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Lifestyle and impact on cardiovascular risk factor control in coronary patients across 27 countries: Results from the European Society of Cardiology ESC-EORP EUROASPIRE V registry

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Abstract

Aims: The aim of this study was to determine whether the Joint European Societies guidelines on secondary cardiovascular prevention are followed in everyday practice.

Design: A cross-sectional ESC-EORP survey (EUROASPIRE V) at 131 centres in 81 regions in 27 countries.

Methods: Patients (<80 years old) with verified coronary artery events or interventions were interviewed and examined ≥6 months later.

Results: A total of 8261 patients (females 26%) were interviewed. Nineteen per cent smoked and 55% of them were persistent smokers, 38% were obese (body mass index ≥30 kg/m^2), 59% were centrally obese (waist circumference: men ≥102 cm; women ≥88 cm) while 66% were physically active <30 min 5 times/week. Forty-two per cent had a blood pressure ≥140/90 mmHg (≥140/85 if diabetic), 71% had low-density lipoprotein cholesterol ≥1.8 mmol/L (≥70 mg/dL) and 29% reported having diabetes. Cardioprotective medication was: anti-platelets 93%, beta-blockers 81%, angiotensin-converting enzyme inhibitors/angiotensin receptor blockers 75% and statins 80%.

Conclusion: A large majority of coronary patients have unhealthy lifestyles in terms of smoking, diet and sedentary behaviour, which adversely impacts major cardiovascular risk factors. A majority did not achieve their blood pressure, low-density lipoprotein cholesterol and glucose targets. Cardiovascular prevention requires modern preventive cardiology programmes delivered by interdisciplinary teams of healthcare professionals addressing all aspects of lifestyle and risk factor management, in order to reduce the risk of recurrent cardiovascular events.

Keywords

EUROASPIRE, lifestyle, cardiovascular risk factors, secondary prevention, guidelines

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Introduction

The main objectives of cardiovascular disease (CVD) prevention are to prevent premature morbidity and mortality, improve quality of life and reduce increasing healthcare costs.[1–6] CVD remains a leading cause of death across Europe with about 44% of the deaths related to coronary heart disease (CHD).[7] The European Society of Cardiology (ESC), together with other partners, has engaged in a comprehensive programme of CVD prevention in clinical practice for almost 25 years. Joint European Societies (JES) recommendations, first published in 1994, have been updated five times, most recently in 2016,[1–6] with the aim to promote evidence-based preventive cardiology by encouraging national guidance on CVD prevention and its communication, implementation and regular audit. Implementation of these guidelines has been repeatedly evaluated by the EUROASPIRE (European Action on Secondary and Primary Prevention by

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Intervention to Reduce Events) surveys.[8–15] The fourth and fifth EUROASPIRE surveys merged with the EuroHeart Survey on Diabetes.[13,14,16,17] From 2012 EUROASPIRE has been part of the EURObservational Research Programme (EORP) of the ESC.

EUROASPIRE V was performed to *identify* risk factors in coronary patients with and without diabetes, describe their *management* through lifestyle modifications and use of drug therapies in order to provide an objective assessment of the *implementation* of current evidence-based CVD prevention. This report focuses on lifestyle adaptation and the control of blood pressure, low-density lipoprotein cholesterol (LDL-C) and diabetes.

Study population and methods

Geographical area and hospital sampling frame

EUROASPIRE V is a cross-sectional study carried out in 2016–2017 in 27 countries as listed in the Supplementary Material Table 1 online. At least one geographical area with a defined population was selected within each country and their serving hospitals (a minimum of two) identified in order to provide any patient with acute coronary symptoms, or requiring revascularization (percutaneous coronary intervention (PCI) or coronary artery bypass surgery (CABG), with a similar chance of being included.

Consecutive patients (≥18 to <80 years old) were identified from diagnostic registers, hospital discharge lists or other sources with a first or recurrent clinical diagnosis or treatment of (i) elective or emergency CABG, (ii) elective or emergency PCI, (iii) acute myocardial infarction (ICD-10 I21) and (iv) acute myocardial ischaemia (ICD-10 I20). The starting date for identification was ≥6 months to <2 years prior to date of study interview. Eligible patients were invited to attend a study visit. The invitation procedure varied between countries, depending on local data protection rules.

Data collection and definitions

The ESC EUROASPIRE V registry conducted by EURObservational Research Programme (EORP) is a cross-sectional survey performed in 131 centres in 81 regions in 27 countries within the European Society of Cardiology. Data collection was undertaken by centrally trained research staff, who, within the stated time window, reviewed patient medical records and interviewed and examined the patients using standardized methods and similar instruments at all centres. Information on personal and demographic details, smoking status, history of obesity, hypertension, dyslipidaemia, glucose metabolism and medication was obtained from medical records. Self-reported information on lifestyle, other risk factor management and medication was obtained at interview. The self-reported questionnaires were all validated versions for each country. The following measurements were performed:

Smoking at the time of interview was defined as self-reported smoking and/or a breath carbon monoxide exceeding 10 ppm[18] by means of Smokerlyzer® (Bedfont Scientific, Model Micro+). Persistent smoking was defined as smoking at time of interview among those who smoked in the month prior to the index event.

Height and weight were measured in light indoor clothes without shoes (SECA scales 701 and measuring stick model 220). Overweight was defined as a body mass index (BMI) ≥25 to <30 kg/m^2 and obesity as BMI ≥30 kg/m^2.

Waist circumference was measured using a metal tape horizontally in the mid-axillary line midway between the lowest rim of the rib cage and tip of the hip bone with the patient standing.[19] Abdominal overweight was defined as a waist circumference of ≥80 to <88 cm for women and ≥94 to <102 cm for men and central obesity as a waist circumference of ≥88 cm for women and ≥102 cm for men.

The *physical activity* target was defined by the following question: "Do you take regular physical activity of at least 30 minutes' duration on average five times a week?"

Blood pressure was measured twice on the right upper arm in a sitting position using an automatic digital sphygmomanometer (Omron M6). The mean was used for analysis with raised blood pressure defined as ≥140/90 mmHg (≥140/85 mmHg if diabetes).

Venous (fasting) blood was drawn for serum total and high-density lipoprotein cholesterol (HDL-C), triglycerides and glycated haemoglobin (HbA1c). The LDL-C was calculated by Friedewald's formula.[20] Elevated LDL-C concentration was defined as ≥1.8 mmol/L (≥70 mg/dL). Plasma glucose was analysed locally with a point-of-care technique (Glucose 201RT, HemoCue®, Ängelholm, Sweden).[21] Elevated fasting glucose among patients with diabetes was defined as ≥6.0 mmol/L (≥110 mg/dL) and elevated HbA1c as ≥7.0% (International Federation of Clinical Chemistry (IFCC) ≥ 53 mmol/mol).

The Laboratory in the National Institute for Health and Welfare (Helsinki, Finland), accredited by the Finnish Accreditation Service and fulfilling requirements of the standard SFS-EN ISO/IEC 17025:2005, acted as the central laboratory. Venous blood was taken into a tube containing clot activator (Vacutainer SST II Advanced, Becton Dickinson) for lipid assays and into a potassium EDTA tube (Vacutainer K2EDTA) for HbA1c assay. Samples were stored locally at –70°C. All measurements were performed on a clinical chemistry analyser (Architect c8000; Abbott

Laboratories, Abbott Park, Illinois, USA). Total cholesterol, HDL-C, creatinine and triglycerides were analysed in serum, and HbA1c in whole blood.

Data management

Electronically collected data were submitted online to the data management centre (EURObservational Research Program (EORP), ESC, Sophia-Antipolis, France).

Statistical analyses

Overall, sample size calculations indicated that groups of 400 patients were sufficient to produce prevalence estimates with a precision of at least 5% with 95% confidence. Descriptive statistics were used to estimate the prevalence of risk factors and medication use at interview. Patients' demographics, risk factor profiles and use of medication were described according to means, standard deviations and proportions. Relevant comparisons of risk factor prevalences were evaluated according to mixed logistic regression analyses accounting for clustering of patients within countries and with additional adjustment for age and gender. All analyses were undertaken using SAS statistical software (release 9.4) in the Department of Public Health, Ghent University, Belgium.

Ethical procedures. National Co-ordinators were responsible for obtaining Local Ethics Committees approvals. Written, informed consent was obtained from each participant and stored in the patient file.

Outcome measures. The main outcome measures were the proportions of coronary patients achieving the lifestyle, risk factor and therapeutic targets as defined in the 2016 guidelines on CVD prevention.[6]

Results

The survey was undertaken at 131 centres covering 81 geographical regions in 27 countries: Belgium, Bosnia & Herzegovina, Bulgaria, Croatia, Czech Republic, Egypt, Finland, Germany, Greece, Ireland, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, The Netherlands, Poland, Portugal, Romania, Russia, Serbia, Slovenia, Spain, Sweden, Turkey, Ukraine and the UK. A total of 16,208 medical records were reviewed and 8261 patients attended the interview with a participation rate (excluding patients who died, moved away or had a change in medical condition) of 56%. Supplementary Table 1 lists the countries, geographical regions and numbers of patients attending interview.

The median time between the index event and the interview was 1.1 years (interquartile range 0.8–1.6). The reasons for not being interviewed were: no response to the invitation letter 56%, refusal to attend for personal reasons 38%, miscellaneous 6%. Patient characteristics at interview are presented in Table 1. Overall, the mean (SD) age at interview was 64 (10) years and 26% were women. Following their index event 78% were under care of a cardiologist and/or a general practitioner (57%), a diabetologist/endocrinologist (11%) and/or a specialist cardiac nurse (4%), with wide variation between countries.

Smoking, body weight and physical activity

Results on smoking, overweight and obesity and physical activity are shown in Table 2. The overall prevalence of *smoking* at time of interview was 19%

Table 1. Patients' characteristics at interview.

Characteristics	All $N = 8261$	Men $n = 6132$	Women $n = 2129$
Age, mean (SD)	63.6 (9.6)	63.0 (9.7)	65.4 (9.2)
<50 years, % (*n*)	9.3 (772)	10.3 (630)	6.7 (142)
50–59 years, % (*n*)	24.7 (2043)	26.4 (1619)	19.9 (424)
60–69 years, % (*n*)	38.1 (3150)	38.0 (2330)	38.5 (820)
≥70 years, % (*n*)	27.8 (2296)	25.3 (1553)	34.9 (743)
Medical history			
Hospitalization for CABG, % (*n*)	18.6 (1535)	20.4 (1253)	13.2 (282)
PCI, % (*n*)	80.2 (6629)	82.1 (5035)	74.9 (1594)
ACS without revascularization, % (*n*)	11.1 (919)	8.4 (516)	18.9 (403)
Stroke, % (*n*)	4.1 (341)	3.7 (229)	5.3 (112)
Peripheral artery disease, % (*n*)	2.7 (221)	2.7 (167)	2.5 (54)

CABG: coronary artery bypass graft surgery; PCI: percutaneous coronary intervention; ACS: acute coronary syndrome

Table 2. Patients' lifestyles at the time of interview.

Lifestyle characteristics	All $N = 8261$	Men		Women	
		Aged < 60 years $n = 2249$	Aged ≥ 60 years $n = 3883$	Aged < 60 years $n = 566$	Aged ≥ 60 years $n = 1563$
Smoking	19%	31%	15%	21%	10%
Persistent smoking	55%	54%	54%	59%	54%
Persistent smokers not having been offered professional advice to quit	15%	14%	15%	12%	18%
Persistent smokers not having attempted to quit smoking since hospital discharge	77%	76%	79%	73%	77%
Persistent smokers not having the intention to quit within the next six months	53%	49%	58%	57%	56%
Overweight and obesity	82%	84%	81%	83%	80%
Obesity	38%	38%	33%	51%	44%
Central obesity	59%	50%	53%	80%	77%
Obese patients never been told they are overweight	24%	24%	25%	23%	24%
Obese patients not having attempted actively to lose weight in last month	50%	47%	52%	45%	54%
Obese patients not seriously considering weight loss in next six months	41%	33%	43%	43%	46%
Obese patients not being aware of their weight target	40%	38%	36%	54%	43%
Obese patients not having been advised to follow dietary guidelines	38%	35%	40%	40%	36%
Regular physical activity ≥ 30 min on average five times a week	34%	39%	35%	28%	27%
Vigorous physical activity for ≥ 20 min at least three times a week	16%	21%	16%	16%	10%
Performing planned physical activity to increase physical fitness	35%	39%	36%	28%	27%
Not performing planned physical activity and no intention to do so in next six months	42%	33%	43%	42%	51%
Not having received personal advice to do more general everyday activities	46%	41%	47%	47%	49%

Smoking: self-reported smoking or >10 ppm carbon monoxide in breath; persistent smoking: self-reported smoking or >10 ppm carbon monoxide in breath in patients reporting to have been smoking in the month prior to the index event; overweight: body mass index (BMI) ≥ 25 to <30 kg/m^2; obesity: BMI ≥ 30 kg/m^2; central obesity: waist circumference ≥ 88 cm for women and ≥ 102 cm for men.

(Figure 1). The prevalence of persistent smoking among those who smoked in the month prior to the coronary event was 55% and 53% intended to quit smoking within the next six months. Although 85% of persistent smokers had been offered professional advice to quit, only 23% tried to stop and only a small proportion (5%) attended a smoking cessation clinic. Nicotine replacement therapy, bupropion and varenicline, were prescribed to a small minority: 7%, 1% and 2% of these patients respectively.

Overall, 44% of patients were *overweight* and 38% were *obese*. The prevalence of central obesity was 59%, markedly higher in women than in men. One in four obese patients reported never being told they were overweight and 23% reported not having had a weight measurement after hospital discharge. Only half of the obese patients had tried to lose weight while 59% were considering losing weight in the next six months. Thirty-eight per cent of obese and 40% of centrally obese patients had not obtained dietary guidelines and were not aware of their weight target.

Two-thirds (66%) of patients (men 63%; women 73%, $p < 0.0001$) were not achieving the defined *physical activity* target. Vigorous activities were taken up by only 16%. Fifty-eight per cent of the patients intended to become more active. Almost half of the patients (46%) did not recall having received personal advice on physical activity.

Blood pressure, lipids and diabetes

The management of blood pressure, LDL-C and self-reported diabetes is presented in Table 3. Overall, 95% of patients were on *blood pressure* lowering drugs (beta-

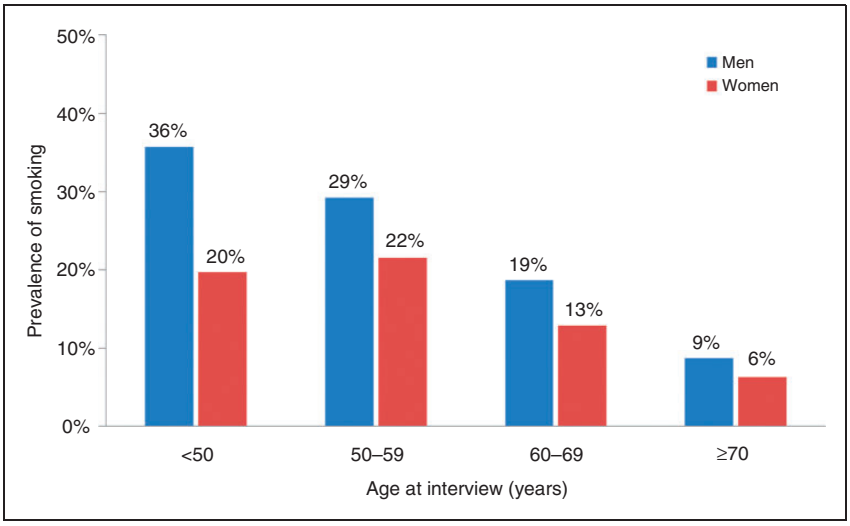

Figure 1. Prevalence of smoking (%) by age and gender at the time of the interview. Self-reported smoking or > 10 ppm CO in breath.

Table 3. Cardiovascular risk factor management at the time of interview.

		Men		Women	
Risk factor	All $N = 8261$	Aged < 60 years $n = 2249$	Aged ≥ 60 years $n = 3883$	Aged < 60 years $n = 566$	Aged ≥ 60 years $n = 1563$
Systolic/diastolic blood pressure ≥130/80 mmHg	71%	68%	74%	65%	72%
Systolic/diastolic blood pressure ≥140/90 mmHg (≥140/85 if diabetes)	42%	35%	46%	38%	44%
Systolic/diastolic blood pressure ≥160/100 mmHg	12%	9%	13%	12%	13%
Using blood pressure lowering drugs	95%	93%	96%	94%	97%
Using drugs specifically to lower blood pressure	78%	69%	80%	78%	85%
Raised blood pressure in patients using drugs specifically to lower blood pressure	46%	40%	50%	44%	48%
Reporting 100% compliance with blood pressure lowering drugs	76%	79%	71%	74%	79%
If blood pressure raised, never been told by a doctor they have high blood pressure	15%	20%	16%	12%	8%
LDL-C ≥1.8 mmol/L	71%	71%	67%	79%	77%
LDL-C ≥2.5 mmol/L	37%	37%	32%	50%	45%
If LDL-C ≥2.5 mmol/L, never been told they have high cholesterol	29%	34%	29%	30%	18%
Using lipid-lowering drugs	84%	85%	86%	76%	82%
Using high-intensity lipid-lowering drugs	50%	53%	50%	47%	45%
Reporting 100% compliance with lipid-lowering drugs	81%	71%	74%	78%	82%
LDL-C ≥1.8 mmol/L in patients using lipid-lowering drugs	68%	68%	65%	76%	74%
Self-reported previous diagnosis of diabetes	29%	22%	32%	29%	35%
Treatment of diabetes: diet	57%	54%	55%	60%	61%
Insulin	32%	26%	30%	46%	37%
Oral antidiabetic drugs	74%	77%	75%	65%	70%
In patients with known diabetes, HbA1c ≥7.0%	46%	48%	41%	65%	47%

LDL-C: low-density lipoprotein cholesterol; HbA1c: glycated haemoglobin

blockers, angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), renin inhibitors, calcium-channel blockers, diuretics or other antihypertensives) and 78% of them confirmed they were on medication specifically to lower their blood pressure. The proportion with a blood pressure ≥130/80 mmHg was 71% while 42% had a blood pressure of ≥140/90 (≥140/85 mmHg if diabetic) and 12% ≥160/100 mmHg. Fifteen per cent of patients with a blood pressure ≥140/90 mmHg (≥140/85 mmHg if diabetic) had never been told they had high blood pressure. Of patients prescribed drugs to lower their blood pressure 54% were at, or below, their recommended blood pressure target and 76% reported complete adherence with the intake of their blood pressure lowering drugs.

The proportion of patients with a *LDL-C* level ≥1.8 mmol/L (≥70 mg/dL) was 71%, and 37% of all patients had a LDL-C ≥ 2.5 mmol/L (≥100 mg/dL). In those with a LDL-C ≥ 2.5 mmol/L (≥100 mg/dL) 29% had never been informed of raised cholesterol and 21% had not had a cholesterol measurement since hospital discharge. Lipid-lowering drugs were prescribed to 84%. Eighty per cent were taking statins and 50% of those on lipid-lowering drugs were taking high-intensity lipid-lowering drugs, or drug combinations, that may reduce LDL-C by >50%. Among patients on lipid-lowering drugs 32% had the target level of LDL-C < 1.8 mmol/L (<70 mg/dL), less so in women than in men ($p < 0.0001$). Of patients on lipid-lowering drugs 76% reported full prescription compliance.

Twenty-nine per cent of all patients reported they had *diabetes*. Management with diet, insulin and oral glucose lowering drugs was 57%, 32% and 74% respectively. A HbA1c ≥ 7.0% (53 mmol/mol) was recorded in 46% of these patients. Sixteen per cent of patients with known diabetes had not had a glucose measurement after discharge.

Less than half of patients (46%) were advised to participate in a cardiac rehabilitation programme and 69% of those advised attended at least half of the sessions; 32% of all patients.

Use of cardioprotective drugs

Antiplatelet medication was prescribed in 93% of patients, 81% were on beta-blockers and 75% on ACE inhibitors or ARBs.

Relations between lifestyle and risk factors

LDL-C was less well controlled among smokers than among non-smokers ($p = 0.001$). A higher proportion of smokers (75%) had a LDL-C ≥ 1.8 mmol/L (≥70 mg/dL) compared with non-smokers (69%, $p < 0.0001$). Overweight and obesity were associated with raised blood pressure and poorly controlled diabetes (Figures 2 and 3). There was a higher proportion with raised blood pressure with increasing BMI in both genders ($p < 0.0001$). Obesity was also associated with an elevated HbA1c in patients with diabetes ($p = 0.001$).

Discussion

The EUROASPIRE V survey revealed that a majority of coronary patients failed to achieve the lifestyle,

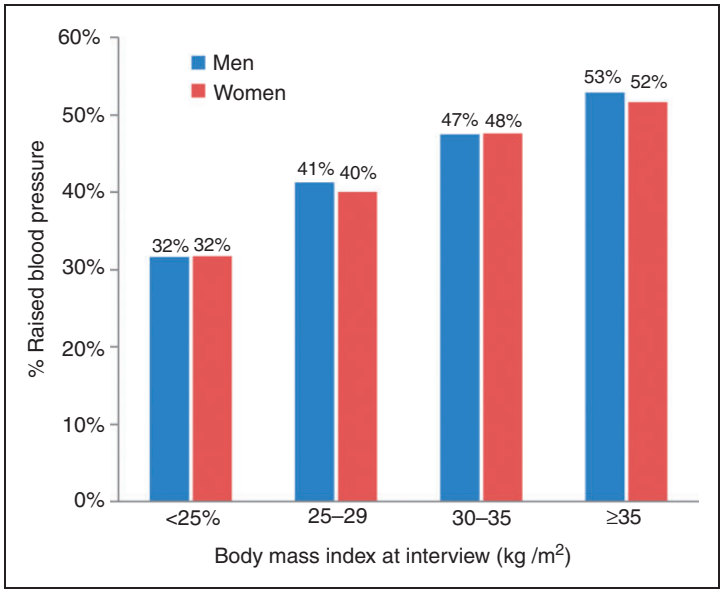

Figure 2. Prevalence of raised blood pressure (%) in men and women by body mass index level. Raised blood pressure: blood pressure ≥140/90 mmHg (≥140/85 mmHg in patients with diabetes mellitus).

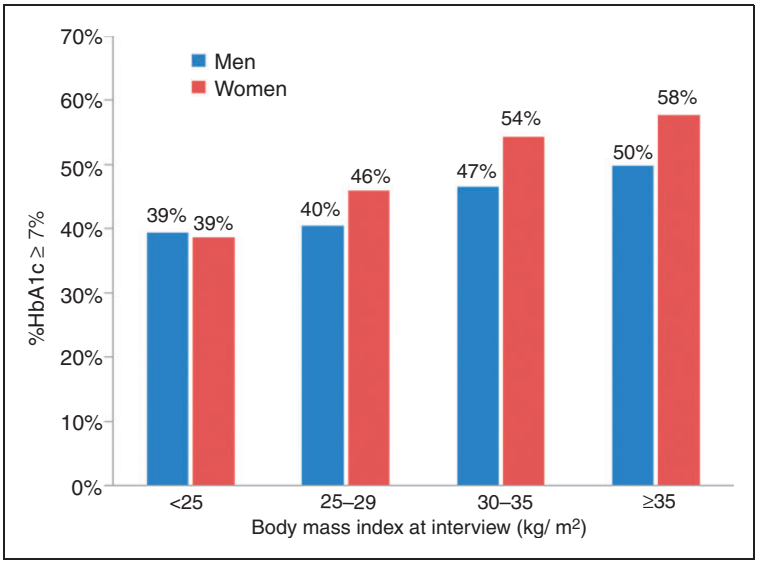

Figure 3. Prevalence of glycated haemoglobin (HbA1c) ≥7.0% (%) in male and female patients with known diabetes by body mass index level.

blood pressure, lipid and glycaemic targets of the 2016 JES guidelines on CVD prevention, and unhealthy lifestyles had an adverse impact on risk factor control in spite of a high use of cardioprotective medications.

The prevalence of smoking is a major challenge especially in patients <50 years, where 56% of men and 46% of women were persistent smokers. Smoking cessation after a myocardial infarction is very effective for secondary prevention.[22,23] Despite compelling evidence smoking cessation strategies were poorly implemented. Only half of persistent smokers had an intention to quit smoking, which without behavioural support, including pharmacotherapies, is a daunting challenge for many patients addicted to nicotine. If encouragement and motivation are insufficient drug therapies should be considered early, including nicotine replacement therapies whilst in hospital, followed by bupropion or varenicline.[24] Pharmacotherapies to support smoking cessation are effective, safe and associated with significant reductions in re-hospitalization and all-cause mortality.[25,26]

Weight reduction in overweight and obese people is recommended in order to reduce blood pressure, LDL-C and the risk of type 2 diabetes and thus the risk of recurrent CVD.[6] Obesity was associated with poorer blood pressure control, a higher prevalence of diabetes and poorer glycaemic control, illustrating the adverse impact of unhealthy lifestyles on risk factor control and the potential of lifestyle modification to further reduce CVD risk. Only two-fifths of obese patients reported trying to lose weight by changing their diet and increasing physical activity. Only half of the patients reported receiving advice to do more general daily physical activities. One in four of patients with a BMI ≥30 kg/m^2 reported they had never been told they were overweight and less than half had tried to lose weight after their hospitalization. Yet, over half were considering losing weight in the next six months, illustrating a willingness to try.

Despite the high use of blood pressure lowering medications just over half of patients had achieved the recommended blood pressure goal and lipid control was unsatisfactory in a large proportion of patients, with more than two-thirds of patients above the target of LDL-cholesterol <1.8 mmol/L (<70 mg/dL). Prescription of lipid-lowering medication is recommended to all patients with documented CHD if not contraindicated.[27] In EUROASPIRE V, four-fifths of patients were on lipid-lowering drugs, mainly statins, but the LDL-C was still poorly controlled, underlining the need for more intensive cholesterol management. Possible explanations could be that the initial doses of statins were too low or there was little or no up-titration of doses following treatment initiation, with only half of patients on high-intensity lipid-lowering drugs at interview.

Nearly one-third of patients had a history of diabetes, of whom just over half had a satisfactory glycaemic control.

The results of EUROASPIRE V are in accordance with earlier surveys of secondary prevention in Europe, the United States and other parts of the world.[28–34] The results of Reduction of Atherothrombosis for Continued Health (REACH) Registry,[28] the WHO study on Prevention of Recurrences of Myocardial Infarction and Stroke (WHO-PREMISE),[29] STabilization of Atherosclerotic plaque By Initiation of darapLadIb

TherapY (STABILITY) trial,[30] the Prospective Urban Rural Epidemiology (PURE) study,[31,32] the prospective observational LongitudinAl RegIstry oF patients with stable coronary arterY disease (CLARIFY) study[33] and the Dyslipidemia International Study (DYSIS)[34] demonstrated poor control of cardiovascular risk factors in patients with CHD.

There may be several reasons for the poor lifestyle adherence. To persuade patients to adapt to healthier habits needs skills in behavioural science and time enough to explain the importance. Moreover, and as shown by Pogosova et al.,[35] a substantial proportion of patients have anxiety and depression symptoms after coronary heart disease events, often left with unsatisfactory treatment. Thus, the receptivity to lifestyle advice may be less than optimal immediately after the coronary event and advice may have to be repeated or reinforced when the patient is in a better condition to accept such counselling. The scientific evidence on the importance of achieving healthier lifestyles for secondary prevention in people with CHD is strong.[1–6] The importance of adherence to lifestyle changes was well documented in the Fifth Organisation to Assess Strategies in Acute Ischemic Syndromes (OASIS) trial. Persistent smokers who did not adhere to diet or exercise had a 3.8-fold increased risk of repeated events compared with never smokers who modified their diet and activity pattern, and adherence to dietary and exercise advice was associated with a relative risk mortality reduction of 55%.[36] In the Randomized Evaluation of Secondary Prevention by Outpatient Nurse Specialists (RESPONSE) 2 trial the effect of comprehensive lifestyle programmes (targeting weight reduction, improved physical activity and smoking cessation) on top of usual care was evaluated in 824 patients after a recent acute coronary syndrome or coronary stenting. The primary outcome at 12 months was defined as improvement in $\geq$1 qualifying lifestyle-related risk factor without deterioration in the other two. The combined outcome was reached more often in the intensive (37%) than in the control group (26%).[37] In the EUROACTION trial of a nurse-led, multidisciplinary hospital programme for coronary patients there were significant improvements in diet (lower saturated fat, increased fruit and vegetables and increased oily fish consumption) and physical activity levels, with three times as many patients achieving the physical activity target in comparison with usual care.[38]

Strengths and limitations

To warrant the representativeness of EUROASPIRE V up to three geographical areas with a population greater than half a million people were selected within each country according to its size, and all hospitals serving that population identified, with a minimum of two within each geographical area. All centres that participated in the previous surveys were invited, and new centres were added from other geographical areas. The average interview rate was low at 56%, reflecting falling participation in medical research generally, but also that some countries, due to data protection laws, restricted the invitation procedure by reducing the possibility to reinforce invitations, thereby limiting participation rate. This may introduce a potential bias but non-participants are more likely to have unhealthy lifestyles and poorer risk factor control and therefore the present findings are, if anything, probably underestimating the true status of preventive cardiology across Europe. A major strength of the EUROASPIRE surveys is that data are based on interviews and standardized methods and equipment, including central laboratory analyses, rather than data from medical records, which are often incomplete as regards risk factor recording. Therefore, our survey provides high quality comparative information on preventive cardiology practice in Europe.

Conclusions

The results of EUROASPIRE V reveal that among patients with CHD many have unhealthy lifestyles in terms of persistent smoking and weight related dietary factors, including sedentary behaviour. These unhealthy lifestyles adversely impact the control of major CVD risk factors such as hypertension, raised LDL-C and the prevalence of diabetes and its control. Despite the high use of cardioprotective drug therapies the majority of patients did not achieve their blood pressure, LDL-C and glucose targets.

Cardiovascular prevention requires a modern preventive cardiology programme with appropriate adaptation to medical and cultural settings in each country. All patients with CHD, or any other form of atherosclerotic disease, should be guaranteed access to such a programme delivered by interdisciplinary teams of healthcare professionals – nurses, dieticians, physiotherapists or physical activity specialists, psychologists and physicians – addressing all aspects of lifestyle, blood pressure, lipids and glucose management, and adherence to cardioprotective medications, in order to reduce their risk of recurrent cardiovascular events, improve quality of life and prolong survival.

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Author contribution

KK contributed to conception and design, data acquisition, analysis and interpretation and drafted and critically revised the manuscript. GDB, DDB, LR, AH, DG, AM, PMV, CJ and DW contributed to conception and design, data acquisition, analysis and interpretation and critically revised the manuscript. AA, CA, JB, JB, ACC, RC, JC, KD, JD, DDS, JDS, MD, MD, VD, AE, ZF, DG, NG, PH, HHA, PJ, NL, SL, DL, SM, LM, DM, EM, RO, NP, ZR, SS, LT, CT and DV contributed to conception and design and data acquisition and critically revised the manuscript. All authors gave final approval and agreed to be accountable for all aspects of work ensuring integrity and accuracy.

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References

1. Pyörälä K, De Backer G, Graham I, et al. Prevention of coronary heart disease in clinical practice. Recommendations of the Task Force of the European Society of Cardiology, European Atherosclerotic Society and European Society of Hypertension. *Eur Heart J* 1994; 15: 1300–1331.
2. Wood D, De Backer G, Faergeman D, et al. Prevention of coronary heart disease in clinical practice. Recommendations of the Second Joint Task Force of European and other Societies on coronary prevention. *Eur Heart J* 1998; 19: 1434–1503.
3. De Backer G, Ambrosioni E, Borch-Johnsen K, et al. European guidelines on cardiovascular disease prevention in clinical practice. Third Joint Task Force of European and other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of eight societies and by invited experts). *Eur J Cardiovasc Prev Rehabil* 2003; 10(Suppl .1): S1–S78.
4. Graham I, Atar D, Borch-Johnsen K, et al. European Guidelines on Cardiovascular Disease Prevention in Clinical Practice: Fourth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts). *Eur J Cardiovasc Prev Rehabil* 2007; 14(Suppl. 2): S1–S113.
5. Perk J, De Backer G, Gohlke H, et al. European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts). Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *Eur Heart J* 2012; 33: 1635–1701.
6. Piepoli MF, Hoes AW, Agewall S, et al. 2016 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. *Eur Heart J* 2016; 37: 2315–2381.
7. Wilkins E, Wilson L, Wickramasinghe K, et al. *European cardiovascular disease statistics 2017*. Brussels: European Heart Network.
8. EUROASPIRE Study Group. EUROASPIRE A European Society of Cardiology survey of secondary prevention of coronary heart disease: Principal results. *Eur Heart J* 1997; 18: 1569–1582.
9. EUROASPIRE Study Group. Lifestyle and risk factor management and use of drug therapies in coronary patients from 15 countries. Principal results from EUROASPIRE II. Euro Heart Survey Programme. *Eur Heart J* 2001; 22: 554–572.
10. EUROASPIRE Study Group. Clinical reality of coronary prevention guidelines: A comparison of EUROASPIRE I and II in nine countries. *Lancet* 2001; 357: 995–1001.
11. Kotseva K, Wood D, De Backer G, et al.; on behalf of EUROASPIRE III Study Group. EUROASPIRE III: A survey on the lifestyle, risk factors and use of cardioprotective drug therapies in coronary patients from 22

European countries. *Eur J Cardiovasc Prev Rehabil* 2009; 16: 121–137.
12. Kotseva K, Wood D, De Backer G, et al.; on behalf of EUROASPIRE Study Group. Cardiovascular prevention guidelines in daily practice: A comparison of EUROASPIRE I, II, and III surveys in eight European countries. *Lancet* 2009; 373: 929–940.
13. Kotseva K, Wood D, De Bacquer D, et al.; on behalf of the EUROASPIRE Investigators. EUROASPIRE IV: A European Society of Cardiology survey on the lifestyle, risk factor and therapeutic management of coronary patients from twenty-four European countries. *Eur J Prev Cardiol* 2016; 23: 636–648.
14. Kotseva K, De Bacquer D, Jennings C, et al.; on behalf of EUROASPIRE Investigators. Adverse lifestyle trends counter improvements in cardiovascular risk factor management in coronary patients: Results from three EUROASPIRE cross sectional surveys 1999–2013 of the European Society of Cardiology. *JACC* 2015; 66: 1633–1640.
15. Kotseva K, Wood D and De Bacquer D. Determinants of participation and risk factor control according to attendance in cardiac rehabilitation programmes in coronary patients in Europe: EUROASPIRE IV survey. *Eur J Prev Cardiol* 2018; 25: 1242–1251.
16. Bartnik M, Ryden L, Ferrari R, et al. The prevalence of abnormal glucose regulation in patients with coronary artery disease across Europe. The Euro Heart Survey on diabetes and heart. *Eur Heart J* 2004; 25: 1880–1890.
17. Anselmino M, Bartni M, Öhrvik J, et al. The Euro Heart Survey on Diabetes and the Heart. *Intern Diabetes Monitor* 2010; 22: 1–9.
18. Middleton ET and Morice AH. Breath carbon monoxide as an indication of smoking habit. *Chest* 2000; 117: 758–763.
19. Lean MEJ, Han TS and Morrison CE. Waist circumference as a measure for indicating need for weight management. *BMJ* 1995; 311: 158–161.
20. Friedewald WT, Levy RI and Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem* 1972; 18: 499–502.
21. Segerhag E, Viveca Gyberg V, Ioannides K, et al. Accuracy of a simplified glucose measurement device – The HemoCue® Glucose 201RT. *Diabetes Technol Ther* 2015; 17: 755–758.
22. Wilson K, Gibson N, Willan A, et al. Effect of smoking cessation on mortality after myocardial infarction: Meta-analysis of cohort studies. *Arch Intern Med* 2000; 160: 939–944.
23. Chritchley J and Capewell S. Mortality risk reduction associated with smoking cessation in patients with coronary heart disease: A systematic review. *JAMA* 2003; 290: 86–97.
24. Jennings C, Kotseva K, DeBacquer D, et al.; on behalf of EUROACTION PLUS Study Group. Effectiveness of a preventive cardiology programme for high CVDrisk persistent smokers: The EUROACTION PLUS Varenicline trial. *Eur Heart J* 2014; 35: 1411–1120.
25. Cahill K, Stevens S, Perera R, et al. Pharmacological interventions for smoking cessation: An overview and network meta-analysis. *Cochrane Database Syst Rev* 2013; 5: CD009329.
26. Rigotti NA, Munafo MR and Stead LF. Smoking cessation interventions for hospitalized smokers: A systematic review. *Arch Intern Med* 2008; 168: 1950–1960.
27. Catapano AL, Graham I, De Backer G, et al. 2016 ESC/EAS guidelines for the management of dyslipidaemias. *Eur Heart J* 2016; 37: 2999–3058.
28. Mehta RH, Bhatt DL, Steg PG, et al. REACH Registry Investigators. Modifiable risk factors control and its relationship with 1-year outcomes after coronary artery bypass surgery: Insights from the REACH registry. *Eur Heart J* 2008; 29: 3052–3060.
29. Mendis S, Abegunde D, Yusuf S, et al.; WHO study on Prevention of REcurrences of Myocardial Infarction and StrokE (WHO-PREMISE). *Bull World Health Organ* 2005; 83: 820–829.
30. Vedin O, Hagstrom E, Stewart R, et al.; Secondary prevention and risk factor target achievement in a global, high-risk population with established coronary heart disease: Baseline results from the STABILITY study. *Eur J Prev Cardiology* 2013; 20: 678–685.
31. Teo K, Lear S, Islam S, et al.; PURE Investigators. Prevalence of a healthy lifestyle among individuals with cardiovascular disease in high-, middle- and low-income countries: The Prospective Urban Rural Epidemiology (PURE) study. *JAMA* 2013; 309: 1613–1621.
32. Yusuf S, Islam S, Chow CK, et al.; Prospective Urban Rural Epidemiology (PURE) Study Investigators. Use of secondary prevention drugs for cardiovascular disease in the community in high-income, middle-income, and low-income countries (the PURE Study): A prospective epidemiological survey. *Lancet* 2011; 378: 1231–1243.
33. Ferrari R, Ford I, Greenaw N, et al.; on behalf of the CLARIFY Registry Investigators. Geographical variations in the prevalence and management of cardiovascular risk factors in outpatients with CAD: Data from the contemporary CLARIFY registry. *Eur J Prev Cardiol* 2015; 22: 1056–1065.
34. Gitt AK, Drexel H, Feely J, et al.; on behalf of the DYSIS Investigators. Persistent lipid abnormalities in statin-treated patients and predictors of LDL-cholesterol goal achievement in clinical practice in Europe and Canada. *Eur J Prev Cardiol* 2011; 19: 221–230.
35. Pogosova N, Kotseva K, De Bacquer D, et al. Psychosocial risk factors in relation to other cardiovascular risk factors in coronary heart disease: Results from the EUROASPIRE IV survey. A registry from the European Society of Cardiology, on behalf of the EUROASPIRE Investigators. *Eur J Prev Cardiol*. Epub ahead of print 23 May 2017. DOI: 10.1177/2047487317711334.
36. Chow CK, Jolly S, Rao-Melacini P, et al.; Association of diet, exercise, and smoking modification with risk of early cardiovascular events after acute coronary syndromes. *Circulation* 2010; 121: 750–758.
37. Minneboo M, Lachman S, Snaterse M, et al. on behalf of the RESPONSE-2 Study Group. Community-based

lifestyle intervention in patients with coronary artery disease: The RESPONSE-2 Trial. *J Am Coll Cardiol* 2017; 70: 318–327.
38. Wood DA, Kotseva K, Connolly S, et al.; on behalf of EUROACTION Study Group. Nurse-coordinated multidisciplinary, family-based cardiovascular disease prevention programme (EUROACTION) for patients with coronary heart disease and asymptomatic individuals at high risk of cardiovascular disease: A paired, cluster-randomised controlled trial. *Lancet* 2008; 371: 1999–2012.