorfer J, Briffa T, Ellis E, Freedman SB. Choice of secondary prevention improves risk factors after acute coronary syndrome: 1-year follow-up of the CHOICE (Choice of Health Options In prevention of Cardiovascular Events) randomised controlled trial. Heart. 2009; 95: 468-475.

16 Siudak Z, Krawczyk-Ołóz A, Twarał J, et al. Patients overestimate the potential benefits of elective percutaneous coronary intervention. Mo Med. 2012; 109: 79-84.