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Featured Article

EUROASPIRE III: a survey on the lifestyle, risk factors and use of cardioprotective drug therapies in coronary patients from 22 European countries

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Aim **The aim of the European Action on Secondary and Primary Prevention by Intervention to Reduce Events III (EUROASPIRE III) survey was to determine whether the Joint European Societies' guidelines on cardiovascular prevention are being followed in everyday clinical practice and to describe the lifestyle, risk factor and therapeutic management in patients with coronary heart disease (CHD) in Europe.**

Methods **The EUROASPIRE III survey was carried out in 2006–2007 in 76 centres from selected geographical areas in 22 countries in Europe. Consecutive patients, with a clinical diagnosis of CHD, were identified retrospectively and then followed up, interviewed and examined at least 6 months after their coronary event.**

Results **Thirteen thousand nine hundred and thirty-five medical records (27% women) were reviewed and 8966 patients were interviewed. At interview, 17% of patients smoked cigarettes, 35% were obese and 53% centrally obese, 56% had a blood pressure $\geq$ 140/90 mmHg ($\geq$ 130/80 in people with diabetes mellitus), 51% had a serum total cholesterol $\geq$ 4.5 mmol/l and 25% reported a history of diabetes of whom 10% had a fasting plasma glucose less than 6.1 mmol/l and 35% a glycated haemoglobin A1c less than 6.5%. The use of cardioprotective medication was: antiplatelets 91%; β-blockers 80%; angiotensin-converting enzyme inhibitors/angiotensin-receptor blockers 71%; calcium channel blockers 25% and statins 78%.**

Conclusion **The EUROASPIRE III survey shows that large proportions of coronary patients do not achieve the lifestyle, risk factor and therapeutic targets for cardiovascular disease prevention. Wide variations in risk factor prevalences and the use of cardioprotective drug therapies exist between countries. There is still considerable potential throughout Europe to raise standards of preventive care in order to reduce the risk of recurrent disease and death in patients with CHD.** ***Eur J Cardiovasc Prev Rehabil*** **16:121–137 © 2009 The European Society of Cardiology**

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Introduction

Cardiovascular disease (CVD), particularly coronary heart disease (CHD), remains the leading cause of death throughout Europe, although there are marked differences in CVD mortality between countries [1,2]. By the year 2000, it caused more than 4.35 million deaths in Europe (1.9 million in the European Union) and accounted for 43% of all deaths in men and for 55% in women of all ages. Although age-specific CHD mortality rates are declining in the majority of European countries, the actual number of patients with CHD has been increasing [3]. CVDs create significant costs to the healthcare system and place an immense burden on both patients and the community because of the resulting physical and psychological disabilities.

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*Investigators and participating centres of EUROASPIRE Study Group are listed in the Appendix at the end of the paper. Previous presentations: The EUROASPIRE III results were presented at the main symposium at the ESC Congress in Vienna 2007, ESH/ISH Congress 2008, IAS Congress 2008 and WCC 2008

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The Joint European Societies' guidelines on the prevention of CVD in clinical practice published in 1994, 1998 and 2003 [4–6] gave the highest priority to patients with coronary or other atherosclerotic disease. The 2003 Joint European Societies' guidelines defined the lifestyle and risk factor goals for patients with CHD as follows: stop smoking, make healthy food choices and be physically active; a body mass index (BMI) less than 25 kg/m^2; blood pressure less than 140/90 mmHg (< 130/80 mmHg in patients with diabetes); total cholesterol less than 4.5 mmol/l; low-density lipoprotien (LDL) cholesterol less than 2.5 mmol/l and appropriate use of cardioprotective drug therapies, in addition to medication used for the treatment of elevated blood pressure, lipids and glucose: aspirin or other platelet-active drugs, β-blockers, angiotensin-converting enzyme (ACE) inhibitors/angiotensin II receptor blockers and anticoagulants.

The European Society of Cardiology (ESC) has carried out three surveys with the acronym EUROASPIRE (European Action on Secondary and Primary Prevention by Intervention to Reduce Events) on lifestyle and risk factor management and use of drug therapies in patients with CHD. EUROASPIRE I was conducted in 1995–1996 in nine countries (The Czech Republic, Finland, France, Germany, Hungary, Italy, The Netherlands, Slovenia and Spain) [7], EUROASPIRE II in 1999–2000 in 15 countries (the previous nine plus Belgium, Greece, Ireland, Poland, Sweden and UK) [8] and EUROASPIRE III in 22 countries (the previous countries, except Sweden, plus Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Romania, Russian Federation and Turkey). The comparison of results in EUROASPIRE II with EUROASPIRE I, in those nine countries participating in both surveys, were described as a 'collective failure of medical practice', because they revealed adverse lifestyle trends – smoking, obesity and central obesity had all increased – and there was no improvement in blood pressure management [9]. Although there was a substantial improvement in lipid management, the majority of patients had not achieved the recommended total and LDL cholesterol goals. The use of cardioprotective drugs had, however, increased in the recommended direction.

The main objectives of EUROASPIRE III were to determine whether the Joint European Guidelines on CVD prevention are being followed in patients with CHD and whether the practice of preventive cardiology in patients with established coronary disease in EUROASPIRE III has improved, by comparison with those centres that took part in EUROASPIRE I and II.

In this paper, the principal results of EUROASPIRE III on the practice of preventive cardiology are reported, based on an analysis of hospital records, discharge documents and patient interviews and examinations at least 6 months after hospitalization for coronary artery bypass graft (CABG) operation, percutaneous coronary intervention, myocardial infarction (MI) or acute myocardial ischaemia without MI. A comparison of the findings of EUROASPIRE I, II and III surveys in those eight countries that took part in all the three surveys are reported elsewhere [10].

Study population and methods

Geographical area and hospital sampling frame

Within each country, one or more geographical areas with a defined population were selected and all hospitals serving this population were identified. A sample of one or more hospitals, or all hospitals, was taken so that any patient presenting within the area with acute symptoms of coronary disease, or requiring revascularization in the form of balloon angioplasty or coronary artery surgery, had an approximately equal chance of being included. Patients admitted to a hospital outside this geographical area were not included in the sample. The same geographical area and hospitals were used in those countries that participated in EUROASPIRE I and II (except Spain) although new hospitals were added from within the area.

Within each hospital, consecutive patients, men and women $\geq$ 18 years of age and less than 80 years of age at the time of identification, with first or recurrent diagnosis or treatments for CHD (see below), were identified retrospectively from diagnostic registers, hospital discharge lists or other source. The starting date for identification was not less than 6 months prior to the expected date of interview. Patients had to fulfil one or more of the following diagnostic criteria:

(1) Elective or emergency CABG operation [this includes emergency CABG for acute myocardial infarction (AMI)].
(2) Elective or emergency percutaneous transluminal coronary angioplasty (PTCA) (this includes emergency PTCA for AMI).
(3) AMI (ST elevation and non-ST elevation MI) (AMI: ICD-10 121).
(4) Acute myocardial ischaemia but no evidence of infarction (troponin negative) (ischaemia: ICD-10 120).

Consecutive patients were identified retrospectively, including those who died during their surgical procedure or in-hospital stay, but not earlier than 3 years before the anticipated interview date. It was recognized that hospital diagnoses for AMI, and acute myocardial ischaemia without evidence of infarction, might not always meet the WHO or other standard diagnostic criteria. It was, however, important to include all cases diagnosed as AMI or myocardial ischaemia in hospital clinical practice, because as a consequence of these

diagnoses, all these patients should have received appropriate management in relation to lifestyles, other risk factors and use of cardioprotective medication.

Data collection

The data collection was conducted by trained research staff that reviewed patients' medical records and interviewed and examined the patients at the hospital or their home at least 6 months after their acute coronary event, using standardized methods and instruments.

Review of patient medical records

The following information was obtained from the hospital medical records on admission and at discharge:

(1) Personal and demographic details.
(2) Personal cardiovascular history, including stroke, transient ischaemic attack (TIA).
(3) Other medical history, including hypertension, dyslipidaemia and diabetes.
(4) Recorded measurements of blood pressure, diabetes, lipids, glucose and smoking status.
(5) Medication (generic name and total daily dose).

Patient interview and examination

The following information was obtained at least 6 months after the admission or procedure for coronary event:

(1) Personal and demographic details.
(2) Personal cardiovascular history, including stroke, TIA and peripheral artery disease (PAD).
(3) Other medical history, including hypertension, hyperlipidaemia and diabetes.
(4) Family history of CHD for patients with premature disease (men < 55 and women < 65 years).
(5) Reported lifestyle and other risk factor management in relation to smoking, diet (including weight reduction), exercise, blood pressure, lipids and glucose.
(6) Medication (generic name and total daily dose).
(7) Level of education, school attendance and employment status.

The following measurements were performed:

(1) Height, weight: height and weight were measured in light indoor clothes without shoes (SECA scales model number 701 and measuring stick model 220. The scales were calibrated at the start of the survey).
(2) Waist circumference.
(3) Blood pressure: blood pressure was measured twice on the right upper arm in a sitting position using automatic digital sphygmomanometers Omron M5-I (Omron Healthcare, Japan).
(4) Heart rate.
(5) Breath carbon monoxide: breath carbon monoxide was recorded in ppm (Smokerlyser, Bedfont Scientific, Model Micro 4; Bedfont Scientific Ltd., Rochester, Kent, UK).
(6) Venous blood for serum total cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, calculated LDL cholesterol, plasma glucose and glycated haemoglobin (HbA1c) in patients with diabetes.

The central laboratory of the study was the Laboratory of Analytical Biochemistry, National Public Health Institute, Helsinki, Finland. The laboratory has been accredited by Finnish Accreditation Service and it fulfils the requirements of the standard SFS-EN ISO/IEC 17025:2005. The scope of accreditation covers all analyses except HbA1c.

The analysis of serum total cholesterol, HDL-cholesterol, triglycerides and plasma glucose were undertaken in all coronary patients at the time of interview. HbA1c was measured only in patients with known diabetes. Venous blood samples were taken in a sitting position with a light stasis into a tube containing clot activator (Venosafe, Terumo Europe, Leuven, Belgium) for lipid assays, into a fluoride-citrate tube (Venosafe) for glucose assay and into a potassium EDTA tube (Venosafe) for HbA1c assay. Serum and fluoride-citrate plasma were separated by centrifuging at 2000 g for 10 min at room temperature. After that serum, plasma and EDTA blood were aliquoted into two bar-code-labelled tubes and stored locally at a minimum of -70°C and then transported frozen to the central laboratory where all measurements were performed on a clinical chemistry analyzer (Architect c8000; Abbott Laboratories, Abbott Park, Illinois, USA). The following methods were used: enzymatic method for measuring the serum total cholesterol, homogenous method for direct measurement of serum HDL cholesterol, enzymatic glycerol phosphate oxidase method for measuring serum triglycerides, enzymatic hexokinase method for plasma glucose and immunoturbidimetric method for blood HbA1c.

For standardizing measurements, the laboratory has taken part in Lipid Standardization Program organized by CDC, Atlanta, Georgia, USA and External Quality Assessment Schemes organized by Labquality, Helsinki, Finland. During the course of the study comprising 12 months in 2007, the coefficient of variation (mean ± SD) and systematic error (bias) (mean ± SD) were 0.8% ± 0.2 and 0.8% ± 0.5 for total cholesterol, 2.3% ± 0.6 and −0.6% ± 1.4 for HDL cholesterol, 1.1% ± 0.4 and −1.1% ± 1.2 for triglycerides, 1.7% ± 0.1 and −0.2 ± 2.5 for glucose and 3.9% ± 1.3 and 0.2% ± 6.7 for HbA1c, respectively.

Quality assurance

To ensure standardization of measurements taken, all equipment were calibrated and serviced as per the

manufacturer's recommendations. Venous blood samples were handled and stored according to the guidelines prepared by the central laboratory. All national coordinators and the principal research staff responsible for teaching the local data collectors were trained in the Co-ordinating Centre, Department of Cardiovascular Medicine, National Heart and Lung Institute, Imperial College London, UK. A random sample of 10 medical records spread across the period of the survey was audited by each national coordinator in the same way and all discrepancies were discussed and corrected.

Data management

Data management was undertaken at the ESC Euro Heart Survey department, European Heart House, Nice, France. All data were collected electronically using a unique identification number for country, centre and individual. The data were submitted through Internet to the data management centre where checks for completeness, internal consistency and accuracy were run. All data were stored under the provisions of the National Data Protection Regulations.

Statistical analyses

All statistical analyses were undertaken using SAS statistical software release 9.1 ((SAS Institute Inc., Cary, North Carolina, USA)) in the Department of Public Health, Ghent University, Belgium. Descriptive statistics were used to estimate the prevalence of risk factors and medication by survey, country and diagnostic category. Sample size calculations indicated that a sample of 400 patients attending interview was sufficient to estimate prevalences of risk factors with a precision of at least 5% and with a confidence interval of 95%.

Ethical procedures

National coordinators were responsible for obtaining approvals from Local Research Ethics Committees. Written informed consent was obtained from each participant by the investigator by means of a signed declaration. The research assistants signed in the case record form to confirm that informed consent was obtained and stored the original of the signed declaration of consent in the patient's file.

Statement of responsibility

The authors had full access to the data and took responsibility for its integrity. All authors have read and agreed to the manuscript as written.

Results

Patients and their characteristics

Geographical areas and participating centres for each country are presented in Table 1. The survey was undertaken in 76 centres in 22 European countries. A total of 13 935 medical records were reviewed and 8966 patients were interviewed at least 6 months after

Table 1 Participating countries and centres

Country	Centre
Belgium	Ghent
	University Hospital Ghent
	A.Z. Maria Middelares – St Jozef
	A.Z. St Lucas
	A.Z. Jan Palfijn
Bulgaria	Sofia
	National Heart Hospital
	Medical Institute – Ministry of Internal Affairs
	Military Medical Academy
Croatia	Zagreb
	University Hospital Centre Zagreb
	University Hospital Dubrava
	University Hospital Sestre Milosrdnice
Cyprus	Nicosia
	Nicosia General Hospital
Czech Republic	Pilsen
	Charles University Hospital
	Prague
	Institute of Clinical Experimental Medicine
Finland	Kuopio
	Kuopio University Hospital
France	Lille
	Institut Pasteur de Lille
	Hôpital Cardiologique Universitaire, Lille
	Hôpital Saint-Philibert, Lomme
	Hôpital Victor Provo, Roubaix
	Hôpital Gustave Dron, Tourcoing
Germany	Münster
	Institut für Epidemiologie und Sozialmedizin, Universität Münster
	Medizinische Klinik und Poliklinik für Kardiologie und Angiologie
	Universität Münster
	Klinik und Poliklinik für Thorax-, Herz- und Gefäßchirurgie, Universität Münster
	St Franziskus Hospital
	Leibniz Institut für Arterioskleroseforschung. Abteilung für Molekulare Genetik kardiovaskulärer Erkrankungen
Greece	Athens
	Onassis Cardiac Surgery Centre
	Hippokration Hospital, University of Athens
	Athens General Hospital 'G Gennimatas'
	2nd Cardiology Department, University of Athens, Attikon Hospital
	3rd Cardiology Department, University of Athens, Laiko Hospital
	Crete
	Pagni Hospital, Herakleion Crete
	Ioannina
	University Hospital of Ioannina
Hungary	Budapest
	Hungarian Institute of Cardiology
	Szt. János Hospital
Ireland	Dublin
	Adelaide and Meath Hospital, Tallaght
	St James's Hospital
Italy	Udine
	Centre for Cardiovascular Prevention
	Venezia
	Department of Internal Medicine, Venice City Hospital
Latvia	Riga
	P Stradins University Hospital
	1st Riga Hospital
Lithuania	Vilnius
	Vilnius University Hospital
The Netherlands	Rijnmond (Rotterdam & Surroundings)
	Thorax Centre, ErasmusMC
	Medisch Centrum Rotterdam Zuid
Poland	Krakow
	Department of Clinical Epidemiology and Population Studies, Institute of Public Health, Jagiellonian University, Medical College

Table 1 (*continued*)

Country	Centre
	First Department of Cardiology and Hypertension, Jagiellonian University Medical College
	Department of Cardiac and Vascular Diseases, Jagiellonian University Medical College
	Department of Cardiology, Ludwik Rydygier District Hospital
	Department of Cardiology, Józef Dietl Hospital
	Department of Cardiology, Gabriel Narutowicz Memorial General Hospital
Romania	Timisoara
	Timisoara Institute of Cardiovascular Diseases
Russian Federation	Moscow
	National Research Centre for Preventive Medicine
Slovenia	Ljubljana
	University Medical Centre
Spain	Valencia
	Department of Cardiology, Hospital Universitario La Fe
	Department of Cardiology, Hospital Arnau de Vilanova
Turkey	Ankara
	Ankara Numune Eğitim ve Araştirma Hastanesi
	Ankara Üniversitesi Tıp Fakültesi
	Gazi Üniversitesi Tıp Fakültesi
	Gülhane Askeri Tıp Akademisi
	Hacettepe Tıp Fakültesi
	Türkiye Yüksek İhtisas Eğitim ve Araştırma Hastanesi
	Istanbul
	Dr Siyami Ersek Hastanesi Göğüs Kalp Cerrahi Merkezi
	Florence Nightingale Hastanesi
	Göztepe Eğitim Araştırma Hastanesi
	International Hospital
	İstanbul Üniversitesi Cerrahpaşa Tıp Fakültesi
	İstanbul Üniversitesi İstanbul Tıp Fakültesi
	İstanbul Üniversitesi Kardiyoloji Enstitüsü
	Koşuyolu Eğitim ve Araştırma Hastanesi
	Izmir
	Atatürk Eğitim ve Araştırma Hastanesi
	Dokuz Eylül Ünivesitesi Tıp Fakültesi
	Ege Üniversitesi Tıp Fakültesi
United Kingdom	Hull
	Castle Hill Hospital
	Hull Royal Infirmary
	London
	Charing Cross Hospital
	Hammersmith Hospital
	Central Middlesex Hospital
	West Middlesex Hospital

admission for an acute coronary event or procedure. A description of the study population enrolled from medical records and the numbers of patient interviews by country, sex, age at index event and diagnostic categories is presented in Table 2. The population sample included 27.4% (3821) women, with the highest proportion of 42.1% in Hungary (286 of 679) and the lowest in Greece, 11.8% (16 of 136). The mean (SD) age was 61.9 (10) years.

Information on risk factors in the discharge documents

The available information on cardiovascular risk factors and measurements at discharge is shown in Table 3. Overall, risk factor recording was incomplete with large variations between countries. The weight, height and waist measurements were available in less than half of the patients and still more than one-third of them had no blood pressure or total cholesterol or glucose recorded in discharge documents.

Table 2 Study population (number) enrolled from medical records and patient interviews by country, sex, age and diagnostic categories

	Patients records (*n*)	Patients interviews (*n*)	Participation rate at interview (%)[a]
Country			
Belgium	592	328	58.3 (328/563)
Bulgaria	711	538	87.6 (538/614)
Croatia	584	455	82.9 (455/549)
Cyprus	496	441	94.8 (441/465)
Czech Republic	598	480	87.1 (480/551)
Finland	258	237	92.6 (237/256)
France	670	341	56.9 (341/599)
Germany	788	550	80.9 (550/680)
Greece	136	122	94.6 (122/129)
Hungary	679	459	78.3 (459/586)
Ireland	636	386	67.5 (386/572)
Italy	885	377	46.8 (377/805)
Latvia	1012	519	78.9 (519/658)
Lithuania	531	509	99.0 (509/514)
Poland	644	506	85.6 (506/591)
Romania	858	521	70.6 (521/738)
Russian Federation	612	412	91.4 (412/451)
Slovenia	530	297	56.9 (297/522)
Spain	786	511	65.0 (511/786)
The Netherlands	593	240	45.5 (240/528)
Turkey	669	338	59.7 (338/566)
United Kingdom	667	399	72.3 (399/552)
Sex			
Men	10 114	6698	74.0 (6698/9054)
Women	3821	2268	70.4 (2268/3221)
Age at index event			
$<$50 years	1766	1074	67.5 (1074/1592)
50–59 years	3999	2673	73.7 (2673/3629)
60–69 years	4953	3353	75.5 (3353/4443)
$\geq$ 70 years	3217	1866	71.5 (1866/2611)
Diagnostic category			
CABG	2468	1755	77.6 (1755/2261)
PTCA	5494	3718	73.4 (3718/5062)
AMI	3147	1743	68.3 (1743/2551)
Ischaemia	2826	1750	72.9 (1750/2401)
Total	13 935	8966	73.0 (8966/12 275)

AMI, acute myocardial infarction; CABG, coronary artery bypass graft; PTCA, percutaneous transluminal coronary angioplasty. [a]Participation rate in patients who were contacted and found alive.

Lifestyle and risk factor status at interview

Patient interviews and examinations were conducted on 64.3% (8966 of 13 935) of all patients (Table 2). The median time between index event and interview was 1.24 years (interquartile range 0.95–1.77 years). The most common reasons for not being interviewed were refusal to participate or no response (39.4%), patient's death (14.9%), change in patient's location (10.1%) and change in health status (6.2%). The adjusted participation rate defined as those who were contacted, found alive and interviewed was 73% (8966 of 12 275). The proportion of women attending interview was 25.3% (2268) and ranged from 11.5% (14 of 122) in Greece to 41.8% (192 of 459) in Hungary. Proportions by diagnostic category were: 19.6% (1755) CABG; 41.5% (3718) PTCA; 19.4% (1743) AMI and 19.5% (1750) with ischaemia.

Table 3 Available information (%) on coronary risk factors and measurements of weight, height, waist, blood pressure, lipids, glucose and HbA1c in hospital discharge documents, by country, sex, age and diagnostic category

	Available information on risk factor history on discharge				Available information on risk factor measurements on discharge									
	Smoking (%)	Hypertension (%)	Dyslipidaemia (%)	Diabetes (%)	Weight (%)	Height (%)	Waist (%)	SBP (%)	TC (%)	HDL cholesterol (%)	LDL cholesterol (%)	TG (%)	Glucose (%)	HbA1c[a] (%)
Country														
Belgium	87.8	81.4	86.8	83.1	81.8	61.1	2.7	96.1	87.9	81.4	80.2	82.6	75.8	18.4
Bulgaria	74.4	99.6	95.3	97.2	70.9	70.9	70.7	99.9	54.1	29.3	29.7	51.5	75.8	0.0
Croatia	94.0	96.5	95.6	98.4	88.4	89.6	31.2	98.6	84.5	82.9	81.5	83.6	91.0	13.7
Cyprus	97.0	95.7	85.2	94.5	64.6	72.0	14.0	77.8	53.3	39.0	39.4	52.4	64.6	1.6
Czech Republic	88.9	95.7	91.0	96.7	36.2	74.4	0.2	29.0	30.1	27.3	27.5	29.9	74.1	4.3
Finland	97.3	100.0	100.0	99.2	9.3	8.2	3.1	8.6	34.6	33.5	33.9	33.5	23.3	3.6
France	57.4	51.8	54.4	42.3	16.6	15.3	0.0	43.3	34.4	32.5	35.9	33.9	13.3	38.7
Germany	44.8	93.1	93.0	91.0	40.2	39.6	0.0	39.1	33.9	32.9	33.9	32.7	26.3	6.5
Greece	93.3	93.3	89.6	91.9	58.5	60.0	53.3	63.0	51.1	51.1	51.1	51.1	54.1	69.2
Hungary	95.9	99.8	97.9	99.1	97.1	97.1	0.2	99.7	91.2	29.6	29.6	90.8	99.7	19.4
Ireland	37.1	42.2	38.1	40.8	0.3	0.2	0.0	0.2	2.1	1.8	1.8	1.6	0.8	0.0
Italy	66.5	85.1	88.6	78.9	59.1	56.7	0.0	84.2	55.5	52.5	52.8	53.2	68.5	10.9
Latvia	89.0	96.9	76.3	96.7	23.5	28.6	22.3	71.1	92.9	73.8	74.3	74.4	91.5	24.7
Lithuania	17.1	89.9	69.0	82.3	6.1	6.1	0.2	84.2	62.7	58.1	57.7	61.0	71.6	6.0
Poland	47.1	49.2	41.7	29.7	4.6	2.8	0.0	22.4	13.5	6.9	6.6	7.3	19.2	0.9
Romania	84.0	84.8	75.9	32.6	43.4	36.9	18.5	86.1	88.9	88.6	87.2	88.7	95.1	5.2
Russian Federation	98.1	99.0	96.0	98.7	74.7	74.7	1.0	97.9	89.8	2.7	2.3	21.7	85.0	0.9
Slovenia	98.6	99.8	99.2	100.0	99.6	99.6	98.8	99.8	99.8	78.9	77.3	97.8	99.6	1.9
Spain	49.3	93.8	89.6	86.6	3.6	4.0	0.0	15.5	1.7	1.7	1.7	1.7	15.9	0.0
The Netherlands	64.9	71.1	63.4	59.2	8.9	8.0	0.0	66.3	58.0	51.4	53.2	55.9	60.3	17.8
Turkey	73.1	75.2	67.0	72.3	16.3	16.1	5.7	75.5	32.0	31.3	30.7	31.0	49.8	6.9
United Kingdom	17.6	19.1	19.3	16.7	0.2	0.0	0.0	4.4	2.6	0.6	0.6	0.8	0.9	2.7
Sex														
Men	69.8	80.3	76.5	74.5	40.4	41.0	12.5	62.7	52.7	41.5	41.6	47.4	57.1	11.0
Women	69.3	84.3	76.3	77.7	39.6	40.9	13.7	65.3	56.1	40.3	40.6	49.9	61.9	11.4
Age at index event														
<50 years	75.0	75.8	75.8	70.3	40.4	39.5	12.4	64.7	55.5	44.1	43.9	49.7	56.0	16.8
50–59 years	73.0	81.0	78.3	74.4	42.6	43.7	12.1	63.0	55.2	41.9	42.0	49.1	57.6	10.7
60–69 years	67.5	82.4	76.3	76.9	39.7	40.4	12.3	63.7	53.7	41.7	41.8	48.9	59.2	10.6
≥ 70 years	65.9	83.3	74.8	77.1	37.8	39.0	14.8	62.6	50.3	37.8	38.2	44.5	59.5	10.9
Diagnostic category														
CABG	66.6	85.3	80.4	80.5	44.2	48.3	9.9	54.5	40.7	26.5	26.0	36.9	55.1	2.9
PTCA	66.4	75.6	74.5	69.1	36.8	37.2	6.3	56.3	51.1	42.6	42.8	45.4	47.9	12.3
AMI	75.9	85.5	77.6	80.3	44.3	44.0	22.3	74.3	63.2	52.1	52.4	58.2	71.6	13.5
Ischaemia	72.2	84.8	75.7	77.9	39.1	38.5	18.2	73.5	59.7	39.8	40.1	52.3	67.9	15.6
Total	69.7	81.4	76.5	75.4	40.2	40.9	12.8	63.4	53.6	41.2	41.3	48.1	58.4	11.2

AMI, acute myocardial infarction; CABG, coronary artery bypass graft; HbA1c, glycated haemoglobin A1c; HDL, high-density lipoprotein; LDL, low-density lipoprotein; PTCA, percutaneous transluminal coronary angioplasty; SBP, systolic blood pressure; TC, total cholesterol; TG, triglycerides. [a]In patients with diabetes.

The prevalence of self-reported cardiovascular events before the index event was: CABG 7.8% (695 of 8923), PTCA 18.1% (1614 of 8907), AMI 30.3% (2682 of 8851), ischaemia 9.0% (788 of 8761), angina pectoris 31.0% (2710 of 8740), stroke 3.8% (343 of 8904), TIA 2.6% (235 of 8879) and PAD 5.3% (465 of 8782). After the index event, 3.5% (31 of 8921) of patients had CABG, 9.2% (818 of 8922) had PTCA, 2.1% (183 of 8919) had AMI, 3.2% (280 of 8882) had ischaemia, 15.0% (1325 of 8818) had angina pectoris, 0.8% (74 of 8923) had stroke, 0.8% had TIA (73 of 8913) and 3.4% (304 of 8793) had PAD. Blood samples were drawn from 8508 patients of whom 6717 (78.9%) had been fasting for at least 6 h.

Reported lifestyle changes by patients to reduce their risk of CHD after their index event are presented in Table 4. Table 5 shows the quantitative distribution of cardiovascular risk factors at interview. The proportions of patients with risk factors above the guideline targets are described in Table 6.

Overall, the prevalence of smoking (self-reported and/or CO in breath > 10 ppm) at interview was 17.2%. The prevalence of persistent smoking among patients smoking in the month before the coronary event was 51.9%, ranging from 32.9% in Romania to 73.3% in Latvia. The vast majority of smokers at interview reported to have received verbal (90.7%) or written (34.6%) advice to stop smoking. Only a small minority of patients (14.3%) was advised to seek professional help or prescribed pharmacological support. About 20.1% of patients were advised to use nicotine-replacement therapy (NRT) and 5.0% to use bupropion. Two-thirds of persistent smokers (64.2%) reported a reduction in the amount they smoked since the cardiac event and 11.2% had stopped but subsequently relapsed. Only 4.5% attended a smoking cessation clinic and NRT and bupropion were prescribed to 11.6 and 1.9% of patients, respectively, and 29.8% of persistent smokers reported taking no action to stop smoking since their coronary event.

Table 4 Reported lifestyle changes since the index event (%) taken by patients to reduce their risk of heart disease by country, age, sex and diagnostic category

	Stop smoking[a] (%)	Healthy diet[b] (%)	Increase physical activity[c] (%)	Lose weight[d] (%)
Country				
Belgium	75.0	84.6	67.2	41.5
Bulgaria	65.3	97.0	27.0	47.5
Croatia	75.5	97.1	76.0	88.9
Cyprus	79.0	95.0	71.8	45.2
Czech Republic	2.7	88.7	29.8	47.0
Finland	59.3	90.6	33.5	48.8
France	80.0	77.6	57.7	47.6
Germany	77.3	84.2	62.2	57.8
Greece	28.6	92.6	62.2	53.3
Hungary	82.6	98.3	66.8	62.3
Ireland	81.3	96.4	72.5	81.1
Italy	82.2	97.6	87.0	68.6
Latvia	52.8	87.6	58.8	57.7
Lithuania	81.2	91.0	72.3	60.4
Poland	87.7	97.0	48.1	63.7
Romania	64.6	98.8	80.9	68.3
Russian Federation	76.3	99.0	51.3	64.8
Slovenia	63.0	96.6	90.5	62.3
Spain	80.9	93.5	36.1	36.5
The Netherlands	64.3	82.1	62.5	32.0
Turkey	73.0	93.7	48.6	69.4
United Kingdom	90.0	84.4	48.2	59.7
Sex				
Men	69.8	92.1	60.3	58.0
Women	75.9	93.1	55.3	59.0
Age at index event				
<50 years	71.7	93.5	61.4	59.5
50–59 years	73.3	94.3	61.9	62.1
60–69 years	67.8	92.3	59.5	59.0
≥ 70 years	67.5	89.8	54.5	52.1
Diagnostic category				
CABG	67.8	92.1	61.5	57.2
PTCA	68.5	91.8	62.5	60.4
AMI	75.5	92.8	61.9	59.2
Ischaemia	72.1	93.3	46.6	53.8
Total	70.8	92.3	59.1	58.2

AMI, acute myocardial infarction; CABG, coronary artery bypass graft; PTCA, percutaneous transluminal coronary angioplasty. [a]For subgroup of smokers. [b]For the total group. [c]For subgroup with overweight and obesity. [d]For the total group, attended at least half of the sessions.

Overall, 92% of all patients tried to change their diet by reducing fat (82.1%) and calorie intake (61.3%), changing fat type (73.5%), increasing fruit and vegetables (77.9%) and fish (64.9%) and reducing salt (71.3%) consumption. Reduction of sugar and alcohol intake was reported by 61.8 and 59.4% of patients, respectively. Increased physical activity after their coronary event was reported by 59.1% of patients, and 23.9% reported to have been following specific advice from a health or exercise professional. A small minority (12.0%) attended a fitness or leisure centre or joined a community-walking group. Just less than half of the patients (48.0%) increased their everyday physical activity. The majority of patients reported mild (57.8%) or no (12.1%) physical activities outside work. Moderate (vigorous activity at least 20 min once or twice a week) and intensive (vigorous activity at least 20 min three or more times a week) activity was reported by 16.4 and 13.8%, respectively. Only 33.8% of patients reported doing some regular exercise to increase their physical fitness.

The prevalence of obesity (BMI $\geq 30\,kg/m^2$) and central obesity (waist circumference $\geq 102\,cm$ for men and $\geq 88\,cm$ for women) was 35.3 and 52.7%, respectively. Since their coronary event, only 51.8% of obese patients had followed dietary recommendations to lose weight, 38.2% increased their regular physical activity and 2.0% tried weight-reducing drugs. About 39.3% of obese patients had not taken any action to lose weight after their coronary event. The prevalence of raised blood pressure, blood cholesterol and blood glucose (in those with self-reported diabetes) and their therapeutic control at interview are presented in Tables 7 and 8. Table 9 shows reported medication at interview and on discharge (in those patients who were interviewed).

Discussion

The results of the EUROASPIRE III survey show that large proportions of coronary patients in Europe do not achieve the lifestyle, risk factor and therapeutic targets set by the Joint European Societies' guidelines on CVD prevention in clinical practice [4–6]. There is considerable variation between European countries in patients' lifestyle, risk factor prevalences and use of cardioprotective medication. Information on risk factor history and measurements in the discharge documents is incomplete. At discharge, weight and height were recorded in two-fifths of patients, waist circumference in one in ten, blood pressure and glucose in two-fifths and the total cholesterol was not available in nearly half of all patients.

There is strong scientific evidence that lifestyle modifications in relation to tobacco smoking, diet and physical activity can reduce the risk of recurrent cardiovascular events in patients with established coronary disease and improve survival [1,11–14]. Nearly one-third of coronary patients in EUROASPIRE III were smokers in the month before the index event and this had fallen by about half at interview. The prevalence of smoking was highest in younger patients (< 50 years of age). Overall, the prevalence of smoking was higher in men than in women in most of the countries. However, in some countries, such as Ireland and The Netherlands, more women smoked. A meta-analysis of smoking cessation after a MI showed a relative risk reduction of coronary mortality by 46% in those who stopped smoking compared with those who continued to smoke [11]. Therefore, all cigarette smokers should receive professional advice and support to stop smoking, as this is a very effective preventive measure. In EUROASPIRE III, only one in seven patients was advised to attend a smoking cessation service and only one-third of those actually did so. Evidence-based treatments were under-used, with about one in ten patients who continued to smoke, receiving pharmacological support in the form of NRT or bupropion. It is of concern that management of smoking is not as effective as it could be with nearly one-third of

Table 5 Quantitative coronary heart disease risk factors at interview, by country, age and diagnostic category

	Body mass index (kg/m^2, mean, SD)	Waist circumference (cm, mean, SD)	Systolic BP (mmHg, mean, SD)	Diastolic BP (mmHg, mean, SD)	Serum total cholesterol (mmol/l, mean, SD)	Serum LDL cholesterol (mmol/l, mean, SD)	Serum HDL cholesterol (mmol/l, median)	Serum triglycerides[a] (mmol/l, median, IR)	Plasma glucose[a] (mmol/l, median, IR)
Country									
Belgium	28.2 (4.2)	99.0 (12.1)	138.7 (21.7)	81.2 (12.2)	4.48 (0.94)	2.53 (0.75)	1.24 (0.30)	1.33 (0.96–1.78)	6.15 (5.64–6.79)
Bulgaria	28.4 (4.6)	98.1 (12.0)	138.5 (20.4)	83.5 (12.3)	5.01 (1.26)	3.20 (1.01)	1.12 (0.32)	1.55 (1.07–2.19)	6.47 (5.91–7.70)
Croatia	29.1 (4.0)	106.7 (11.6)	143.5 (21.0)	86.4 (12.7)	4.58 (1.08)	2.72 (0.92)	1.16 (0.29)	1.36 (1.02–1.94)	6.54 (6.04–7.25)
Cyprus	29.3 (4.3)	99.8 (10.4)	137.2 (18.6)	82.3 (10.5)	4.60 (1.04)	2.78 (0.83)	1.04 (0.24)	1.51 (1.08–2.09)	6.47 (5.90–8.01)
Czech Republic	29.3 (4.5)	102.3 (11.7)	144.2 (19.9)	85.0 (11.6)	4.62 (1.33)	2.59 (0.90)	1.18 (0.27)	1.52 (1.15–2.11)	6.57 (6.03–7.94)
Finland	27.7 (4.1)	94.4 (12.1)	140.9 (14.8)	82.5 (8.5)	4.10 (0.86)	2.20 (0.67)	1.25 (0.32)	1.25 (0.95–1.76)	6.15 (5.71–6.65)
France	28.8 (4.9)	102.9 (12.4)	141.4 (21.0)	80.1 (11.7)	4.37 (1.08)	2.42 (0.84)	1.16 (0.33)	1.48 (1.05–2.10)	6.35 (5.83–7.32)
Germany	29.6 (4.5)	100.9 (11.2)	139.7 (21.3)	81.3 (11.6)	4.63 (1.05)	2.64 (0.80)	1.18 (0.26)	1.38 (1.00–1.96)	6.40 (6.01–6.93)
Greece	28.0 (3.9)	98.6 (11.0)	130.8 (14.4)	79.0 (8.5)	4.43 (1.11)	2.59 (0.89)	1.04 (0.25)	1.19 (0.89–1.68)	6.39 (5.64–7.78)
Hungary	29.9 (5.0)	100.4 (11.5)	137.5 (21.5)	80.1 (11.9)	4.82 (1.25)	2.82 (0.99)	1.13 (0.28)	1.61 (1.11–2.12)	6.66 (6.12–7.95)
Ireland	28.9 (4.5)	98.4 (11.6)	139.9 (20.1)	80.4 (11.5)	4.10 (0.98)	2.24 (0.77)	1.19 (0.28)	1.30 (0.88–1.86)	6.09 (5.78–6.63)
Italy	28.1 (4.0)	98.9 (11.0)	142.8 (19.7)	83.9 (10.2)	4.59 (0.99)	2.73 (0.84)	1.16 (0.27)	1.33 (1.00–1.77)	6.60 (6.07–7.71)
Latvia	29.2 (4.8)	98.8 (12.5)	142.4 (20.3)	84.1 (11.0)	5.15 (1.29)	2.96 (1.05)	1.27 (0.32)	1.52 (1.15–2.11)	6.20 (5.85–6.71)
Lithuania	29.3 (4.5)	99.7 (11.7)	145.9 (23.0)	86.6 (12.8)	5.64 (1.28)	3.68 (1.15)	1.24 (0.33)	1.41 (1.06–2.04)	6.24 (5.84–6.77)
Poland	28.0 (3.6)	100.5 (10.9)	145.5 (21.4)	83.8 (11.6)	4.20 (0.87)	2.29 (0.59)	1.18 (0.28)	1.18 (0.87–1.72)	6.08 (5.73–6.80)
Romania	28.6 (4.4)	97.8 (11.5)	137.4 (20.6)	94.9 (11.1)	4.72 (1.11)	2.77 (0.94)	1.22 (0.29)	1.36 (1.04–1.92)	6.40 (5.97–7.22)
Russian Federation	29.4 (4.4)	101.8 (11.4)	141.8 (21.9)	82.0 (11.9)	4.79 (1.33)	2.92 (1.16)	1.07 (0.23)	1.50 (1.15–2.14)	6.50 (6.03–7.51)
Slovenia	28.0 (4.3)	87.6 (15.5)	131.9 (15.4)	80.4 (9.4)	5.35 (1.22)	3.42 (1.02)	1.14 (0.27)	1.45 (1.05–2.16)	6.35 (5.81–6.94)
Spain	28.8 (4.1)	100.9 (10.3)	143.6 (20.9)	83.6 (11.0)	4.47 (0.97)	2.59 (0.85)	1.19 (0.27)	1.43 (1.00–1.86)	6.41 (5.93–7.12)
The Netherlands	29.1 (4.5)	103.2 (11.8)	140.5 (20.5)	82.4 (12.8)	4.53 (0.97)	2.77 (0.82)	1.12 (0.28)	1.20 (0.89–1.74)	6.53 (5.94–7.78)
Turkey	28.6 (4.0)	96.7 (11.5)	141.1 (22.7)	83.1 (12.3)	4.66 (1.18)	2.81 (0.99)	1.05 (0.22)	1.46 (1.09–2.04)	6.10 (5.67–6.94)
United Kingdom	28.6 (5.3)	98.3 (14.2)	135.9 (20.9)	78.7 (12.1)	4.07 (0.99)	2.28 (0.83)	1.16 (0.29)	1.19 (0.86–1.62)	5.84 (5.46–6.47)
Age at index event									
<50 years	29.3 (4.8)	100.4 (12.4)	131.1 (16.6)	83.5 (11.7)	4.79 (1.37)	2.85 (1.08)	1.08 (0.27)	1.57 (1.09–2.29)	6.11 (5.74–6.64)
50–59 years	29.3 (4.6)	100.8 (12.4)	136.4 (19.1)	83.7 (11.7)	4.73 (1.18)	2.79 (0.96)	1.13 (0.28)	1.49 (1.06–2.12)	6.40 (5.91–7.23)
60–69 years	28.8 (4.4)	99.5 (12.2)	141.8 (20.8)	82.7 (11.7)	4.68 (1.17)	2.76 (0.98)	1.17 (0.29)	1.36 (1.02–1.90)	6.40 (5.90–7.39)
≥ 70 years	28.3 (4.2)	97.9 (12.6)	145.4 (22.0)	81.4 (11.8)	4.64 (1.19)	2.76 (1.02)	1.20 (0.30)	1.28 (0.98–1.77)	6.36 (5.86–7.21)
Diagnostic category									
CABG	28.9 (4.4)	100.0 (11.5)	143.1 (21.9)	82.5 (11.5)	4.66 (1.21)	2.74 (0.96)	1.15 (0.28)	1.42 (1.06–1.98)	6.44 (5.96–7.30)
PTCA	28.9 (4.4)	100.4 (11.8)	139.8 (20.4)	82.5 (11.8)	4.55 (1.15)	2.65 (0.96)	1.16 (0.28)	1.37 (1.02–1.94)	6.33 (5.86–7.17)
AMI	28.5 (4.4)	97.8 (13.7)	139.2 (20.9)	83.2 (12.0)	4.79 (1.23)	2.89 (1.03)	1.15 (0.30)	1.41 (1.03–2.00)	6.36 (5.85–7.13)
Ischaemia	29.1 (4.7)	99.0 (13.1)	139.4 (19.9)	83.0 (11.6)	4.92 (1.21)	2.99 (1.00)	1.17 (0.30)	1.36 (1.00–1.93)	6.36 (5.83–7.22)
Total	28.9 (4.5)	99.6 (12.4)	140.3 (20.7)	82.7 (11.8)	4.69 (1.20)	2.77 (0.99)	1.16 (1.29)	1.39 (1.02–1.96)	6.36 (5.87–7.21)

AMI, acute myocardial infarction; BP, blood pressure; CABG, coronary artery bypass graft; HDL, high-density lipoprotein; IR, interquartile range; LDL, low-density lipoprotein; PTCA, percutaneous transluminal coronary angioplasty. [a]For patients fasting ≥ 6 h (78.9% of all patients).

Table 6 Prevalence (%) of coronary heart disease risk factors at interview, by country, age and diagnostic category

	Current smoking[a] (%)							Lipids (%)			Diabetes mellitus (%)		
	Men	Women	Total	Over-weight (%)[b]	Obesity (%)[c]	Increased waist circumference (%)[d]	Raised blood pressure (%)[e]	Elevated TC[f]	Decreased HDL[g]	Elevated TG[h]	Self-reported diabetes	Undiagnosed diabetes[i]	Diabetes[j]
Country													
Belgium	16.5	6.4	15.0	80.3	25.5	45.5	51.5	44.5	22.5	26.6	18.6	12.8	29.6
Bulgaria	22.5	11.0	19.0	79.2	30.3	50.4	55.2	63.7	45.6	44.5	28.2	27.6	44.6
Croatia	15.1	13.6	14.7	86.6	37.4	78.0	62.3	49.9	34.1	33.3	20.5	18.4	35.3
Cyprus	26.1	8.6	23.8	88.0	38.2	45.9	52.6	48.8	51.2	40.4	30.5	16.8	41.7
Czech Republic	20.9	13.7	19.4	84.1	36.7	55.6	66.0	46.4	31.2	41.2	31.1	17.6	43.9
Finland	13.9	7.6	11.8	74.3	23.6	40.9	68.4	25.8	27.0	29.2	19.8	7.8	25.8
France	22.6	12.7	20.5	77.0	35.7	56.7	55.4	41.4	36.4	39.1	35.0	7.5	40.4
Germany	17.2	8.1	15.3	85.8	41.8	52.8	53.7	51.5	27.8	32.1	24.2	14.5	24.4
Greece	18.5	0.0	16.4	75.2	23.1	42.3	32.2	40.7	48.3	21.1	18.3	30.5	38.8
Hungary	17.2	15.6	16.6	84.9	47.3	64.6	53.9	55.4	46.8	44.6	43.4	19.2	49.7
Ireland	16.2	23.6	17.9	92.4	34.7	47.9	52.2	26.7	32.5	30.6	14.5	7.3	19.5
Italy	13.7	7.7	12.5	78.7	28.2	51.5	62.0	48.1	33.8	28.4	25.5	18.8	39.3
Latvia	29.3	6.7	21.6	80.9	40.7	52.6	58.6	64.0	25.5	38.9	15.5	10.5	23.8
Lithuania	19.2	4.4	15.9	84.7	40.3	51.3	67.0	81.5	26.7	38.0	16.6	10.9	25.5
Poland	13.3	15.9	13.8	76.7	24.6	54.0	65.5	31.2	26.1	25.9	20.5	11.6	29.6
Romania	21.8	15.2	19.8	79.2	34.6	51.4	55.4	53.2	31.9	34.8	27.2	15.1	38.6
Russian Federation	10.3	10.5	10.4	85.4	38.6	59.7	56.4	53.2	51.5	40.0	23.7	19.8	38.6
Slovenia	26.8	8.2	20.1	74.3	28.2	28.2	30.8	76.6	39.8	37.3	10.7	19.8	28.5
Spain	10.6	8.9	10.1	83.8	37.8	56.3	58.2	42.1	31.8	34.2	21.6	15.8	33.2
The Netherlands	18.5	9.3	16.1	84.3	38.0	64.0	58.5	46.5	42.7	26.1	33.4	14.9	43.3
Turkey	25.6	12.3	23.1	83.6	35.5	41.2	55.2	48.3	50.2	36.6	27.1	8.5	33.6
United Kingdom	22.7	13.1	20.1	75.6	29.4	45.9	47.4	30.9	38.1	22.7	23.8	4.2	25.1
Age at index event													
<50 years	38.6	34.5	38.0	83.1	39.3	48.6	39.4	52.9	49.4	44.3	14.3	9.3	21.3
50–59 years	27.0	19.3	25.6	84.0	38.9	53.0	50.6	52.8	37.9	39.1	22.8	15.4	34.2
60–69 years	15.1	10.6	13.9	82.2	35.0	53.8	58.5	50.9	34.7	33.7	26.6	15.9	37.2
≥ 70 years	6.9	3.2	5.7	78.3	30.5	52.0	64.1	48.9	33.9	27.6	27.2	15.5	37.2
Diagnostic category													
CABG	12.6	7.2	11.4	83.0	35.0	52.0	62.7	50.2	36.3	36.1	30.1	14.0	38.2
PTCA	19.8	13.2	18.4	82.1	35.3	53.0	54.6	45.7	35.3	33.8	22.7	14.2	33.2
AMI	24.0	11.8	20.7	79.4	33.6	49.5	52.6	54.6	38.2	36.2	22.1	15.3	33.9
Ischaemia	20.9	10.0	17.1	82.2	37.3	55.8	55.6	59.6	38.6	33.8	25.5	17.2	36.1
Total	19.3	11.0	17.2	81.8	35.3	52.7	56.0	51.1	36.7	34.7	24.6	14.9	34.8

AMI, acute myocardial infarction; CABG, coronary artery bypass graft; HDL, high-density lipoprotein; PTCA, percutaneous transluminal coronary angioplasty; TC, total cholesterol; TG, triglycerides. [a]Self-reported and/or CO in breath >10 ppm. [b]BMI ≥ 25 kg/m^2. [c]BMI ≥ 30 kg/m^2. [d]Waist circumference ≥ 102 cm for men and ≥ 88 cm for women. [e]Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg (systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 80 mmHg in patients with diabetes). [f]Serum total cholesterol ≥ 4.5 mmol/l. [g]Serum HDL cholesterol < 1 mmol/l for men and < 1.2 mmol/l for women. [h]Fasting serum triglycerides ≥ 1.7 mmol/l. [i]Fasting plasma glucose ≥ 7.0 mmol/l. [j]Glucose ≥ 7.0 mmol/l and/or history of diabetes (in patients fasting ≥ 6 h).

smokers reporting that they had taken no action to stop smoking since their coronary event.

In this survey, a large majority of patients reported changing their diet with regard to reducing fat, calorie intake and salt, and increasing fruit and vegetables, fish and oily fish consumption, but these results were not validated by an independent dietary assessment and are undermined to an extent by the objective measures of obesity and central obesity. Two-fifths of patients reported no increase in physical activity after their coronary event and only one-third reported doing some regular exercise to increase their physical fitness. All coronary patients will benefit from a professional, multidisciplinary, prevention and rehabilitation programme that addresses all aspects of lifestyle – smoking cessation, consuming a healthy diet and becoming physically active – together with, effective management of blood pressure, lipids and glucose and appropriate prescribing of cardioprotective medications. The reality is that less than half of all coronary patients in this survey were advised to participate in a cardiac rehabilitation programme after hospitalization and three-quarters of these patients attended at least half of the sessions; only one-third of the eligible population.

In EUROASPIRE III, the prevalence rates of overweight and obesity are alarming in all countries. Less than one in five patients was found to be at the target BMI of less than 25 kg/m^2. Compared with the previous two surveys, the prevalence of obesity has substantially increased with more than one-third of patients in EUROASPIRE III being obese (BMI ≥ 30 kg/m^2) and more than half having central obesity (waist circumference ≥ 102 cm in men and ≥ 88 cm in women). Recording of height, weight and especially waist circumference in discharge documents was poor. One in five of these obese patients said they had never been told they were overweight, half had not

Table 7 Therapeutic control of blood pressure and serum cholesterol at interview, by centre and diagnostic category; goal for blood pressure: systolic blood pressure <140 and diastolic BP <90 mmHg (<130/80 mmHg in patients with diabetes); goal for cholesterol: serum total cholesterol < 4.5 mmol/l

	No BP-lowering medication[a]		BP-lowering medication[a]		All patients		No lipid-lowering medication		Lipid-lowering medication		All patients	
	n	Reaching goal (%)	*n*	Reaching goal (%)	*n*	Reaching goal (%)	*n*	Reaching goal (%)	*n*	Reaching goal (%)	*n*	Reaching goal (%)
Country												
Belgium	27	37.0	296	50.0	326	48.5	24	25.0	192	58.9	218	55.5
Bulgaria	15	80.0	522	43.9	538	44.8	202	38.1	333	35.4	537	36.3
Croatia	16	43.8	438	37.4	454	37.7	76	30.3	367	54.2	443	50.1
Cyprus	48	47.9	393	47.3	441	47.4	33	24.2	328	54.0	361	51.2
Czech Republic	9	66.7	464	33.6	477	34.0	53	28.3	389	57.3	446	53.6
Finland	4	50.0	233	31.3	237	31.6	5	40.0	154	75.3	159	74.2
France	6	33.3	330	44.8	341	44.6	34	32.4	300	61.7	338	58.6
Germany	29	48.3	515	46.4	549	46.3	75	29.3	460	51.7	540	48.5
Greece	10	80.0	111	66.7	121	67.8	10	40.0	108	61.1	118	59.3
Hungary	13	53.8	444	45.9	458	46.1	99	24.2	357	50.4	457	44.6
Ireland	30	43.3	354	48.0	385	47.8	37	56.8	344	75.0	382	73.3
Italy	12	58.3	363	37.2	376	38.0	38	34.2	331	53.8	370	51.9
Latvia	15	40.0	502	41.4	519	41.4	138	14.5	367	44.1	506	36.0
Lithuania	26	34.6	478	33.1	506	33.0	255	12.2	187	27.3	453	18.5
Poland	8	62.5	495	33.5	505	44.6	77	28.6	424	70.8	502	46.8
Romania	18	38.9	503	44.4	521	43.6	85	18.8	430	50.2	515	46.8
Russian Federation	17	58.8	395	43.7	412	69.2	171	12.3	239	52.3	410	23.4
Slovenia	4	50.0	290	69.6	297	41.8	26	46.2	263	31.4	292	57.9
Spain	46	50.0	461	41.7	509	41.5	109	35.8	381	58.9	492	53.5
The Netherlands	14	50.0	224	40.3	238	34.5	15	40.0	219	58.5	234	68.8
Turkey	29	44.8	306	44.8	337	44.8	111	22.5	207	67.1	319	51.7
United Kingdom	35	42.9	360	53.9	399	52.6	38	42.1	334	72.5	375	69.1
Age at index event												
<50 years	73	60.3	760	60.8	838	60.6	139	21.6	653	52.4	796	47.1
50–59 years	139	51.8	2279	49.3	2426	49.4	388	22.2	1870	52.4	2267	47.2
60–69 years	143	48.3	3245	41.4	3402	41.5	634	23.8	2576	55.4	3228	49.1
≥ 70 years	76	30.3	2193	36.1	2280	35.9	550	30.4	1615	58.4	2176	51.1
Diagnostic category												
CABG	58	32.8	1684	37.6	1750	37.3	280	20.7	1349	56.0	1638	49.8
PTCA	181	48.1	3512	45.3	3709	45.4	492	29.5	2975	58.3	3480	54.3
AMI	76	50.0	1661	47.3	1741	47.4	396	22.5	1245	52.9	1653	45.4
Ischaemia	116	55.2	1620	43.8	1746	44.4	543	26.2	1145	47.4	1696	40.4
Total	431	48.3	8477	43.9	8946	44.0	1711	25.4	6714	55.0	8467	48.9

AMI, acute myocardial infarction; BP, blood pressure; CABG, coronary artery bypass graft; PTCA, percutaneous transluminal coronary angioplasty. [a]BP-lowering medication: β-blocker, calcium antagonist, angiotensin-converting enzyme inhibitor, angiotensin II receptor blocker, diuretic or other antihypertensive drug.

followed dietary recommendations to lose weight and almost two-third had not increased their physical activity. All coronary patients should be professionally encouraged, where appropriate, to lose weight and reduce central obesity. A calorie-restricted diet, principally from reducing saturated fat, is central to weight reduction. Regular physical activity, suitably adapted to an individuals' fitness level, helps with both weight reduction and maintenance of reduced body weight. The contribution of drug therapies to the management of obesity is modest and some products can have serious side effects.

In this survey, a history of hypertension was documented in four-fifths of patients, but only two-thirds had a blood pressure recorded in the discharge record. The control of blood pressure was not optimal with the majority of patients not reaching the blood pressure goal at the time of interview. Of those on blood pressure-lowering medication, only two-fifths had reached the blood pressure target of less than 140/90 mmHg (< 130/80 in patients with diabetes mellitus). All coronary patients require specific lifestyle advice for blood pressure lowering, and where necessary antihypertensive medication. Lifestyle changes can not only reduce blood pressure in people with mildly elevated levels, but also reduce the number of drugs required to control blood pressure. After MI, elevated blood pressure is associated with an increased risk of re-infarction, coronary death or stroke [15]. Several randomized controlled trials in patients with CHD have shown a reduction in the incidence of CVD events by reducing blood pressure targets to lower levels [16]. The recently published 2007 Joint European Societies' Guidelines on CVD prevention defined a lower blood pressure target of less than 130/80 mmHg in patients with established CVD or diabetes, if feasible [1]. The EUROASPIRE III results show that three-quarters of coronary patients in Europe are currently not reaching this new target and only a quarter of those on blood pressure-lowering medication were controlled.

There are several possible explanations for poor blood pressure control in these coronary patients. First, the high

Table 8 Glycaemic control among patients with self-reported diabetes

	Fasting glucose < 6.1 mmol/l		HbA1c < 6.5%	
	n	%	*n*	%
Country				
Belgium	6/41	14.6	16/34	47.1
Bulgaria	13/61	21.3	61/128	47.7
Croatia	3/82	3.7	14/73	19.2
Cyprus	3/86	3.5	19/92	20.7
Czech Republic	8/139	5.8	48/123	39.0
Finland	8/31	25.8	9/20	45.0
France	13/117	11.1	39/112	34.8
Germany	2/18	11.1	–	–
Greece	0/8	0.0	8/21	38.1
Hungary	6/63	9.5	65/170	38.2
Ireland	7/48	14.6	12/42	28.6
Italy	0/90	0.0	17/83	20.5
Latvia	8/40	20.0	23/55	41.8
Lithuania	8/61	13.1	–	–
Poland	16/129	12.4	46/91	50.5
Romania	4/118	3.4	–	–
Russian Federation	6/43	14.0	12/30	40.0
Slovenia	5/53	9.4	18/60	30.0
Spain	12/161	7.5	46/155	29.7
The Netherlands	1/11	9.1	20/44	45.5
Turkey	11/75	14.7	15/63	23.8
United Kingdom	20/66	30.3	19/67	28.4
Age at interview				
<50 years	8/86	9.3	24/82	29.3
50–59 years	27/406	6.7	124/358	34.6
60–69 years	71/625	11.4	210/616	34.1
≥ 70 years	54/424	12.7	149/407	36.6
Index event				
CABG	38/360	10.6	110/331	33.2
PTCA	55/639	8.6	170/509	33.4
AMI	36/290	12.4	99/278	35.6
Ischaemia	31/252	12.3	128/345	37.1
Total	160/1541	10.4	507/1463	34.7

AMI, acute myocardial infarction; CABG, coronary artery bypass graft; HbA1c, glycated haemoglobin A1c; PTCA, percutaneous transluminal coronary angioplasty.

prevalence of obesity and central obesity may mitigate the effects of antihypertensive medications, to some extent. Second, such medications are often prescribed at low doses, and then not uptitrated to achieve the blood pressure target. Poor patient adherence with these drugs may also be an important factor over the long term. The measurement of blood pressure by study personnel, rather than the doctors and nurses they knew, may also have resulted in higher blood pressure levels as has been shown by comparing office measurement with home or continuous measurements.

In EUROASPIRE III, the total cholesterol levels were only available in just over half of the discharge documents. At interview, nearly half of these patients had a total cholesterol ≥ 4.5 mmol/l and in those on lipid-lowering medication just over half had reached the total cholesterol goal of less than 4.5 mmol/l. This is despite the increased use of lipid-lowering medication with nearly four-fifths of patients being on lipid-lowering drugs, principally statins, at interview. Individual clinical trials and subsequent meta-analyses of cholesterol lowering show that such treatments, mainly statins, reduce cardiovascular morbidity and mortality and can prolong survival in patients with established CVD. More recent trial evidence supports the view that early in-hospital treatment, and subsequent compliance with medication after discharge, is of benefit in reducing the risk of further cardiovascular events in the short term [17]. Recent studies, addressing more intensive lipid-lowering therapy, have shown that lowering LDL cholesterol levels below previously recommended treatment goals could provide additional clinical benefit. The 2007 Joint European Societies' recommendations set new goals of a total cholesterol less than 4.0 mmol/l and an LDL cholesterol less than 2.0 mmol/l in patients with established CVD or diabetes, if feasible [1]. When applying these new targets to this patient population, more than two-thirds of patients have elevated total cholesterol and only one-third of those on lipid-lowering medication achieve the total cholesterol goal of less than 4.0 mmol/l. Therefore, a large majority of coronary patients will require more intensive cholesterol management and optimal use of lipid-lowering drug therapies to achieve these lower targets.

In this survey, about a quarter of the coronary patients had previously diagnosed diabetes. In addition, 14.9% of patients without a history of diabetes had fasting plasma glucose ≥ 7 mmol/l. Therefore, the proportion of patients with diabetes, either known or undiagnosed, is just over a third which is close to the estimate of 31% in the Euro Heart Survey of Diabetes Mellitus [18]. Screening for undiagnosed diabetes and impaired glucose regulation (impaired fasting glycaemia or impaired glucose intolerance) should become an integral part of the assessment of patients with CHD or other atherosclerotic disease. Glucose control in patients with previously diagnosed diabetes is poor. Nearly nine out of ten of these patients had a fasting plasma glucose level ≥ 6.1 mmol/l and about two-thirds had a HbA1c ≥ 6.5%. The long-term prognosis after MI, unstable angina, CABG and PTCA is worse in diabetic patients than in nondiabetic patients [19–23]. This high cardiovascular risk status of diabetic patients requires a more comprehensive approach to their care by addressing all risk factors and not just glycaemic control. Evidence from clinical trials indicates that a multifactorial intervention directed towards the traditional risk factors for CAD effectively reduces microvascular and macrovascular complications in patients with type-2 diabetes mellitus [24].

The use of cardioprotective drug therapies, which have been shown to reduce morbidity and mortality in clinical trials are recommended, in addition to drugs used for the treatment of elevated blood pressure and glucose [25–32]. The following drug classes are recommended in the Joint European Societies' guidelines for CVD prevention: aspirin or other platelet-modifying drugs in all patients except those who are aspirin intolerant,

Table 9 Reported medication (%) at the time of interview (I), and recorded medication in the medical records at discharge (D) and interview, of those interviewed, by country, age and diagnostic category

	Antiplatelets (%)		β-blockers (%)		ACE inhibitors/ angiotensin II receptor blockers (%)		Calcium antagonists (%)		Diuretics (%)		Lipid-lowering drugs (%)		Statins (%)		Anticoagulants (%)	
	D	I	D	I	D	I	D	I	D	I	D	I	D	I	D	I
Country																
Belgium	95.1	93.5	83.0	80.0	46.0	50.2	11.7	13.5	13.0	11.7	83.0	88.6	83.3	87.7	9.0	6.2
Bulgaria	87.9	85.5	82.3	82.3	69.9	66.2	20.4	22.3	35.9	43.4	62.5	62.3	65.6	59.1	7.8	8.6
Croatia	97.8	93.6	81.5	83.0	70.1	68.9	25.7	31.6	21.1	20.4	80.7	83.1	80.9	83.1	3.7	4.4
Cyprus	98.1	97.7	60.2	62.0	61.0	68.7	15.5	20.4	18.3	24.0	89.0	91.2	89.4	90.5	1.4	1.6
Czech Republic	95.4	92.0	87.3	91.2	67.4	76.2	17.7	26.2	31.3	39.2	88.6	88.0	90.1	86.1	15.0	6.3
Finland	94.5	94.1	94.5	93.2	58.6	59.1	19.4	19.0	15.2	13.1	95.8	95.4	95.8	95.4	17.7	13.9
France	98.5	97.3	82.7	74.7	73.6	80.1	19.4	27.4	21.2	23.2	88.2	89.9	90.9	87.5	14.0	5.4
Germany	98.2	90.6	90.7	84.6	79.3	73.0	34.9	27.3	34.9	37.4	89.0	86.2	89.4	85.0	35.6	7.5
Greece	98.4	98.4	75.4	77.0	65.3	64.8	21.3	24.6	18.0	24.6	81.0	91.8	83.5	91.8	4.1	3.3
Hungary	90.0	85.4	91.9	85.2	71.9	81.0	48.0	38.0	64.2	53.9	77.6	78.2	78.0	74.9	6.3	6.6
Ireland	98.8	97.1	84.2	76.9	58.9	61.6	15.5	16.6	13.7	13.2	89.5	90.1	90.4	88.8	1.2	2.6
Italy	95.2	97.1	81.7	86.7	66.0	71.5	15.6	23.1	24.7	25.0	72.1	89.6	72.9	89.1	2.7	2.9
Latvia	88.6	83.8	86.5	84.9	71.7	68.7	41.4	38.5	38.5	24.2	83.9	72.3	83.9	72.3	5.2	4.3
Lithuania	89.8	73.6	78.2	78.5	60.7	79.0	11.2	22.8	37.0	35.5	38.2	41.6	38.4	36.1	3.5	11.1
Poland	97.4	93.8	89.9	72.1	89.7	68.3	19.1	25.0	33.2	25.8	94.2	93.8	95.0	92.9	2.8	8.3
Romania	97.3	89.7	91.9	86.7	70.1	80.7	19.4	21.4	39.5	34.3	85.8	84.7	85.8	83.1	7.3	6.5
Russian Federation	97.3	89.4	89.1	87.7	85.7	72.2	18.9	21.5	45.6	38.2	66.0	83.5	66.7	81.8	0.5	6.7
Slovenia	94.3	91.3	80.1	80.1	76.7	76.7	10.1	17.0	26.4	43.7	85.5	58.3	86.1	56.8	9.1	1.5
Spain	91.9	91.2	61.7	85.7	48.3	84.0	35.1	14.3	11.0	35.0	63.1	91.2	67.6	89.8	3.8	7.8
The Netherlands	97.9	89.6	74.0	59.7	61.2	51.9	23.8	34.0	32.4	20.8	87.2	77.4	87.6	73.5	12.5	4.5
Turkey	99.4	91.4	83.1	73.8	73.6	69.0	11.4	14.2	17.7	27.6	82.0	65.9	82.3	65.0	2.7	2.1
United Kingdom	98.4	93.9	74.9	65.1	72.8	77.0	17.7	23.3	19.5	20.8	91.5	88.9	92.0	88.4	1.6	2.0
Age at index event																
<50 years	97.3	93.3	84.3	79.3	63.4	64.1	13.2	13.9	13.3	13.4	85.2	82.6	86.2	80.6	5.1	2.3
50–59 years	95.7	92.1	83.5	80.8	68.5	68.8	18.9	22.4	23.9	24.2	83.9	83.0	85.0	81.3	6.2	4.3
60–69 years	94.9	90.5	83.0	80.0	69.4	72.3	24.2	26.3	30.7	31.5	79.2	80.3	80.2	78.4	8.0	5.4
≥ 70 years	93.8	87.7	80.3	78.5	70.8	73.3	26.9	27.7	39.6	40.7	74.1	74.6	74.7	73.4	10.3	8.7
Diagnostic category																
CABG	93.1	89.6	84.6	85.1	54.0	68.0	30.0	26.6	47.9	36.8	72.0	82.8	72.5	81.0	19.8	9.7
PTCA	98.7	93.9	84.2	80.8	72.3	72.1	19.3	24.2	19.9	23.5	87.3	85.8	88.3	84.2	4.6	3.7
AMI	94.8	90.9	81.2	79.3	75.1	75.2	12.7	17.7	26.7	30.7	77.3	75.8	77.9	74.6	5.2	6.2
Ischaemia	89.6	83.7	78.2	72.6	71.1	66.7	31.2	29.6	34.1	37.1	73.8	67.9	75.3	65.7	5.1	5.2
Total	95.1	90.5	82.5	79.8	69.0	70.9	22.5	24.5	29.5	30.2	79.7	79.8	80.7	78.1	7.8	5.6

ACE, angiotensin-converting enzyme; AMI, acute myocardial infarction; CABG, coronary artery bypass graft; PTCA, percutaneous transluminal coronary angioplasty.

β-blockers in those after MI, ACE inhibitors/angiotensin-receptor blockers in those with impaired left ventricular function, lipid-lowering drugs (statins) in all patients and anticoagulants in those at risk of systemic embolization [1].

At interview, nine out of ten patients were on antiplatelet medication, principally aspirin, with the exception of Latvia, Bulgaria and Lithuania, which can be explained by the higher use of anticoagulants in these countries. Overall, four-fifths of patients were on β-blockers, ranging from 60% in Cyprus and Spain to more than 90% in The Czech Republic and Finland. More than two-thirds of patients were on ACE inhibitors or angiotensin II receptor blockers, with large differences between countries, varying from almost 50% in Belgium and Spain to more than 80% in France, Hungary, Poland and Slovenia.

Despite the overwhelming clinical evidence of the benefits of lipid-lowering medication, and especially statins, one-fifth of coronary patients were still not taking such therapy. There was more than a two-fold difference between countries, varying from 42% in Lithuania to more than 90% in Cyprus, Finland, Greece, Ireland, The Netherlands and Slovenia. Calcium channel blockers were used in just under one-quarter of patients. There was nearly a three-fold difference between countries, which varied between 13% and 14% in Belgium, Slovenia and Turkey, to 38% in Hungary and Latvia.

Although some of this variation in prescribing will be a function of the health economies of these countries, it is interesting to see that in western European countries such as France, Germany, Italy, Spain and the United Kingdom there is a still considerable variation in clinical practice, which may have more to do with professional attitudes and patient preferences than economics.

Earlier national and multinational surveys conducted in Europe, the United States and other parts of the world also reported a high prevalence and an inadequate control of cardiovascular risk factors in patients with established CHD [33–46]. The results of the Reduction of Atherothrombosis for Continued Health Registry [33] and the

WHO study on Prevention of Recurrences of Myocardial Infarction and Stroke [34] showed that classic cardiovascular risk factors were consistent and common in patients with CHD but they were largely undertreated and undercontrolled in many regions of the world. A number of national multicentre studies in Europe have also shown an inadequate risk factor management in patients with CHD [PREVESE I and II studies in Spain, [35–36] Usik 1995 and 2000 and PREVENIR surveys (1998 and 1999) in France [37] the TASPIC-CRO study in Croatia [38]]. The unfavourable trends in the prevalence, awareness, treatment and control of cardiovascular risk factors in patients with a history of MI and stroke were investigated over an interval of nearly a decade by using data from two nationally representative samples of the US population: the Third National Health and Nutrition Examination Survey conducted in 1988–1994 and the National Health and Nutrition Examination Survey conducted in 1999–2002 and 2003–2004 [39–42]. Analysis of current practice patterns for the use of prophylactic drug therapies in patients hospitalized with AMI reveals that a significant proportion of patients did not receive treatment at the time of discharge [43–47].

The findings of this EUROASPIRE III survey must be considered within the context of study limitations. The most important limitation is that the patient populations from participating countries were identified from selected geographical areas, and largely academic hospitals, and are not representative of all coronary patients in each country. However, this bias is likely to overestimate the extent to which risk factors are being controlled, and therefore results for the generality of coronary patients seen in every day clinical practice are likely to be worse. An important strength of the EUROASPIRE surveys is that they are not just based on abstracted medical record data but face-to-face interviews and examinations using the same protocol and standardized methods and instruments, including central laboratory analyses of lipids and glucose. Patients were interviewed at a median interval of more than 1 year after their admission for a coronary intervention or acute event, which is ample time to achieve the guideline standards. Therefore, this survey provides contemporary information on lifestyle, risk factor and therapeutic management for CVD prevention.

The results of EUROASPIRE III survey show that despite the existence and wide dissemination of clear, evidence-based guidelines, their integration into routine clinical care is still disappointing. Although implementation of clinical guidance is improving over time, there is still a large proportion of coronary patients who are not reaching the lifestyle, risk factor and therapeutic targets for CVD prevention. Continuous updating and dissemination of evidence-based guidelines for the prevention, awareness, treatment and control of risk factors in coronary patients is only one part of the strategy to reduce the risk of recurrent disease.

Analyses of the barriers to changing clinical practice have shown that obstacles can arise at societal, institutional, professional and patient levels and these are likely to be different in different parts of Europe [48]. Information on attitudes towards guidelines has been obtained from the Reassessing European Attitudes about Cardiovascular Treatment survey [49]. This survey evaluated the acceptance and implementation of CHD guidelines and lipid treatment guidelines among primary care physicians in five European countries. The most common barriers to implementation of the prevention programmes were reported as lack of time, prescribing costs and poor patient compliance. The different stages of the healthcare organization, financial disincentives, lack of medical training, clinical uncertainty or information overload can also influence the effectiveness of care. It is important to understand such obstacles to develop an effective intervention. Interventions have to be based on a patient-centred approach, where the doctor pays full attention to patient's concerns, and respects the patient's choice. The decision to change lifestyle or take lifelong medication has to be taken by the patient, so the treatment goals should be set by the doctor in collaboration with the patient. However, these EUROASPIRE results indicate that both clinicians and patients pay insufficient attention to the lifestyle risk factors – smoking, diet, physical activity – which then unfavourably impact on obesity, blood pressure, lipid and glucose management. The challenge is to motivate and engage more physicians to routinely practice preventive cardiology.

There is considerable potential throughout Europe to raise the standards of preventive cardiology through more effective lifestyle intervention, control of other risk factors and appropriate use of cardioprotective medication [50]. The recent EUROACTION project has shown that it is possible to achieve a higher standard of preventive care for coronary patients and their families with a professional, comprehensive and multidisciplinary programme [51]. We need such programmes, appropriately adapted to the medical, cultural and economic setting of a country, which can be accessed by all coronary patients.

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Appendix

The EUROASPIRE III survey was carried out under the auspices of the European Society of Cardiology, Euro Heart Survey programme. EUROASPIRE was originally an initiative of the ESC Working Group on Epidemiology and Prevention and the first EUROASPIRE survey was undertaken as part of work of the Joint ESC/EAS/ESH Implementation Group on Coronary Prevention.

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