European Heart Journal (2011) **32**, 2143–2152
doi:10.1093/eurheartj/ehr080

Achievement of treatment goals for primary prevention of cardiovascular disease in clinical practice across Europe: the EURIKA study

José R. Banegas[1,2]*, Esther López-García[1,2], Jean Dallongeville[3], Eliseo Guallar[4,5,6,7], Julian P. Halcox[8], Claudio Borghi[9], Elvira L. Massó-González[10], Francisco J. Jiménez[11], Joep Perk[12], Philippe Gabriel Steg[13], Guy De Backer[14], and Fernando Rodríguez-Artalejo[1,2]

[1]Department of Preventive Medicine and Public Health, School of Medicine, Universidad Autónoma de Madrid/IdiPAZ, Avda Arzobispo Morcillo, 2, 28029 Madrid, Spain; [2]CIBER of Epidemiology and Public Health, Madrid, Spain; [3]Inserm U 744, Institut Pasteur de Lille, 59019 Lille Cedex, France; [4]Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD 21205, USA; [5]Department of Medicine, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD 21205, USA; [6]Welch Center for Prevention, Epidemiology and Clinical Research, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD 21205, USA; [7]Department of Cardiovascular Epidemiology and Population Genetics, National Center for Cardiovascular Research (CNIC), Madrid 28029, Spain; [8]Wales Heart Research Institute, Cardiff University, Heath Park, Cardiff CF14 4XN, UK; [9]Department of Internal Medicine, Aging and Clinical Nephrology, University of Bologna, Bologna, Italy; [10]Medical Department, AstraZeneca Farmacéutica Spain, S.A., 28003 Madrid, Spain; [11]Medical Department, AstraZeneca Europe, 1935 Zaventem, Belgium; [12]School of Health and Caring Sciences, Linnaeus University, 391 82 Kalmar, Sweden; [13]INSERM U 698, Assistance Publique–Hôpitaux de Paris and Université Paris-Diderot, Paris, France; and [14]Department of Public Health, University of Gent, 9000 Gent, Belgium

Received 23 December 2010; revised 15 February 2011; accepted 25 February 2011; online publish-ahead-of-print 6 April 2011

See page 2098 for the editorial comment on this article (doi:10.1093/eurheartj/ehr090)

Aims Most studies on the primary prevention of cardiovascular disease (CVD) have been limited to patients at high CVD risk. We assessed the achievement of treatment goals for CVD risk factors among patients with a substantial variation in CVD risk.

Methods and results This study was conducted with 7641 outpatients aged ≥50 years, free of clinical CVD and with at least one major CVD risk factor, selected from 12 European countries in 2009. Risk factor definition and treatment goals were based on the 2007 European guidelines on CVD prevention. Cholesterol fractions and glycated haemoglobin (HbA1c) were measured in a central laboratory. Cardiovascular disease risk was estimated with the SCORE equation. Patients' mean age was 63 years (48% men), and 40.1% had a high CVD risk. Among treated hypertensives (94.2%), only 38.8% achieved the blood pressure target of <140/90 mmHg [between-country range (BCR): 32.1–47.5%]. Among treated dyslipidaemic patients (74.4%), 41.2% attained both the total- and LDL-cholesterol target of <5 and <3 mmol/L, respectively (BCR: 24.3–68.4%). Among treated type 2 diabetic patients (87.2%), 36.7% achieved the <6.5% HbA1c target (BCR: 23.4–48.4%). Among obese patients on non-pharmacological treatment (92.2%), 24.7% reached the body mass index target of <30 kg/m^2 (BCR: 12.7–37.1%). About one-third of controlled patients on treatment were still at high remaining CVD risk. Although most patients were advised to reduce excess weight and to follow a low-calorie diet, less than half received written recommendations.

Conclusions In Europe, a large proportion of patients in primary prevention have CVD risk factors that remain uncontrolled, and lifestyle counselling is not well implemented; moreover, there is substantial between-country variation, which indicates additional room for improvement. Raised residual CVD risk is relatively frequent among patients despite control of their primary risk factors and should be addressed.

Keywords Cardiovascular disease • Prevention • Hypertension • Dyslipidaemia • Diabetes • Obesity • Europe

* Corresponding author. Tel: +34 914975425, Fax: +34 914975353, Email: joseramon.banegas@uam.es

Introduction

Despite compelling evidence for the efficacy of primary prevention,[1–3] cardiovascular disease (CVD) remains the main cause of mortality in Europe.[2,4] One important reason could be the insufficient implementation of evidence-based CVD prevention guidelines.[2] Some country-specific studies, mostly conducted in high-risk patients, have shown that control of CVD risk factors is sub-optimal despite widespread treatment[5–12] but the few multinational surveys available have focused on single risk factors,[13,14] did not directly measure risk factors at the study visit,[15] or were limited to patients with pre-existing CVD or at high or very high risk of CVD.[16–19] Hence, there is limited comparable information on management and control of CVD risk factors in primary prevention patients over a wider range of global CVD risk across Europe. These patients, however, comprise a large fraction of all patients attended in primary care and, because of their large number, give rise to a large proportion of CVD events in the population.[20]

In order to provide a comprehensive assessment of clinical practice in the primary prevention of CVD across Europe, we studied patients with major CVD risk factors but with varying degrees of CVD risk. In these patients, we assessed the achievement of treatment goals for the main CVD risk factors. We also estimated these patients' residual risk on treatment, determined by the SCORE equation.[21–23] The SCORE equation for estimating CVD risk is a central element in the European prevention guidelines, but it has yet not been used in any major international study.

Methods

Study design and participants

The European Study on Cardiovascular Risk Prevention and Management in Usual Daily Practice (EURIKA)[24] was a cross-sectional study conducted simultaneously in 12 European countries (Austria, Belgium, France, Germany, Greece, Norway, Russia, Spain, Sweden, Switzerland, Turkey, and the UK; ClinicalTrials.gov identifier, NCT00882336). These countries were selected to represent the complete spectrum of CVD risk across Europe, as well as a variety of different healthcare systems. Data collection started in May 2009 and ended in January 2010.

Participating physicians were selected to represent practitioners involved in CVD prevention in primary care centres or outpatient clinics in each country. OneKey, a large database containing information on the characteristics of practicing physicians (http://crm.cegedim.com/solutions/data/Pages/default.aspx) served as the sampling frame. Directories of health centres, drawn from official webs, registries, and addresses of health administrations and professional organizations in the public and private sectors, were used to make up the physicians panel or universe of doctors potentially participating in the study. A total of 399 298 physicians are included in the OneKey database for the 12 countries considered (9848 in Austria, 12 588 in Belgium, 69 173 in France, 74 963 in Germany, 11 699 in Greece, 6181 in Norway, 54 592 in Russia, 59 266 in Spain, 8740 in Sweden, 8093 in Switzerland, 39 825 in Turkey, and 44 330 in UK). A total of 226 290 were men (56.7%) and 173 008 women (43.3%). Onekey was used to select a random sample of physicians stratified by age, sex, and specialty, including family medicine and other medical specialties involved in CVD risk factor control, such as cardiology, internal medicine, and endocrinology. Physician sex and age strata were proportional to their distribution in the OneKey database. A total of 809 physicians (~60 per country) participated in EURIKA. About 64% of them were general/primary care practitioners. The percentage of participating physicians among those invited was 7.4% in Austria, 13.8% in Belgium, 10.8% in France, 8.0% in Germany, 14.5% in Greece, 8.5% in Norway, 6.3% in Spain, 3.1% in Sweden, 3.4% in Switzerland, 22.8% in Turkey, 6.6% in the UK.

Selection criteria for patients were being 50 years of age or older, free from clinical CVD, and with at least one of the classic CVD risk factors (hypertension, dyslipidaemia, diabetes, obesity, or tobacco consumption documented in the clinical record). Physicians were given a randomisation list to select a sample of patients cited for medical visit each day during the study period. Approximately 12 300 patients were invited to participate, of whom 7641 (62%) accepted.

The study protocol was approved by the appropriate clinical research Ethics Committee in each participating country. All patients provided written informed consent.

Assessment of cardiovascular disease risk factors

Patient information was collected from clinical records, and from an *ad hoc* standardized interview, a physical exam, and a fasting blood sample. Information on smoking and physical activity was obtained from patient interviews. Hypertension, dyslipidaemia, diabetes, and obesity were considered present if their diagnosis was documented in the medical record. The prescription of specific medical advice for hypertension, dyslipidaemia, diabetes, obesity, and smoking was ascertained by questionnaire addressed to the physician.

Physical examination included height and weight measurement using calibrated scales and stadiometers, with participants wearing light clothing and without shoes.[2,24] Waist circumference (WC) was measured to the nearest 0.1 cm, at the midpoint between the lowest rib and the iliac crest with patients unclothed to the waist. Blood pressure (BP) was determined in standardized conditions, using calibrated mercury sphygmomanometers or validated automated devices, and appropriate-size cuffs.[2,24] The average of three readings was used for analyses.

A 12 h fasting blood sample was obtained on the day of physical examination or, if not possible, on the following day. Blood samples were sent to a central laboratory in Belgium for the analysis (The Bio Analytical Research Corporation, www.barclab.com). High-density lipoprotein cholesterol was measured by a modified enzymatic method (Roche P-Modular analyzer), total cholesterol by the CHOD-PAP method (Roche P-Modular), triglycerides by the GPO-PAP method (Roche P-Modular), and low-density lipoprotein cholesterol was calculated by the Friedewald formula. Glycosylated haemoglobin (HbA1c) was measured by ion-exchange (high-performance liquid chromatography/Menarini 8160).

In each country, a 10% random sample of all study centres underwent a site visit for data monitoring and audit to ensure data quality.

Treatment goals for cardiovascular disease risk factors

Treatment goals were evaluated in accordance with the Fourth European guidelines based on data from the physical examination or from the blood sample drawn at the study visit.[2] Target BP was systolic/diastolic (SBP/DBP) $<$140/90 mmHg, except for patients with diabetes where it was $<$130/80 mmHg. Target lipid levels were $<$5 mmol/L (190 mg/dL) total cholesterol and $<$3 mmol/L (115 mg/

dL) LDL-cholesterol, except for patients with diabetes where the goal was <4.5 mmol/L (175 mg/dL) total cholesterol, and <2.5 mmol/L (100 mg/dL) LDL-cholesterol. The target HbA1c was <6.5%, and the target fasting plasma glucose (FPG) was <6.1 mmol/L (110 mg/dL) in all patients. The target body mass index (BMI) was <30 kg/m^2 and the target WC was <102 cm in men and <88 cm in women.

We calculated the 10 year risk of fatal CVD for each patient using the SCORE equation, based on age, sex, current smoking, total cholesterol, and SBP measured at the study visit. These values were independent of treatment. We used the equation developed for low-risk regions for patients in Belgium, France, Greece, Spain, and Switzerland, and the equation for high-risk regions for patients in Austria, Germany, Norway, Russia, Sweden, Turkey, and the UK.[2,4,21,22] A 10 year risk of CVD death ≥5% was regarded as high CVD risk.[2,25]

Statistical analyses

The main outcome was the proportion of patients achieving treatment goals. Generalized mixed linear models were used to identify clinical variables associated with attainment of treatment goals for CVD risk factors. Regression models included sex, age, smoking, hypertension, dyslipidaemia, diabetes, obesity, physical inactivity, and country (random effect variable). Also, control of CVD risk factors in each country was compared with the average across participating countries, using logistic regression models adjusted for sex and age. All variables were modelled as categorical with dummy terms. Statistical significance was set at two-tailed $P < 0.05$. Analyses were performed with the SAS system (version 9.1, SAS Institute, Inc., Cary, NC, USA).

Results

The average (SD) age of participating patients was 63.2 (±8.9) years. Also, 48.4% of participants were men, 48.4% had a history of smoking (21.3% current smokers), 72.7% had hypertension, 57.7% had dyslipidaemia, 26.8% had type 2 diabetes, 43.6% were obese, 19.8% were physically inactive, and 50.2% did light physical activity only (activity during most weeks, not causing shortness of breath, increased heart rate and perspiration) (*Table 1*). About 40% of patients was at high CVD risk despite being or not being treated, with a between-country range (BCR) of 29–57.3% (*Table 1*).

Achievement of treatment goals

Among 5559 patients with hypertension, 94.2% were on antihypertensive drugs. Target BP was reached by 38.8% of treated patients (BCR: 32.1–47.5%) (*Table 2*).

Of 4407 patients with dyslipidaemia, 74.4% were treated with lipid-lowering drugs. Target total cholesterol and LDL-cholesterol levels were reached by 41.2% of treated patients (BCR: 24.3–68.4%) (*Table 2*). The proportion of patients attaining the total cholesterol target alone was 43.3% (BCR: 27.6–70.8%).

Among 2046 patients with type 2 diabetes, 87.2% were treated with antidiabetic drugs. The recommended HbA1c level of <6.5% was reached by 36.7% of treated patients (BCR: 23.4–48.4%) (*Table 2*). In addition, 20% of treated patients achieved the target FPG of <6.1 mmol/L (BCR: 6.0–43.1%). Only 7.2% of treated patients with diabetes achieved both their target FPG and HbA1c levels.

Of 3324 patients with a diagnosis of obesity prior to study enrolment, 92.2% were on lifestyle treatment (weight reduction advice) (*Table 2*). The target of BMI <30 kg/m^2 was reached by 24.7% of these patients (BCR: 12.7–37.1%). In addition, 6.8% of patients achieved a WC <102 cm (men) or <88 cm (women) (BCR: 2.2–12.0%), and only 3.2% of patients attained both BMI and WC goals (BCR: 0.4–6.0%).

Finally, the percentage of treated patients with 1, 2, or the 3 main CVD risk factors (hypertension, dyslipidaemia, diabetes) at goal was 41.3, 18.6, and 3.7%, respectively.

Remaining cardiovascular disease risk in patients achieving treatment goals

Among the 2032 hypertensive patients with BP controlled on drug treatment, 34.8% remained at high CVD risk (*Table 3*). Likewise, 39.2% of the 1350 controlled dyslipidaemic patients, 38% of the 655 controlled diabetic patients, and 39% of the 738 controlled obese patients also still had a high residual CVD risk, with wide between-country ranges.

Lifestyle medical advice

Almost 89% of smokers were asked about their smoking habit, but only 64% had their degree of addiction assessed, and as few as 38.8% agreed on a smoking cessation strategy (*Table 4*). Weight reduction was the medical advice most frequently given to obese patients. Advice on a healthy diet (low in fat and rich in vegetables and fruit) was provided to >80% of patients, but only half of them were given written dietary advice and as few as one-quarter to one-third was referred to a dietician. Appropriate advice on physical activity (at least 30 min, with moderate or vigorous intensity, on most days of the week) was given to ~80% of physically inactive patients. Between-country range in lifestyle medical advice was wide.

Variables associated with achievement of treatment goals

Female patients were less likely to achieve risk factor goals in dyslipidaemia and men less likely to attain their BP goal (*Table 5*). Patients over 65 years were more likely to achieve control of dyslipidaemia and obesity. Control of hypertension was much lower in diabetic patients and in those with obesity. Control of diabetes was lower in dyslipidaemic patients, and control of obesity was lower in those with hypertension, diabetes, and physical inactivity. Lastly, countries in Eastern Europe showed generally lower than average attainment of treatment goals for most CVD risk factors (*Table 6*).

Discussion

Principal findings

The EURIKA study is the first to attempt a large-scale comparative assessment of the status of primary CVD prevention among patients with varying degrees of CVD risk across Europe. Its main finding was that, currently in 2010, the control of CVD risk factors in primary prevention is generally poor. Less than half of hypertensive and dyslipidaemic patients attained treatment goals, and only one-third of patients with diabetes met the HbA1c goal. We also observed that the no-smoking advice was the least frequently provided professional advice, that

Table 1 Socio-demographic and clinical characteristics of patients in the EURIKA study, by country

	AUS (*n* = 624)	BEL (*n* = 638)	FRA (*n* = 593)	GER (*n* = 678)	GRE (*n* = 620)	NOR (*n* = 611)	RUS (*n* = 604)	SPA (*n* = 642)	SWE (*n* = 628)	SWI (*n* = 667)	TUR (*n* = 663)	UK (*n* = 673)	Total (*n* = 7641)
Age, mean ± SD	61.9 ± 8.6	64.6 ± 8.9	64.1 ± 8.8	65.3 ± 8.8	65.3 ± 8.9	62.9 ± 8.5	58.3 ± 7.3	63.1 ± 9.0	64.9 ± 8.6	65.2 ± 9.9	59.4 ± 7.6	65.0 ± 8.9	63.2 ± 8.9
Men, %	47.6	48.9	54.8	49.1	46.0	48.8	31.8	51.4	50.2	52.8	47.2	51.1	48.4
Smoking, %	50.4	39.8	43.5	47.9	51.6	63.0	40.6	41.7	51.0	49.9	46.9	53.7	48.4
Current smokers, %	23.8	16.2	16.5	16.5	33.9	28.1	25.2	17.2	16.9	21.5	23.7	16.4	21.3
Former smokers, %	26.6	23.6	27.0	31.3	17.7	34.9	15.4	24.5	34.0	28.4	23.2	37.2	27.1
Hypertension, %	71.6	70.2	73.2	81.0	66.6	69.7	80.5	67.8	82.2	71.2	66.5	72.7	72.7
Dyslipidaemia, %	59.0	68.0	56.7	59.6	72.6	54.8	50.5	67.3	49.8	59.1	34.5	60.5	57.7
Type 2 diabetes mellitus, %	23.4	27.1	24.3	37.8	28.4	23.2	15.7	28.3	26.1	30.7	31.7	22.7	26.8
Obesity, %	50.7	49.5	36.7	49.0	50.2	36.8	56.6	40.2	37.5	45.3	36.2	35.5	43.5
Physical inactivity, %	16.5	29.5	32.9	12.1	30.8	16.5	12.6	22.6	5.9	20.5	28.3	9.8	19.8
Light physical activity, %	54.5	48.3	38.5	51.5	43.3	51.1	54.6	46.5	50.6	50.5	52.1	60.1	50.2
High cardiovascular disease risk, %	43.1	31.2	29.5	57.1	27.3	51.5	29.0	29.1	57.3	36.9	33.6	53.8	40.1

AUS, Austria; BEL, Belgium; FRA, France; GER, Germany; GRE, Greece; NOR, Norway; RUS, Russia; SPA, Spain; SWE, Sweden; SWI, Switzerland; TUR, Turkey; UK, United Kingdom; SD, standard deviation. Calculation of SCORE risk was based on the following data: age, sex, systolic blood pressure and total cholesterol values at the study visit, and smoking status.

Table 2 Achievement of goals among patients treated for the main cardiovascular risk factors, by country

	AUS	BEL	FRA	GER	GRE	NOR	RUS	SPA	SWE	SWI	TUR	UK	Total, *n* (%)
Hypertension, *n*	447	448	434	549	413	426	486	435	516	475	441	489	5559
Drug treated, %	92.8	96.4	97.2	97.3	97.3	90.1	85.4	92.4	96.3	95.2	94.6	95.5	94.2
Controlled (SBP <140 mmHg and DBP <90 mmHg), %[a]	35.9	43.7	45.5	36.3	47.5	34.6	35.9	41.0	33.6	37.4	32.1	42.8	38.8
Dyslipidaemia, *n*	368	434	336	404	450	335	305	432	313	394	229	407	4407
Drug treated, %	58.7	75.1	81.2	65.1	80.2	75.5	49.8	81.2	85.9	74.6	80.3	82.6	74.4
Controlled (TC <5 mmol/L), %[a]	32.9	54.6	39.9	33.5	39.1	45.8	27.6	32.8	48.0	45.9	30.4	70.8	43.3
Controlled (TC <5 mmol/L and LDL-c <3 mmol/L), %[a]	31.9	52.8	37.7	30.4	37.4	41.9	24.3	31.0	45.3	44.6	30.4	68.4	41.2
Type 2 diabetes, *n*	146	173	144	256	176	142	95	182	164	205	210	153	2046
Drug treated, %	86.3	90.7	93.7	80.9	92.0	82.4	84.2	87.9	83.5	89.8	95.2	77.8	87.2
Controlled (HbA1c <6.5%), %	39.7	48.4	41.5	40.6	43.8	41.9	26.2	33.7	23.4	41.8	26.0	27.7	36.7
Controlled (FPG <6.1 mmol/L), %	16.7	19.7	27.4	27.0	15.4	35.9	7.5	13.1	43.1	16.3	6.0	13.4	20.0
Controlled (HbA1c <6.5% and FPG <6.1 mmol/L), %	7.9	6.4	6.7	11.1	8.0	15.4	3.7	3.1	10.9	8.1	2.5	1.7	7.2
Obesity, *n*	315	315	217	332	311	224	342	256	235	298	240	239	3324
Treatment with lifestyle advice, %	91.7	91.7	98.2	94.6	94.5	86.2	97.7	97.6	72.3	88.6	96.2	94.1	92.2
Controlled (BMI <30 kg/m^2), %	28.0	29.2	19.6	28.8	37.1	26.7	23.3	21.1	23.3	23.8	16.1	12.7	24.7
Controlled (WC <102/88 cm), %	6.2	12.0	2.9	9.0	7.6	4.9	5.9	11.2	3.6	7.0	2.2	5.2	6.8
Controlled (BMI <30 kg/m^2 and WC <102/88 cm), %	3.2	6.0	2.4	5.3	4.1	2.7	0.9	4.1	2.4	3.8	0.4	1.4	3.2

AUS, Austria; BEL, Belgium; FRA, France; GER, Germany; GRE, Greece; NOR, Norway; RUS, Russia; SPA, Spain; SWE, Sweden; SWI, Switzerland; TUR, Turkey; UK, United Kingdom; SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; LDL-c, low density lipoprotein cholesterol; HbA1c, glycated haemoglobin; FPG, fasting plasma glucose; BMI, body mass index; WC, waist circumference.
[a]If diabetes: blood pressure <130/80 mmHg, total cholesterol <4.5 mmol/L, and LDL cholesterol <2.5 mmol/L.

Table 3 Remaining cardiovascular risk in patients achieving treatment goals

	Hypertension		Dyslipidaemia		Type 2 diabetes		Obesity	
	High risk	Low risk	High risk	Low risk	High risk	Low risk	High risk	Low risk
All countries								
Treated and controlled[a]								
Number	707	1325	529	821	249	406	288	450
Percentage	34.8	65.2	39.2	60.8	38.0	62.0	39.0	61.0
Between-country range								
Treated and controlled[a]								
Percentage	20.3–45.0	50.0–79.7	19.6–57.5	46.2–80.4	19.6–59.4	40.6–80.4	24.1–59.3	40.7–75.9

Calculation of SCORE risk was based on the following data: age, sex, systolic blood pressure and total cholesterol values at the study visit, and smoking status.
[a]Hypertension control: blood pressure <140/90 mmHg (<130/80 mmHg if diabetes). Dyslipidaemia control: total cholesterol <5 mmol/L and LDL cholesterol <3 mmol/L (if diabetes: <4.5 and <2.5 mmol/L, respectively). Diabetes control: HbA1c <6.5%. Obesity control: body mass index <30 kg/m^2.

many patients were not given written dietary counselling, and that only a small proportion of patients achieved a satisfactory BMI and WC.

Although high-risk patients are the top priority in CVD prevention,[2] lower-global risk patients with important individual risk factors comprise a numerically important segment (60%) of the EURIKA population. These patients may benefit from both population strategies and specific interventions.[26] Therefore, lifestyle changes should be encouraged and implemented more effectively in these patients.

There were a substantial proportion of patients at high remaining CVD risk (35–39% for the different individual risk factors) among those who achieved specific treatment goals. This is due to presence of risk factors in addition to the main one under

Table 4 Medical advice on lifestyle among patients with cardiovascular risk factors

	All countries		Between-country range
	n	%	%
Tobacco smoking ($n = 3652$)			
Ask about tobacco smoking, %	3212	88.7	67.6–96.8
Assess degree of addiction, %	2291	64.0	44.0–84.7
No-smoking advice, %	2435	68.0	46.7–83.9
Smoking cessation strategy, %	1389	38.8	22.6–71.1
Hypertension ($n = 5559$)			
No-smoking advice, %	1501	63.0	44.5–77.5
Salt reduction advice, %	4070	74.0	45.2–99.0
Alcohol reduction advice, %	2557	46.5	25.6–66.1
Healthy diet advice, %	4575	82.5	53.3–98.5
Written dietary advice, %	2405	52.7	24.0–83.9
Referred to a dietitian/nutritionist, %	971	21.3	12.7–41.8
Weight reduction advice (if BMI ≥30), %	2419	92.5	73.4–98.2
Physical activity advice (if no or light PA), %	850	79.7	56.5–96.7
Dyslipidaemia ($n = 4407$)			
No-smoking advice, %	1344	65.8	54.3–83.3
Healthy diet advice, %	3753	85.5	69.2–98.4
Written dietary advice, %	2141	57.3	27.9–88.6
Referred to a dietitian/nutritionist, %	820	21.9	13.2–46.3
Weight reduction advice (if BMI ≥30), %	1882	92.5	86.2–98.5
Physical activity advice (if no or light PA), %	694	80.5	61.0–97.0
Type 2 diabetes ($n = 2046$)			
No-smoking advice, %	584	64.9	53.0–82.3
Healthy diet advice, %	1813	88.9	76.0–100
Written dietary advice, %	1083	60.1	41.2–85.3
Referred to a dietitian/nutritionist, %	632	34.9	22.8–49.1
Weight reduction advice (if BMI ≥30), %	1083	95.2	86.7–98.9
Physical activity advice (if no or light PA), %	373	83.8	56.2–100
Obesity (BMI ≥30) ($n = 3324$)			
No-smoking advice, %	969	65.7	43.4–79.7
Healthy diet advice, %	2978	89.9	64.3–99.7
Written dietary advice, %	1715	57.8	27.8–85.9
Referred to a dietitian/nutritionist, %	878	29.6	17.1–50.0
Weight reduction advice, %	3066	92.2	72.3–98.2
Physical activity advice (if no or light PA), %	701	82.9	64.7–96.4
Physical inactivity ($n = 1489$)			
Weight reduction advice (if BMI ≥30), %	787	92.9	76.4–100
Physical activity advice, %	1162	78.3	56.4–96.0

BMI ≥30, body mass index ≥30 kg/m^2. PA, physical activity. No PA, physical inactivity.

consideration. For example, among dyslipidaemic patients with LDL at goal, BP or smoking status is frequently not at target, or HDL cholesterol may not be within satisfactory limits.[23] Thus, despite effective statin treatment, multifactorial lifestyle and, where appropriate, pharmacological measures are clearly needed to address this appreciable level of residual risk.

Reasons for not achieving treatment goals

In multivariate analyses, treated diabetes and obesity were associated with poor control of hypertension, in line with previous studies.[27] Despite most obese patients receiving medical advice to follow a low-calorie diet and try to lose weight, many were likely not to comply, which may partly account for the low rate

Table 5 Sociodemographic and clinical characteristics associated with control of treated hypertension, dyslipidaemia, type 2 diabetes, and obesity

	Control of hypertension (BP <140/90 mmHg)[a] odds ratio (95% CI)	Control of dyslipidaemia (TC <5 and LDL-c <3 mmol/L)[a] odds ratio (95% CI)	Control of type 2 diabetes (HbA1c <6.5%) odds ratio (95% CI)	Control of obesity (BMI <30 kg/m^2) odds ratio (95% CI)
Gender				
Women vs. men	1.13 (1.02–1.28)	0.67 (0.58–0.77)	1.00 (0.83–1.20)	1.09 (0.92–1.29)
Age				
≥65 vs. 50–64 years	0.91 (0.78–1.05)	1.30 (1.12–1.52)	1.11 (0.90–1.37)	1.88 (1.65–2.14)
Cardiovascular risk factors				
Smoking vs. no	1.02 (0.93–1.11)	0.90 (0.81–1.01)	0.94 (0.74–1.19)	1.30 (1.12–1.52)
Hypertension vs. no	—	1.42 (1.13–1.78)	1.03 (0.86–1.22)	0.56 (0.46–0.68)
Dyslipidaemia vs. no	1.27 (1.13–1.43)	—	0.80 (0.63–0.99)	1.16 (1.02–1.32)
Type 2 diabetes vs. no	0.20 (0.16–0.25)	1.03 (0.91–1.15)	—	0.79 (0.68–0.92)
Obesity vs. no	0.80 (0.72–0.91)	1.12 (0.92–1.36)	1.13 (0.88–1.45)	—
Physical inactivity vs. no	0.93 (0.76–1.14)	1.00 (0.75–1.33)	1.08 (0.82–1.42)	0.68 (0.54–0.85)

Generalized mixed linear model adjusted for all variables in table as appropriate, and for country (random effect variable).
CI, confidence interval; BP, blood pressure; TC, total cholesterol; LDL-c, LDL cholesterol; HbA1c, glycated haemoglobin; BMI, body mass index.
[a]If diabetes: blood pressure <130/80 mmHg; or total cholesterol <4.5 mmol/L and LDL <2.5 mmol/L.

of obesity control. However, the EUROACTION study has shown that a nurse-led, multi-disciplinary team approach can yield significant lifestyle improvements and risk factor reductions in coronary patients and those at risk of developing CVD.[28] In addition, treated dyslipidaemic women showed worse control, regardless of CVD risk and country. This could be due to a less rigorous approach towards women by clinicians, though earlier studies have reported conflicting results.[29] Anyway, clinicians should make a specific point of assessing risk factors in women.

Lastly, the between-country variation in attainment of treatment targets may be due to differences in patients' clinical and socio-economic characteristics, in adherence to CVD prevention guidelines, and in healthcare systems between countries. Countries in Eastern Europe showed generally lower than average attainment of treatment goals for most CVD risk factors. Patients in Russia had a lower than average level of drug treatment for hypertension and dyslipidaemia, and this may partially explain the lower control of BP and cholesterol. Also, a higher level of diabetes and physical inactivity was observed in patients in Turkey, which may be related to the lower control of obesity. Likewise, patients in Spain had a higher proportion and lower control of dyslipidaemia than other countries, and patients in Sweden had a higher proportion and lower control of hypertension. The wide range of drug treatments used across countries suggests important differences in drug prescription policies or market penetration. Lifestyle interventions also widely varied among countries. Improvement in smoking cessation strategies, effective healthy diet advice, weight reduction advice in obese patients, and physical activity advice may substantially increase risk factors control in countries performing poorly.

Comparison with other studies

The EUROASPIRE III primary-prevention arm determined whether the 2003 guidelines on CVD prevention were followed in high-risk patients studied in 2006.[19,22] EURIKA, which assessed the 2007 European guidelines in 2010 in patients with a wide range of CVD risk, found higher levels of hypertension and dyslipidaemia control, but lower level of diabetes control than EUROASPIRE. Nevertheless, no formal direct comparison can be made between studies due to different patient populations and protocols. In addition, EURIKA included determination of LDL cholesterol, and not only total cholesterol in contrast with other major cross-national initiatives.[16–19] The use of total cholesterol as the only parameter for assessment of dyslipidaemia and the sole treatment target overestimates the number of patients with lipids at goal. This translates in practice into ~1 million-treated dyslipidaemic patients who might be falsely considered to be adequately controlled in the participating countries (data not shown), and may preclude optimal treatment of patients in whom the LDL-c remains uncontrolled.

Strengths and limitations

The use of common and standardized procedures for data collection allowed for a fair comparison of results across European countries. The use of a central laboratory for blood analyses, including LDL cholesterol and HbA1c, was also an important strength of the EURIKA study in comparison with other similar research initiatives.[16–19]

Table 6 Control of treated hypertension, dyslipidaemia, type 2 diabetes, and obesity in each country vs. the average rate of control across the 12 participating countries

	Control of hypertension (BP <140/90 mmHg)[a] odds ratio (95% CI)	Control of dyslipidaemia (TC <5 and LDL-c <3 mmol/L)[a] odds ratio (95% CI)	Control of type 2 diabetes (HbA1c <6.5%) odds ratio (95% CI)	Control of obesity (BMI <30 kg/m^2) odds ratio (95% CI)
Country				
AUS vs. average control	0.88 (0.67–1.15)	0.73 (0.51–1.04)	1.16 (0.71–1.91)	1.20 (0.81–1.77)
BEL vs. average control	1.30 (0.99–1.69)	1.69 (1.22–2.34)	1.66 (1.05–2.63)	1.27 (0.86–1.86)
FRA vs. average control	1.37 (1.04–1.79)	0.78 (0.56–1.10)	1.25 (0.77–2.03)	0.75 (0.48–1.18)
GER vs. average control	1.09 (0.84–1.40)	0.74 (0.52–1.04)	1.21 (0.78–1.87)	1.25 (0.85–1.83)
GRE vs. average control	1.68 (1.28–2.22)	0.88 (0.64–1.20)	1.38 (0.87–2.19)	1.82 (1.25–2.65)
NOR vs. average control	0.77 (0.58–1.02)	1.02 (0.72–1.44)	1.27 (0.77–2.10)	1.12 (0.73–1.74)
RUS vs. average control	0.76 (0.58–0.99)	0.38 (0.25–0.59)	0.63 (0.34–1.15)	0.94 (0.66–1.38)
SPA vs. average control	1.02 (0.77–1.33)	0.66 (0.48–0.92)	0.90 (0.56–1.44)	0.83 (0.54–1.26)
SWE vs. average control	0.76 (0.59–0.99)	1.20 (0.86–1.69)	0.54 (0.32–0.91)	0.94 (0.59–1.49)
SWI vs. average control	1.05 (0.80–1.36)	1.18 (0.85–1.65)	1.27 (0.81–1.99)	0.96 (0.64–1.45)
TUR vs. average control	0.71 (0.54–0.94)	0.62 (0.42–0.90)	0.62 (0.39–0.99)	0.59 (0.37–0.94)
UK vs. average control	1.03 (0.79–1.33)	3.03 (2.16–4.27)	0.68 (0.40–1.15)	0.45 (0.27–0.74)

Logistic regression models adjusted for sex and age.
CI, confidence interval; BP, blood pressure; TC, total cholesterol; LDL-c, LDL cholesterol; HbA1c, glycated haemoglobin; BMI, body mass index.
AUS, Austria; BEL, Belgium; FRA, France; GER, Germany; GRE, Greece; NOR, Norway; RUS, Russia; SPA, Spain; SWE, Sweden; SWI, Switzerland. TUR, Turkey; UK, United Kingdom.
[a]If diabetes: blood pressure <130/80 mmHg; or total cholesterol <4.5 mmol/L and LDL-c (LDL cholesterol) <2.5 mmol/L.

A limitation of EURIKA is that the OneKey database, which is the largest available database of practicing physicians in Europe, is not statistically fully representative of all European physicians. The percentage of physicians in the various participating countries who are included on this database ranges from 10% in Russia to 50% in Spain. It is feasible that physicians participating in a study of this nature may be more aware of and more successful at achieving treatment goals than those who did not participate. Even so, it is clear that control of CVD risk factors can still be improved substantially. Also, the inclusion period was short (a few months), so that frequent users of health services might have been overrepresented in the study sample. By the same token, less frequent clinic attenders and 'at risk' patients with undetected risk factors who have never attended for formal assessment are likely to be underrepresented in our cohort. However, the large number of practitioners included, the coverage of all relevant work-settings involved in CVD prevention, and the random selection of study patients suggest that EURIKA provides a comprehensive picture of the status of primary CVD prevention in clinical practice across Europe.

In addition, there is concern that the SCORE equation may overestimate risk in many Western European countries with decreasing secular trends in CVD mortality as well as in elderly patients.[30] Conversely, the SCORE equation may underestimate risk in Russia and other Eastern European countries that are experiencing extremely high rates of CVD mortality. In particular, in Russia the calculated CVD risk was lower than expected. This was partially due to the fact that study participants in Russia had the lowest mean age and the lowest percentage of men among the EURIKA countries but also raises an important question regarding the accuracy and representativeness of the current SCORE system for CVD risk assessment in very high-risk countries. Also, risk estimation in the elderly remains a challenge, and the optimal threshold for defining high CVD risk in those ≥65 years needs further investigation.[25,26]

Lastly, we were only able to assess current level of residual risk in relation to risk factor control in this cross-sectional survey of patients with CVD risk factors. Additional work would be required to address the important question of the effectiveness of risk factor control in relation to the level of global risk at the time of diagnosis or initiation of preventive treatment. However, we have calculated that among the 2443 patients with a diagnosis of hypertension or dyslipidaemia with complete information on systolic BP and total cholesterol at diagnosis time (pre-treatment levels), 41% of treated hypertensive patients (26% of high risk and 45% of low risk) were at BP goal, and 42% of treated dylipidaemic patients (41% of high risk and 42% of low risk) were at LDL goal. Also, though we do not know the time frame for risk factor treatment, the mean duration of the current medication for most CVD risk factors was 4–5 years, with rather narrow between-country range (data not shown).

Clinical implications

The EURIKA study has shown that: (i) many patients with treated CVD risk factors remained inadequately controlled, (ii) a large proportion of patients achieving treatment goals for individual risk factors remained at high-residual CVD risk, and (iii) lifestyle interventions are generally not well implemented. Finally, the large

differences observed in risk factors control across countries suggest additional room for improvement in countries performing poorly. We support a more comprehensive application of the recommendations of the European guidelines for CVD primary prevention to address the observed treatment gaps.

Contributors

J.R.B. and F.R.A. drafted the manuscript. All authors made substantial contributions to study protocol, reviewed the manuscript for important intellectual content, and approved the final manuscript.

Funding

The EURIKA study was funded by AstraZeneca. The study was run by an independent academic steering committee. The authors had full access to all data and had final responsibility for the contents of the manuscript and the decision to submit it for publication. Funding to pay the Open Access publication charges for this article was provided by AstraZeneca.

Conflict of interest: E.G. has received research grants from AstraZeneca. J.P.H. and J.D. have received speaker fees and consulting fees from AstraZeneca. P.G.S. reports receiving research grants from Servier; speaking or consulting fees from Astellas, AstraZeneca, Bayer, Boehringer Ingelheim, Bristol-Myers Squibb, Daiichi-Sankyo, Endotis, Glaxo Smith Kline, Menarini, Medtronic, Merck-Sharpe and Dohme, Otsuka, Pierre Fabre, Hoffmann-La Roche, Sanofi-Aventis, Servier, and The Medicines Company, and is a stockholder in Atherovax. E.L.M.-G. and F.J.J. are employees of AstraZeneca. The rest of authors declare that they have no competing interests.

References

1. Akesson A, Weismayer C, Newby PK, Wolk A. Combined effect of low-risk dietary and lifestyle behaviors in primary prevention of myocardial infarction in women. *Arch Intern Med* 2007;**167**:2122–2127.
2. Graham I, Atar D, Borch-Johnsen K, Boysen G, Burell G, Cifkova R, Dallongeville J, De Backer G, Ebrahim S, Gjelsvik B, Herrmann-Lingen C, Hoes A, Humphries S, Knapton M, Perk J, Priori SG, Pyorala K, Reiner Z, Ruilope L, Sans-Menendez S, Op Reimer WS, Weissberg P, Wood D, Yarnell J, Zamorano JL, Walma E, Fitzgerald T, Cooney MT, Dudina A, Vahanian A, Camm J, De Caterina R, Dean V, Dickstein K, Funck-Brentano C, Filippatos G, Hellemans I, Kristensen SD, McGregor K, Sechtem U, Silber S, Tendera M, Widimsky P, Zamorano JL, Altiner A, Bonora E, Durrington PN, Fagard R, Giampaoli S, Hemingway H, Hakansson J, Kjeldsen SE, Larsen L, Mancia G, Manolis AJ, Orth-Gomer K, Pedersen T, Rayner M, Ryden L, Sammut M, Schneiderman N, Stalenhoef AF, Tokgözoglu L, Wiklund O, Zampelas A; European Society of Cardiology (ESC); European Association for Cardiovascular Prevention and Rehabilitation (EACPR); Council on Cardiovascular Nursing; European Association for Study of Diabetes (EASD); International Diabetes Federation Europe (IDF-Europe); European Stroke Initiative (EUSI); Society of Behavioural Medicine (ISBM); European Society of Hypertension (ESH); WONCA Europe (European Society of General Practice/Family Medicine); European Heart Network (EHN); European Atherosclerosis Society (EAS). European guidelines on cardiovascular disease prevention in clinical practice: full text. Fourth 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). *Eur J Cardiovasc Prev Rehabil* 2007;**14**(Suppl. 2):S1–S113.
3. Unal B, Critchley JA, Capewell S. Modelling the decline in coronary heart disease deaths in England and Wales, 1981–2000: comparing contributions from primary prevention and secondary prevention. *BMJ* 2005;**331**:614.
4. Allender S, Scharbotough P, Peto V, Rayner M, Leal J, Luengo-Fernández R, Gray A. *European Cardiovascular Disease Statistics: 2008 Edition*. London: British Heart Foundation, 2008.
5. Fagard RH, Van Den Enden M, Leeman M, Warling X. Survey on treatment of hypertension and implementation of World Health Organization/International Society of Hypertension risk stratification in primary care in Belgium. *J Hypertens* 2002;**20**:1297–1302.
6. Geller JC, Cassens S, Brosz M, Keil U, Bernarding J, Kropf S, Bierwirth RA, Lippmann-Grob B, Schultheiss HP, Schlüter K, Pels K. Achievement of guideline-defined treatment goals in primary care: the German Coronary Risk Management. (CoRiMa) study. *Eur Heart J* 2007;**28**:3051–3058.
7. Van Ganse E, Laforest L, Burke T, Phatak H, Souchet T. Mixed dyslipidaemia among patients using lipid-lowering therapy in French general practice: an observational study. *Clin Ther* 2007;**29**:1671–1681.
8. Steinhagen-Thiessen E, Bramlage P, Lösch C, Hauner H, Schunkert H, Vogt A, Wasem J, Jöckel KH, Moebus S. Dyslipidemia in primary care—prevalence, recognition, treatment and control: data from the German Metabolic and Cardiovascular Risk Project (GEMCAS). *Cardiovasc Diabetol* 2008;**7**:31. doi:10.1186/1475-2840-7-31.
9. Strang AC, Kaasjager HAH, Basart DCG, Stroes ESG. Prevalence of dyslipidaemia in patients treated with lipid-modifying drugs in the Netherlands. Part of the Dyslipidaemia International Study. *Neth J Med* 2010;**68**:168–174.
10. Resnick HE, Foster GL, Bardsley J, Ratner RE. Achievement of American Diabetes Association clinical practice recommendations among U.S. adults with diabetes, 1999–2002: the National Health and Nutrition Examination Survey. *Diabetes Care* 2006;**29**:531–537.
11. Zachariadou T, Stoffers HEJH, Christophi CA, Philalithis A, Lionis C. Implementing the European guidelines for cardiovascular disease prevention in the primary care setting in Cyprus: lessons learned from a health care services study. *BMC Health Serv Res* 2008;**8**:148 doi:10.1186/1472-6963-8-148.
12. Roccatagliata D, Avanzini F, Monesi L, Caimi V, Lauri D, Longoni P, Marchioli R, Tombesi M, Tognoni G, Roncaglioni MC, Collaborative Group Risk and Prevention Study. Is global cardiovascular risk considered in current practice? Treatment and control of hypertension, hyperlipidemia, and diabetes according to patientś risk level. *Vas Health Risk Manag* 2006;**2**:507–514.
13. Waters DD, Brotons C, Chiang CW, Ferrières J, Foody J, Jukema JW, Santos RD, Verdejo J, Messig M, McPherson R, Seung KB, Tarasenko L, Lipid Treatment Assessment Project 2 Investigators. Lipid treatment assessment project 2: a multinational survey to evaluate the proportion of patients achieving low-density lipoprotein cholesterol goals. *Circulation* 2009;**120**:28–34.
14. Wang YR, Alexander GC, Stafford RS. Outpatient hypertension treatment, treatment intensification, and control in Western Europe and the United States. *Arch Intern Med* 2007;**167**:141–147.
15. Steinberg BA, Bhatt DL, Mehta S, Poole-Wilson PA, O'Hagan P, Montalescot G, Ballantyne CM, Cannon CP. Nine-year trends in achievement of risk factor goals in the US and European outpatients with cardiovascular disease. *Am Heart J* 2008;**156**:719–727.
16. Bhatt DL, Steg PG, Ohman EM, Hirsch AT, Ikeda Y, Mas JL, Goto S, Liau CS, Richard AJ, Röther J, Wilson PW, REACH Registry Investigators. International prevalence, recognition, and treatment of cardiovascular risk factors in outpatients with atherothrombosis. *JAMA* 2006;**295**:180–189.
17. Kotseva K, Wood D, De Backer G, De Bacquer D, Pyörälä K, Keil U, EUROASPIRE 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.
18. Kotseva K, Wood D, De Backer G, De Bacquer D, Pyörälä K, Keil U, 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.
19. Kotseva K, Wood D, De Backer G, De Bacquer D, Pyörälä K, Reiner Z, Keil U, EUROASPIRE Study Group. EUROASPIRE III. Management of cardiovascular risk factors in asymptomatic high-risk patients in general practise: cross-sectional survey in 12 European countries. *Eur J Cardiovasc Prev Rehabil* 2010;**17**:530–540.
20. Rose G. The strategy of prevention: lessons from cardiovascular disease. *BMJ* 1981;**282**:1847–1851.
21. Conroy RM, Pyörälä K, Fitzgerald AP, Sans S, Menotti A, De Backer G, De Bacquer D, Ducimetière P, Jousilahti P, Keil U, Njølstad I, Oganov RG, Thomsen T, Tunstall-Pedoe H, Tverdal A, Wedel H, Whincup P, Wilhelmsen L, Graham IM, SCORE project group. Estimation of ten-year risk of fatal cardiovascular disease in Europe: the SCORE project. *Eur Heart J* 2003;**24**:987–1003.
22. De Backer G, Ambrosioni E, Borch-Johnsen K, Brotons C, Cifkova R, Dallongeville J, Ebrahim S, Faergeman O, Graham I, Mancia G, Cats VM, Orth-Gomér K, Perk J, Pyörälä K, Rodicio JL, Sans S, Sansoy V, Sechtem U, Silber S, Thomsen T, Wood D, European Society of Cardiology Committee for Practice Guidelines. 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**:S1–S10.
23. Fruchart JC, Sacks F, Hermans MP, Assmann G, Brown WV, Ceska R, Chapman MJ, Dodson PM, Fioretto P, Ginsberg HN, Kadowaki T, Lablanche JM,

Marx N, Plutzky J, Reiner Z, Rosenson RS, Staels B, Stock JK, Sy R, Wanner C, Zambon A, Zimmet P. The residual reduction initiative: a call to action to reduce residual vascular risk in patients with dyslipidaemia. *Am J Cardiol* 2008; **102**(Suppl):1K–34K.
24. Rodríguez-Artalejo F, Guallar E, Borghi C, Borghi C, Dallongeville J, De Backer G, Halcox JP, Hernández-Vecino R, Jiménez FJ, Massó-González EL, Perk J, Steg PG, Banegas JR, EURIKA Investigators. Rationale and methods of the European Study on Cardiovascular Risk Prevention and Management in Daily Practice (EURIKA). *BMC Public Health* 2010;**10**:382 doi:10.1186/1471-2458-10-382.
25. Cooney MT, Dudina AL, Graham IM. Value and limitations of existing scores for the assessment of cardiovascular risk. A review for clinicians. *J Am Coll Cardiol* 2009;**54**:1209–1227.
26. Cooney MT, Dudina A, D'Agostino R, Graham IM. Cardiovascular risk-estimation systems in primary prevention. Do they differ? Do they make a difference? Can we see the future? *Circulation* 2010;**122**:300–310.
27. Saydah SH, Fradkin J, Cowie CC. Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. *JAMA* 2004;**291**:335–342.
28. Wood DA, Kotseva K, Connolly S, Jennings C, Mead A, Jones J, Holden A, De Bacquer D, Collier T, De Backer G, Faergeman O, EUROACTION Study Group, 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.
29. Tabenkin H, Eaton CB, Roberts MB, Parker DR, McMurray JH, Borkan J. Differences in cardiovascular disease risk factor management in primary care by sex of physician and patient. *Ann Fam Med* 2010;**8**:25–32.
30. Müller-Nordhorn J, Binting S, Roll S, Willich SN. An update on regional variation in cardiovascular mortality within Europe. *Eur Heart J* 2008;**29**:1316–1326.

CARDIOVASCULAR FLASHLIGHT

doi:10.1093/eurheartj/ehr175
Online publish-ahead-of-print 30 May 2011

An unusual heart

Fulvio Gabbarini*, Annamaria Villar, and Gabriella Agnoletti

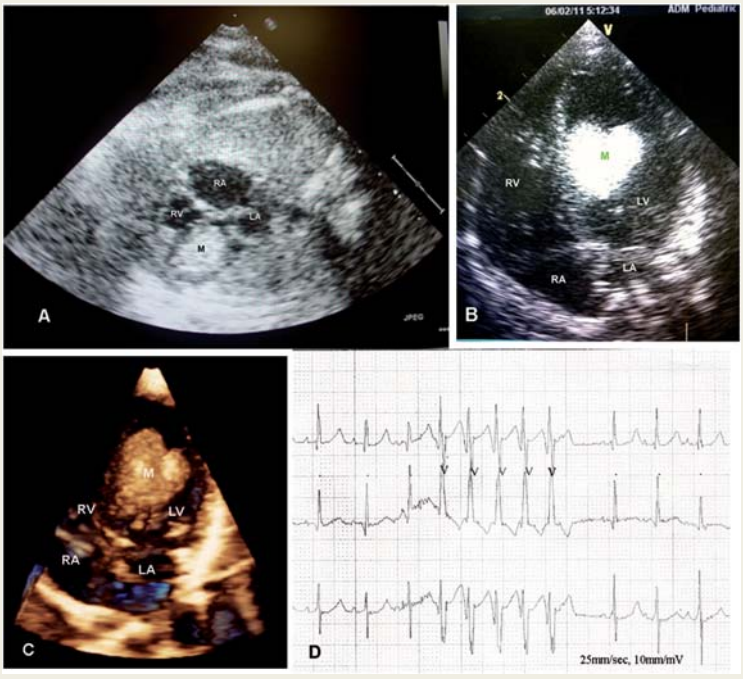
Department of Pediatric Cardiology, Children Hospital Regina Margherita, Piazza Polonia 94, 10126 Torino, Italy

* Corresponding author. Tel: +39 0113135804, +39 3403134529, Fax: +39 011501773, Email: fulvio.gabbarini@fastwebnet.it, fulvio.gabbarini@oirmsantanna.piemonte.it

In a female foetus of 31 weeks we diagnosed a mass of 15 × 17 mm, occupying most of the left ventricular cavity, which did not cause arrhythmia, cardiac failure, or obstruction.

After birth, we confirmed the presence of an intraventricular mass and performed 3D echocardiography to highlight the spatial relationship with cardiac structures.

The mass had an unusual heart shape and was visibly smaller (13 × 12 mm) compared with the prenatal aspect (*Figure 1*). There was no obstruction to left ventricular inflow or outflow and basal ECG was normal. The screening for tuberous sclerosis was negative. The baby remained asymptomatic during the hospitalization, but was readmitted 15 days later for the occurrence of runs of ventricular tachycardia, discovered by Holter monitoring, which we treated with beta-blockers.



During the foetal and neonatal period, rhabdomyomas represent the majority of cardiac tumours and are closely associated with tuberous sclerosis. Cardiac rhabdomyomas may be found in asymptomatic patients and may be incidentally discovered during echocardiography, or may cause cardiac dysfunction requiring medical and/or surgical intervention. On rare occasions, life-threatening conditions occur. These tumours generally regress after birth, and cardiac-related problems are rare after the perinatal period. Regression *in utero* is rare: in a meta-analysis, Chao AS *et al.* presented 266 cases of cardiac rhabdomyomas diagnosed with antenatal ultrasonography and only one regressed.

This contribution confirms that the reduction of the mass size can start during foetal life and shows that the first arrhythmic event may occur several days after birth.

Panel A. Foetal echocardiography shows that the mass completely fills the left ventricular cavity.

Panel B. B-Mode postnatal echocardiography shows that the mass is adherent to the interventricular septum, has a heart shape form, and its size has diminished.

Panel C. 3D transthoracic echocardiography highlights the heart shape form of the mass.

Panel D. Holter monitoring shows a run of non-sustained ventricular tachycardia.

M, mass; RA, right atrium; RV, right ventricle; LA, left atrium; LV, left ventricle; V, ventricular tachycardia.