ORIGINAL ARTICLE

Smoking cessation in patients with established coronary artery disease: data from the POLASPIRE survey

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ABSTRACT

BACKGROUND   Smoking cessation in patients with coronary artery disease (CAD) is related to decreased risk of cardiovascular events.

AIMS   To evaluate factors related to persistent smoking in patients with established coronary artery disease.

METHODS   Patients aged 80 years or younger and hospitalized for acute coronary syndrome or a myocardial revascularization procedure were interviewed 6 to 18 months after the recruiting event. Medical history, smoking behavior, and exposure to environmental smoke were assessed during the interview. Self--reported smoking status was validated by carbon monoxide in exhaled air measurement. Persistent smoking was defined as smoking at the time of interview among those who smoked during the month prior to the recruiting event.

RESULTS   We analyzed the data of 1034 patients, including 764 (73.9%) who reported smoking at any time in the past and 296 (28.6%) who smoked within 1 month before the recruiting hospitalization. At the time of the interview, the overall smoking rate was 17.2%, whereas 54.7% of patients were persistent smokers. Secondhand smoke exposure and duration of smoking were associated with lower likelihood whereas older age, high socioeconomic status, cardiac rehabilitation following a cardiovascular event, and consultation with a cardiologist were associated with higher likelihood of smoking cessation.

CONCLUSIONS   Over half of all smokers hospitalized for CAD are still smoking 6 to 18 months after discharge. Older age, secondhand smoking, low socioeconomic status, lack of consultation with a cardiologist, and cardiac rehabilitation following hospitalization were related to persistent smoking. Our findings may help develop strategies aimed at assisting smoking cessation in patients with CAD.

INTRODUCTION   Smoking is a major modifiable cardiovascular risk factor.[1-3] Smoking cessation in patients with coronary artery disease (CAD), including those with a history of myocardial infarction cuts the risk of recurrent cardiovascular events and all-cause mortality

WHAT'S NEW?
Our results suggest that three-quarters of patients with established coronary artery disease (CAD) are current or prior smokers and roughly 55% of those who smoked in the month prior to the recruiting event are persistent smokers. Overall, the smoking rate was 17% and thus did not differ significantly from surveys published 10 and 20 years ago. Approximately a quarter of all CAD patients and roughly half of all persistent smokers are exposed to environmental tobacco smoke. We found that more patients are exposed to environmental tobacco smoke at home than at work. Secondhand smoke exposure and duration of smoking were associated with lower likelihood of smoking cessation in our population, whereas in the case of older age, high socioeconomic status, cardiac rehabilitation following an cardiovascular event, and specialized cardiac care, this likelihood was higher.

substantially.[4] However, only half of smokers with CAD in Europe are able to successfully quit smoking.[5,6] The European guidelines on cardiovascular prevention in clinical practice recommend a comprehensive approach to risk factor management in the secondary prevention of CAD.[7] Optimal secondary prevention includes lifestyle modification, appropriate pharmacotherapy, control of blood pressure and low-density lipoprotein (LDL) cholesterol and no exposure to tobacco in any form.[1,7] Several recent surveys showed a considerable potential for further improvement of secondary prevention in European countries, including Poland.[6,8] Moreover, the available data suggest that the proportion of patients still smoking following a hospitalization due to CAD has not changed substantially for over 20 years.[9,10] Despite convincing evidence, smoking cessation strategies have been poorly implemented.[5,6]

The POLASPIRE survey is the most recent survey in Poland designed to gauge the implementation of the recently published guidelines for the secondary prevention of CAD by assessing control of main risk factors and prescription rates of cardioprotective medication in patients with established CAD.[8] The aim of the present analysis was to investigate factors related to smoking cessation following hospitalization due to CAD.

METHODS The POLASPIRE study was a cross-sectional, multicenter survey carried out in 4 regions: one in northern, one in central, and 2 in the southern part of Poland in 2016 to 2017 and was described in detail elsewhere.[8] Briefly, in each region, at least one teaching and one municipal hospital took part in the survey. In total, 14 departments of cardiology from 12 different hospitals participated. Seven departments were located in teaching hospitals and 7 in municipal hospitals. The inclusion criteria for the POLASPIRE survey were as follows: past hospitalization for acute coronary syndrome or a myocardial revascularization procedure and be age from 18 to 80 years. Centrally trained research staff collected data using standardized methods and the same instruments in all centers. Overall, 1236 patients were invited to participate in the study and their medical records were reviewed.

The survey participants were interviewed 6 to 18 months after discharge from the hospital. A patient's personal medical history, lifestyle, and medications used were assessed using a standard questionnaire. The participants' education was assessed on the basis of the number of years of formal education completed. Self-perceived income was based on the answers to the question: "In your opinion, your family income is: very low, low, intermediate, high." The following question was aimed at measuring loneliness: "Do you have somebody with whom you share your problems or happiness?" Height and weight were measured in a standing position without shoes and heavy outerwear using standard scales with a vertical ruler (SECA). The scales were calibrated at the start of the survey. Body mass index (BMI) was calculated according to the following formula: BMI = weight [kg] / (height [m])^2. Obesity was defined as BMI of 30 kg/m^2 or greater. Blood pressure was measured twice in the right arm in a sitting position after 5 minutes of rest at least. The average of the 2 readings was used in the present analysis. High blood pressure was defined as blood pressure of 140/90 mm Hg or greater or 140/85 mm Hg or greater in patients with diabetes. A fasting venous blood sample was taken to measure plasma lipid and creatinine levels. For the purposes of the present report, the results of analyses performed no later than 12 hours after blood collection were used. The level of LDL cholesterol was calculated according to the Friedewald formula. A high cholesterol level was defined as LDL cholesterol of 1.8 mmol/l or greater. Glomerular filtration rate was defined using the Modification of Diet in Renal Disease formula. Patient psychosocial characteristics were assessed using the Hospital Anxiety and Depression Scale.[11]

Finally, we constructed a socioeconomic status (SES) summary score on the basis of various socioeconomic components. This score was the sum of the following subscores: educational level (primary school completed or less, 0 points; intermediate, 2; college / university, 4), perceived income (very low = 0; low = 2; intermediate = 4; high = 6), loneliness (yes = 0; no = 2), employment (yes, 2; no, 0), and being married (yes = 1; no = 0). Based on this summary score, varying from 0 to 15, we subdivided our sample in 2 groups: patients at a "low SES level" had a summary score of 7 or less, and those having a "high SES level" had scores of 8 or more.

Assessment of smoking behavior Information on smoking behavior was collected using a standard interview questionnaire. The patients were asked if they had ever smoked and if they were smoking during the month prior to hospital admission for the recruiting event. The study participants were also asked about the mean number of cigarettes they smoked, duration of their smoking habit, any attempts they had made to quit smoking, and secondhand smoke exposure. Smoking at the time of interview was defined as self-reported smoking verified by the concentration of breath carbon monoxide using a smoker analyzer (Bedfont Scientific, Model Micro+, Bedfont Scientific, Kent, United Kingdom). Breath carbon monoxide exceeding 10 ppm was considered to be an indication of current smoking. Pre-event smoking was defined as being current smoker within the month prior to the recruiting event. Persistent smoking was defined as smoking at the time of interview among those who had smoked during the month prior to the recruiting event. The survey's protocol was approved by the institutional Bioethics Committees. Every patient signed an informed consent form.

Statistical analysis Categorical variables were reported as percentages and continuous variables as means (SD) or medians (interquartile ranges [IQRs]). The χ^2 or the Fisher exact test was applied to all the categorical variables. The Shapiro–Wilk test was used to assess the normality. Normally distributed continuous variables were compared using the t test. Variables without normal distributions were evaluated by means of the Mann–Whitney test. The Bonferroni correction was used to account for the multiple comparisons. Stepwise, multivariable logistic regression analysis was performed to assess factors independently related to smoking during the postdischarge period. A 2-tailed P value of less than 0.05 was regarded as indicating statistical significance. The statistics were calculated with the STATISTICA 13 software (TIBCO Software, Palo Alto, United States).

RESULTS Overall, 1034 patients participated in the survey and their data were analyzed, including 764 (73.9%) who reported having smoked at any time in the past and 296 (28.6%) who smoked within the month preceding the recruitment, whereas 270 (26.1%) participants reported they had never smoked. The characteristics of the study groups are presented in TABLE 1 (after exclusion of 16 cases who did not smoke within the month preceding the recruiting hospitalization and smoked at the time of follow-up interview). At the time of the interview, the smoking rate was 17.2% (16.4% of patients reported current smoking). Among those who were smokers within the month prior to the recruiting hospitalization, 54.7% were smoking at the time of the interview. Smokers were younger than nonsmoking patients and more often were hospitalized for cardiovascular disease before the recruiting event. Persistent smokers participated in the cardiac rehabilitation program less often and less frequently consulted a cardiologist following discharge from the hospital. They were also more likely to have high LDL cholesterol levels. On the other hand, there was a trend for more prevalent obesity among quitters (TABLE 1). Among those who were not current smokers before the recruiting event, 16 (2.2%) were smokers at the time of the interview. This group consisted of 12 men and 4 women, the mean (SD) age was

TABLE 1 Characteristics of the study groups (continued on the next page)

Characteristics		Not smoking before the recruiting event, not smoking after the recruiting event (n = 722)	P value	Smoking before the recruiting event, not smoking after the recruiting event (n = 134)	P value	Smoking before the recruiting event, smoking after the recruiting event (n = 162)
Age, y		68 (62.8–73.7)	<0.001	63.1 (59–69.1)	0.014	61.5 (55.9–66)
Sex	Male	503 (69.7)	0.18	101 (75.4)	0.72	125 (77.2)
	Female	219 (30.3)		33 (24.6)		37 (22.8)
Marital status	Married	534 (74)	0.24	95 (70.9)	0.88	115 (71.1)
	Divorced / separated	47 (6.5)		15 (11.2)		22 (13.6)
	Widowed	115 (15.9)		18 (13.4)		18 (11.1)
	Never married	26 (3.6)		5 (3.7)		6 (3.7)
Living alone		114 (15.8)	0.63	23 (17.2)	0.49	25 (15.4)
Loneliness		22 (3)	0.34	6 (4.5)	0.95	7 (4.3)
Duration of education, y		12 (10–15)	0.8	12 (11–14)	0.21	12 (11–13)

Characteristics		Not smoking before the recruiting event, not smoking after the recruiting event (n = 722)	*P* value	Smoking before the recruiting event, not smoking after the recruiting event (n = 134)	*P* value	Smoking before the recruiting event, smoking after the recruiting event (n = 162)
Household income[a]	High	35 (4.9)	0.56	7 (5.2)	0.94	6 (3.7)
	Medium	473 (65.5)		81 (60.4)		98 (60.5)
	Low	185 (25.6)		38 (28.4)		48 (29.6)
	Very low	29 (4)		8 (6)		10 (6.4)
Employed		196 (27.1)	0.006	52 (38.8)	0.82	65 (40.1)
High socioeconomic status		267 (37)	0.05	62 (46.3)	0.1	59 (36.4)
Recruiting event	Myocardial infarction	235 (32.5)	<0.001	76 (56.7)	0.25	75 (46.3)
	Unstable angina	178 (24.7)		18 (13.4)		21 (13)
	PCI	275 (38.1)		37 (27.6)		60 (37)
	CABG	34 (4.7)		3 (2.2)		6 (3.7)
Hospitalization in teaching hospital		595 (82.4)	0.59	113 (84.3)	0.82	135 (83.3)
Previous hospitalization for cardiovascular disease[b]		403 (55.8)	<0.001	42 (31.3)	0.009	75 (46.3)
Participation in a cardiac rehabilitation program following discharge		197 (27.3)	0.001	55 (41)	0.004	41 (25.3)
Physician specialty	Cardiologist	637 (88.2)	0.68	117 (87.3)	0.006	120 (74.1)
	General practitioner	622 (86.1)	0.37	111 (82.8)	0.37	141 (87)
	Diabetologist	76 (10.5)	0.76	15 (11.2)	0.94	18 (11.1)
	Other physician	22 (3)	0.36	2 (1.5)	0.25	6 (3.7)
	No physician	6 (0.8)	0.29	0	0.37	1 (0.6)
Obesity		310 (42.9)	0.48	62 (46.3)	0.05	57 (35.2)
Diabetes		277 (38.4)	0.03	38 (28.4)	0.9	47 (29)
High blood pressure[c]		324 (44.9)	0.19	52 (38.9)	0.4	55 (33.9)
High LDL cholesterol[d]		450 (62.3)	0.09	73 (54.5)	0.004	114 (70.4)
GFR <60 ml/kg/1.73 m²		153 (21.2)	0.009	15 (11.2)	0.58	15 (9.3)
Depression score[e]		5 (3–8)	0.54	5 (2–8)	0.72	6 (2–8)
Anxiety score[e]		6 (3–8)	0.93	5 (3–8)	0.61	6 (3–8)

Data are presented as number (percentage) of patients or median (interquartile range).

a Based on the patient's report

b Hospitalization before the recruiting event due to: coronary artery bypass grafting, percutaneous coronary intervention, acute coronary syndrome, chronic coronary syndrome, heart failure, stroke, or peripheral artery disease

c Blood pressure ≥140/90 mm Hg or ≥140/85 mm Hg in patients with diabetes

d Low-density lipoprotein cholesterol ≥1.8 mmol/l

e Based on the Hospital Anxiety and Depression Scale

Abbreviations: CABG, coronary artery bypass grafting; GFR, glomerular filtration rate; LDL, low-density lipoprotein; PCI, percutaneous coronary intervention

60.9 (8.6) years (*P* <0.01) compared with the rest of nonsmokers prior to the recruiting hospitalization), and 13 (81.3%) were hospitalized for cardiovascular disease prior to the recruitment event (*P* = 0.04). The majority of them were former smokers and only one participant reported that he had never smoked before the recruitment event but started to smoke after discharge.

The characteristics of smoking behavior are presented in TABLE 2. Successful quitters reported a shorter duration of smoking and less frequent exposure to second-hand smoke at work and at home. Overall, 23.7% of participants were exposed to environmental tobacco smoke, including 6.8% exposed at work and 16.6% exposed at home. Among those who were professionally

TABLE 2 Characteristics of the smoking behavior

Characteristics		Not smoking before the recruiting event, not smoking after the recruiting event (n = 722)	P value	Smoking before the recruiting event, not smoking after the recruiting event (n = 134)	P value	Smoking before the recruiting event, smoking after the recruiting event (n = 162)
Duration of smoking, y		20 (15–35)[a]	<0.001	35 (30–45)	0.11	40 (30–45)
Number of smoked cigarettes daily in the postdischarge period		–	–	–	–	10 (4–15)
Planning to stop smoking		–	–	–	–	79 (48.8)
E-cigarettes use		0	>0.99	0	0.07	4 (2.5)
Secondhand smoking	At work	30 (4.2)	0.83	6 (4.5)	<0.001	34 (21)
	At home	84 (11.6)	0.04	24 (17.9)	<0.001	59 (36.4)
	Other places	19 (2.6)	<0.001	19 (14.2)	0.89	22 (13.6)
Any secondhand smoking		117 (16.2)	<0.001	41 (30.6)	<0.001	84 (51.9)

Data are presented as number (percentage) of patients or median (interquartile range).

a　Among participants who reported smoking at any time (n = 452)

TABLE 3 Smoking cessation therapies

Therapy		Smoking before the recruiting event, smoking after the recruiting event (n = 162)	Smoking before the recruiting event, not smoking after the recruiting event (n = 134)	P value	Total (n = 296)
Trying to stop smoking since recruiting event		104 (64.2)	134 (100)	<0.001	238 (80.4)
Trying to reduce number of smoked cigarettes since the recruiting event		124 (76.5)	9 (6.7)	<0.001	133 (44.9)
Smoking cessation clinic		0	1 (0.7)	0.27	1 (0.3)
Nicotine replacement therapy	Since recruiting event	9 (5.6)	1 (0.7)	0.02	10 (3.4)
	At the time of the follow-up examination	0	0	–	0
Bupropion	Since recruiting event	0	0	–	0
	At the time of the follow-up examination	0	0	–	0
Varenicline	Since recruiting event	1 (0.6)	1 (0.7)	0.89	2 (0.7)
	At the time of the follow-up examination	0	0	–	0

Data are presented as number (percentage) of patients.

active, 22% were exposed to environmental tobacco smoke at work. The smoking cessation therapies used by the pre-event smokers are presented in TABLE 3. Smoking cessation was only attempted by 64.2% of persistent smokers whereas 76.5% tried to reduce the number of cigarettes they smoked. At the time of the interview, none of the smokers used nicotine replacement therapy, bupropion or varenicline, and only a few patients tried these therapies during the period from discharge to the follow-up examination.

The results of multivariable analyses are presented in TABLE 4. Secondhand smoke exposure and duration of smoking were associated with lower likelihood whereas older age, high socioeconomic status, cardiac rehabilitation following cardiovascular event, and consultation with a cardiologist were associated with a higher likelihood of smoking cessation following the recruiting hospitalization.

DISCUSSION　The present results suggest that roughly three-quarters of patients with established CAD are current or prior smokers and 55% of those smoking in the pre-event period were persistent smokers. There is strong

TABLE 4 Results of a multivariable analysis with smoking and persistent smoking as dependent variables

Variable	Odds ratio (95% CI)	*P* value	Wald χ² statistics
Persistent smoking (n = 296)			
Age, per 10 years	0.43 (0.29–0.64)	<0.001	17.88
Duration of smoking, per ten years	1.53 (1.20–1.96)	<0.001	11.59
Secondhand smoking	2.27 (1.35–3.84)	0.002	9.49
Consultation with a cardiologist	0.41 (0.21–0.82)	0.01	6.48
Cardiac rehabilitation following discharge	0.51 (0.29–0.89)	0.02	5.61
High socioeconomic status	0.54 (0.31–0.93)	0.03	4.98
Previous hospitalization due to cardiovascular disease[a]	1.73 (1.01–2.97)	0.04	4.04
Smoking (n = 1034)			
Smoking before recruiting event	25.97 (13.81–48.85)	<0.001	102.32
Age, per 10 years	0.43 (0.31–0.59)	<0.001	27.12
Duration of smoking, per 10 years	1.55 (1.27–1.89)	<0.001	18.76
Consultation with a cardiologist	0.42 (0.23–0.77)	0.005	8.07
Previous hospitalization due to cardiovascular disease[a]	1.87 (1.15–3.04)	0.01	6.4
Secondhand smoking	1.81 (1.14–2.89)	0.01	6.23
High socioeconomic status	0.57 (0.35–0.92)	0.02	5.19
Cardiac rehabilitation following discharge	0.60 (0.36–0.99)	0.047	3.94

a Hospitalization before the recruiting event due to: coronary artery bypass grafting, percutaneous coronary intervention, acute coronary syndrome, chronic coronary syndrome, heart failure, stroke, or peripheral artery disease

scientific evidence that the long-term survival of patients with CAD may be improved by providing optimal secondary prevention including smoking cessation therapies.[7] The results of the EUROASPIRE surveys showed that smoking rates among patients with established CAD have not changed significantly in Europe over the last 2 decades (21% in 1999 to 2000 vs 20% in 2006 to 2007 vs 18% in 2012 to 2013).[9] There is solid scientific evidence for the effectiveness of various types of nicotine replacement therapy, bupropion, cytisine, and varenicline.[12-15] Smoking cessation is the most cost--effective strategy in cardiovascular prevention.[7] Despite convincing evidence, smoking cessation strategies were poorly implemented in the participants of our survey. Indeed, the low prescription rates of smoking cessation therapies may be one of the major determinants of the high rate of persistent smoking. Nicotine replacement therapy, varenicline, and bupropion were used significantly less often in the POLASPIRE as compared with the EUROASPIRE survey.[5] The participation rate in smoking cessation programs was also extremely low in the study group. Indeed, despite the increase in the number of available smoking cessation strategies, educational campaigns, laws restricting smoking in public spaces in an increasing number of European countries, and a decline in average smoking prevalence in many European countries, including Poland, postevent cessation rates in patients with CAD remain at the level of 50%.[5,16]

In line with previous reports, increasing age, cardiac rehabilitation following a cardiovascular event, absence of passive smoking, and high socioeconomic status were associated with smoking cessation in our population.[5,17,18] On the other hand, we did not find evidence that depression and anxiety are related to persistent smoking. Previous studies reported conflicting results regarding the relation between these factors and persistent smoking.[5,19-21]

Secondhand smoke exposure increases cardiovascular risk and decreases the probability of smoking cessation in various settings.[5,17,20,22] We found that about a quarter of patients following CAD hospitalization are exposed to environmental tobacco smoke. Importantly, half of all persistent smokers were exposed to second-hand smoke. In general, our results show that more patients are exposed to environmental tobacco smoke at home than at work. However, among professionally active patients, a comparable proportion are exposed to environmental tobacco smoke at work and at home.

We found that specialized cardiology care was independently related to lower probability of smoking both when we analyzed the study group as a whole as well as when we limited the analysis to pre-event smokers. There are at least 3 possible explanations for this finding. Firstly, patients consulted and not consulted by a cardiologist may differ with respect to a number of unrecognized features, including higher compliance with the physicians' recommendations. Secondly, cardiologists may devote more time to controlling major cardiovascular risk factors compared with general practitioners. Finally, as a specialist has usually greater authority than a general practitioner, this might partially explain the finding. The relationship between a consultation with a cardiologist and smoking prevalence in patients with CAD could help explain the lower risk of death among postinfarction patients consulted by a cardiologist.[23]

Our results suggest that smoking rates in patients with established CAD might be reduced by lowering environmental tobacco smoking and increasing access to cardiac rehabilitation and cardiac care. A program of managed care for myocardial infarction survivors recently launched in Poland has particularly addressed both factors.[24]

Limitations Apart from the cross-sectional design which does not allow to address causality, the present analysis has several limitations. Firstly, we were unable to assess the relation between smoking status and the risk of cardiovascular complications.[8] Secondly, participants of the present study were not representative of all CAD patients. Participants were limited to those who had experienced an acute CAD event or had undergone a revascularization procedure. Thirdly, we only included patients aged 80 years or younger. Therefore, our results do not refer directly to older patients. However, an important advantage of our analysis is that our results are not based solely on abstracted medical record data but took into account face-to-face interviews and examinations using the same protocol and standardized methods and instruments. Therefore, to our best knowledge, presented results provide the most current and reliable information on smoking management for secondary prevention of CAD.

Conclusions Over half of all smokers hospitalized due to CAD smoke 6 to 18 months after discharge. Secondhand smoke exposure and duration of smoking were associated with lower likelihood, whereas older age, high socioeconomic status, cardiac rehabilitation following cardiovascular event, and specialized cardiac care were associated with higher likelihood of smoking cessation. Our findings may be useful for developing strategies to assist smoking cessation in patients with CAD.

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