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FASTTRACK SPECIAL ARTICLE

Cardiovascular disease in Europe: epidemiological update

Melanie Nichols[1,2]*, Nick Townsend[1], Peter Scarborough[1], and Mike Rayner[1]

[1]British Heart Foundation Health Promotion Research Group, Nuffield Department of Population Health, University of Oxford, Oxford, UK; and [2]WHO Collaborating Centre for Obesity Prevention, Faculty of Health, Deakin University, Geelong, Australia

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This overview provides a Europe-wide update on the current burden of cardiovascular disease, and specifically of coronary heart disease and stroke. Cardiovascular disease continues to cause a large proportion of deaths and disability in Europe, and places a substantial burden on the health care systems and economies of Europe. The overall picture, and the distribution of the burden, continues to evolve in a developing Europe. There have been major improvements in recent years on many measures of cardiovascular disease; however, these improvements have not been universal, and substantial inequalities persist.

Keywords Cardiovascular disease • Epidemiology • Coronary heart disease • Mortality • Morbidity • Treatment

Introduction

This overview provides a Europe-wide update on the current burden of cardiovascular disease (CVD), and specifically of coronary heart disease (CHD) and stroke. Cardiovascular disease continues to cause a large proportion of deaths and disability in Europe, and places a substantial burden on the health care systems and economies of Europe. The overall picture, and the distribution of the burden, continues to evolve in a developing Europe. There have been major improvements in recent years on many measures of CVD; however, these improvements have not been universal, and substantial inequalities persist.[1,2]

This summary of the current burden and distribution of CVD and CHD in Europe is based on the *European Cardiovascular Disease Statistics 2012* report,[1] with additional updated data where available. *European Cardiovascular Disease Statistics 2012*, published jointly by the European Heart Network and the European Society of Cardiology, is the fourth in a series of Europe-wide compendia. It aims to bring together the most up to date statistics available on a range of issues related to CVD, CHD, and stroke for a wide audience including policy makers, health professionals, medical researchers, and others with an interest in the burden, distribution, causes, and effects of CVD in Europe.

Methods

The report and this summary both draw on international data sources that provide comparable data across the greatest number of European countries. The 53 member states of the World Health Organization (WHO) European region were included in the definition of Europe.

This overview focuses on the mortality, morbidity, and treatment data associated with CVD in Europe. Further detail on these topics, including country-specific data, and information about associated risk factors, including diet, physical activity, smoking, alcohol consumption, hypertension, hypercholesterolaemia, overweight and obesity, and diabetes prevalence across Europe, and the economic cost of CVD in the EU, is available in the full *European Cardiovascular Disease Statistics 2012* report.[1] Data reported in this paper have been sourced from the WHO Mortality Database,[3] the WHO European Region's Health for All Database,[4] the Organization for Economic Co-operation and Development (OECD) health statistics[5] and the European Commission EuroStat database.[6]

The report and this overview have been compiled using international data sets. A wide range of potential data sources were consulted in order to select data which achieved a balance between the quality of the data, the greatest number of countries included, representativeness of the data within countries, and regularity of updates to the data. Comparability of the data varies by topic, and no data sources were available for any of the topics investigated that provided complete, up to date, high quality and representative information for all 53 countries.

Estimates of mortality rates and proportions were calculated using age- and cause-specific data by country from the WHO Mortality Database;[3] however, the summaries, interpretations, and conclusions are those of the authors. The WHO database collates data reported by national authorities based on their civil registration systems and contains data for 52 of 53 European countries (no data available for Andorra). Where data are presented for the 'most recent year', this relates to the most recent data for which both mortality and population data were available in the WHO data sets, with the exceptions of Monaco, Montenegro and Turkey, for

* Corresponding author. Tel: +61 352278446, Fax: +61 352278376, Email: melanie.nichols@deakin.edu.au

which no population data were available. These countries are included in the calculations for total numbers of deaths and premature deaths, but could not be included in the section on age-standardized death rates. Although for the majority of countries mortality data are quite recent (43 of 52 countries have data up to 2009, 2010, or 2011), there is some variability which reduces the comparability of estimates, particularly for the two countries where the most recent mortality data are >10 years old (Monaco, 1987 and Turkmenistan, 1998). The years to which the data relate for each country are given in the tables. Premature mortality is defined as deaths occurring before a particular age in a population, although there is no functional consensus on what this age should be. An appropriate measure of premature mortality may vary between countries and over time. While deaths before the age of 65 is a common measure of premature mortality, amid increasing life expectancies it may be more appropriate to consider all deaths up to age 70 or 75 years to be premature. In this report, data for mortality before both 65 and 75 years are presented for comparison.

All data are presented as age-standardized where possible. Exceptions, where data were not available as age-standardized are the hospital discharge rates and treatment data.

All mortality data have been fully updated based on the May 2013 data released by the WHO.[3] For all other sections, where data reported here are referenced to the *European Cardiovascular Disease Statistics 2012* report, complete details of the original data sources are provided in the report. Where data have been updated since the publication of that report, full reference is given here to the original data sources and analysis.

Mortality

Cardiovascular disease remains the leading cause of mortality in Europe among both men and women, causing almost 4.1 million deaths per year, or 46% of all deaths in Europe (*Table 1*). Almost 1.8 million of these deaths were due to CHD (20% of all deaths), and close to a further 1.1 million due to stroke (12% of all deaths). Cardiovascular disease causes a greater proportion of deaths among women (51%) than men (42%) overall, however, among women, these deaths are more likely to be in old age.

Cardiovascular disease is the leading cause of death in Europe among both men and women (*Figure 1*). Among women, the most recent available data show that this is the case in all countries of Europe. Among men, this is the case in all but nine countries; Belgium, France, Israel, Luxembourg, Netherlands, Portugal, San Marino, Slovenia, and Spain, where cancer now causes a greater proportion of deaths than CVD annually. When more specific cardiovascular causes of death are compared with the cancers that cause the most deaths (lung cancer among men and breast cancer among women), CHD alone causes more deaths than lung cancer among men in all but five countries (France, Monaco, Netherlands, San Marino, and Turkey), and more deaths than breast cancer among women in all countries except Monaco and San Marino (which each had <10 deaths due to CHD and breast cancer).

Premature mortality

Premature mortality is a measure of unfulfilled life expectancy, and provides some insight into the potentially preventable, unnecessary loss of life that impacts on productive years. Cardiovascular disease caused almost 1.5 million deaths before the age of 75 in Europe for the most recent year of data, including over 710 000 deaths of Europeans aged <65 years. Almost half of these deaths were due to CHD alone, while between one-fifth and one-quarter were due to stroke.

Mortality rates across European countries

Although CVD imposes a heavy burden on all health systems and societies in Europe, the burden in mortality rates from CVD and CHD in Europe shows stark differences in the rates at which citizens of Europe die from these conditions, with up to seven-fold differences in age-standardized CVD mortality rates, and 20-fold

Table 1 Number and percentage of deaths from cardiovascular diseases in Europe: latest available year[a]

	Cardiovascular disease (total)		Coronary heart disease		Cerebrovascular disease		Other cardiovascular diseases	
Males								
Total deaths (all ages)	1 862 004	42%	876 478	20%	431 957	10%	553 569	12%
Premature deaths—before age 75	946 280	37%	477 833	18%	203 614	8%	264 833	10%
Premature deaths—before age 65	508 228	31%	253 734	16%	95 555	6%	158 939	10%
Females								
Total deaths (all ages)	2 222 657	51%	905 706	21%	631 639	15%	685 312	16%
Premature deaths—before age 75	544 769	38%	237 673	16%	157 782	11%	149 314	10%
Premature deaths—before age 65	202 175	27%	77 477	10%	54 922	7%	69 776	9%
Total								
Total deaths (all ages)	4 084 661	46%	1 782 184	20%	1 063 596	12%	1 238 881	14%
Premature deaths—before age 75	1 491 049	37%	715 506	18%	361 396	9%	414 147	10%
Premature deaths—before age 65	710 403	30%	331 211	14%	150 477	6%	228 715	10%

Source: WHO Mortality Database.
[a]No data available for Andorra.

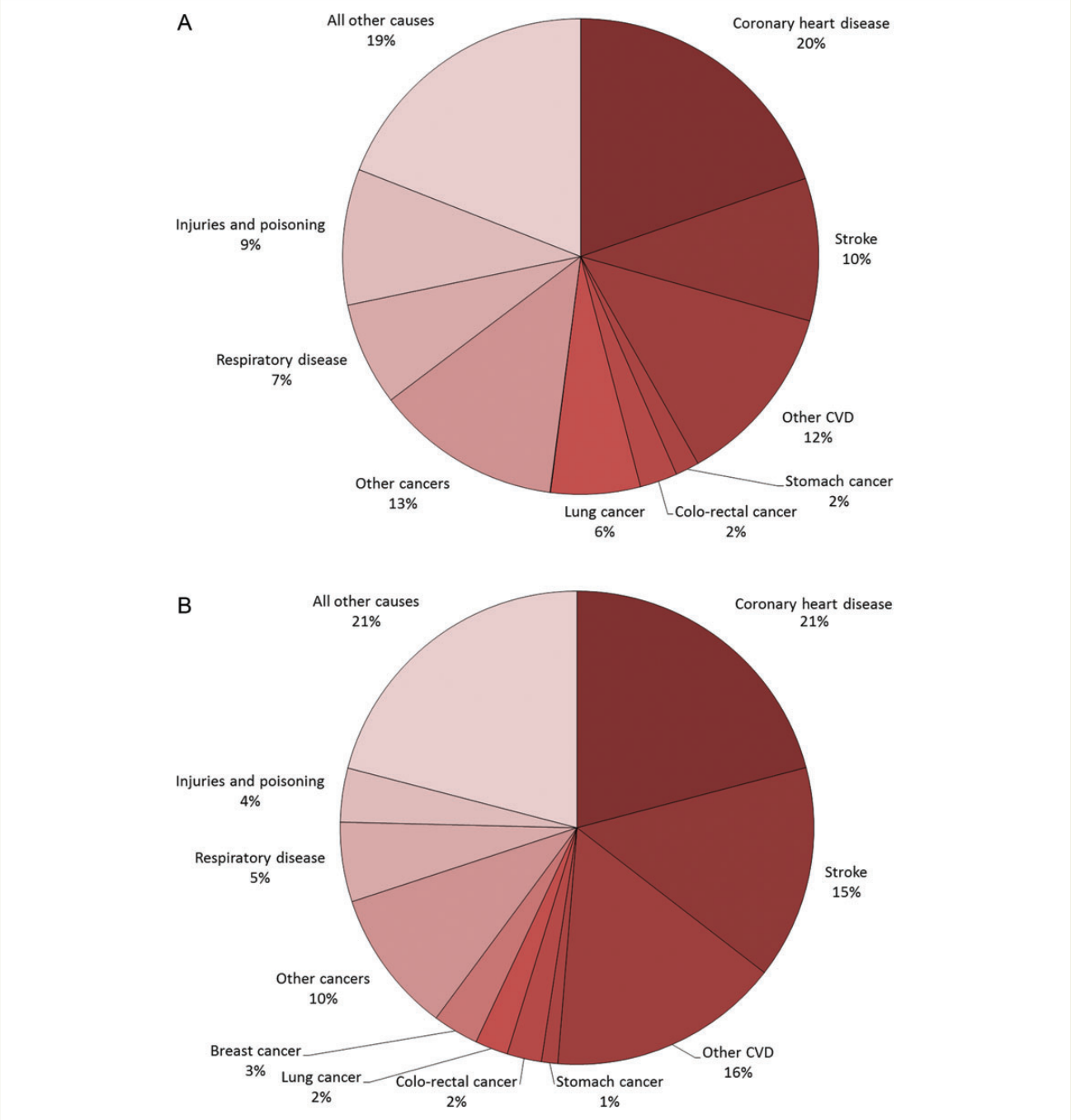

Figure 1 Deaths by cause from latest available year, Europe, among (*A*) men and (*B*) women. *Note*: No data available for Andorra. *Source*: WHO Mortality Database.

differences in age-standardized CHD mortality rates between countries with the highest and lowest rates (*Table 2*). For both sexes, the lowest rates of CVD death were found in Israel, France, Spain, and the Netherlands (all <175 deaths per 100 000 men, and <115 deaths per 100 000 women), while the rates exceeded 900 deaths per 100 000 men in the Russian Federation, and exceeded 600 deaths per 100 000 women in Uzbekistan. Very high CVD mortality rates were also found for both men and women in Turkmenistan; however, the most recent data available for that country were from 1998. In general, CVD death rates were lowest in European countries which enjoy relatively high average life expectancies, and highest in countries with shorter average life expectancies.[7]

Trends in mortality

Mortality rates from CHD in Europe have shown striking improvements over the last three decades.[2] Although these improvements have not been shared equally, there is evidence for some degree of

Table 2 Age-standardized death rates from cardiovascular disease and coronary heart disease by country and sex (per 100 000 population)

Country	Year	Males						Females					
		CVD, total			CHD			CVD, total			CHD		
		All ages	<75 years	<65 years	All ages	<75 years	<65 years	All ages	<75 years	<65 years	All ages	<75 years	<65 years
Albania	2004	490.7	209.3	97.8	156.5	87.9	47.6	354.8	122.6	48.7	89.6	37.4	15.8
Armenia	2009	640.4	298.0	164.7	407.4	201.1	116.8	450.6	129.9	48.4	252.0	71.3	27.1
Austria	2011	240.7	87.1	45.3	125.1	51.7	27.9	160.7	33.1	14.7	65.2	15.0	6.3
Azerbaijan	2007	616.8	363.0	190.6	149.3	96.6	55.1	488.9	212.0	89.8	93.2	41.7	17.7
Belarus	2009	892.7	563.9	316.2	642.2	390.1	212.8	427.6	201.8	88.7	283.6	123.6	47.8
Belgium	2009	205.7	86.6	47.7	76.3	38.0	21.1	132.1	38.4	19.2	32.2	11.6	5.8
Bosnia and Herzegovina	2011	474.7	201.5	119.3	93.5	57.1	39.0	385.4	116.4	52.8	54.8	22.8	11.3
Bulgaria	2011	732.4	384.5	219.8	145.6	86.2	54.1	478.3	167.6	80.8	73.5	26.6	11.7
Croatia	2011	415.9	179.2	93.0	195.1	91.7	51.2	297.5	76.6	28.3	122.8	30.3	10.8
Cyprus	2011	228.4	95.3	54.6	102.2	58.7	37.9	169.9	33.5	15.5	44.4	15.5	8.4
Czech Republic	2011	412.9	182.1	92.1	219.9	96.6	48.7	268.1	72.3	29.2	128.4	30.5	10.8
Denmark	2006	243.8	99.5	50.4	97.7	40.7	20.8	154.4	47.6	20.0	51.7	15.3	5.9
Estonia	2011	510.1	270.0	142.0	255.6	129.1	65.1	279.2	79.9	31.5	124.2	28.8	9.9
Finland	2011	275.8	126.1	68.5	165.5	73.3	37.6	146.1	35.7	16.1	71.4	14.7	5.3
France	2009	155.8	64.8	37.0	49.7	24.4	14.8	90.7	23.2	12.0	18.8	5.1	2.5
Georgia	2010	325.1	196.8	108.7	80.3	52.1	30.5	190.1	82.8	34.3	38.7	16.6	6.9
Germany	2011	231.0	93.5	49.7	103.0	45.9	24.8	163.9	38.2	18.2	52.5	13.0	5.7
Greece	2010	251.9	115.6	69.7	89.1	61.9	44.9	206.6	42.6	20.4	37.7	15.3	9.9
Hungary	2011	516.2	273.3	155.0	275.2	145.8	82.9	319.3	106.2	49.5	159.1	49.7	21.8
Iceland	2009	218.6	79.7	40.2	117.5	43.4	20.9	131.9	22.7	5.2	54.6	7.9	0.8
Ireland	2009	237.9	101.9	50.3	143.7	67.6	33.7	151.4	42.2	19.4	69.2	19.7	8.7
Israel	2010	144.9	58.5	28.1	70.3	28.6	13.7	97.8	24.4	9.2	35.2	7.8	2.5
Italy	2010	196.4	69.9	36.5	76.9	32.4	17.6	131.0	27.7	12.5	37.6	8.5	3.6
Kazakhstan	2010	809.8	534.9	319.2	264.9	186.9	114.2	485.3	239.9	118.1	124.3	65.4	29.9
Kyrgyzstan	2010	841.8	478.5	260.7	534.2	270.7	134.5	588.4	239.7	106.1	373.4	125.0	44.3
Latvia	2010	674.7	405.3	230.6	375.4	215.3	115.7	353.1	139.5	66.5	174.2	62.6	26.3
Lithuania	2010	667.0	352.3	202.5	436.2	214.0	118.2	383.0	116.4	54.6	238.8	62.2	26.3
Luxembourg	2010	211.2	79.4	42.4	68.8	34.8	20.3	134.0	31.9	15.9	27.0	7.5	3.6
Malta	2011	288.6	113.9	55.0	177.4	83.1	39.7	185.6	48.3	20.1	91.5	25.7	9.4
Netherlands	2011	170.9	66.4	34.0	54.6	25.5	14.0	113.4	31.8	15.6	24.5	8.6	4.2
Norway	2011	183.6	67.8	33.2	82.5	36.9	19.1	116.4	26.0	12.0	39.8	9.7	4.4
Poland	2011	415.3	211.5	119.4	128.2	72.5	40.4	244.8	75.7	34.2	59.5	20.3	8.7
Portugal	2011	174.7	71.0	37.3	49.1	26.3	15.0	126.8	31.7	13.5	24.2	7.7	3.6
Republic of Moldova	2011	797.3	414.3	205.9	530.1	252.9	121.0	570.0	225.2	87.9	377.3	128.0	43.7
Romania	2010	647.3	311.5	164.2	238.3	127.5	74.5	453.9	144.4	58.6	146.3	48.9	21.1
Russian Federation	2010	915.1	563.2	336.0	500.9	310.5	181.0	516.8	214.9	103.3	254.5	102.5	44.0
San Marino	2005	242.2	55.7	29.3	30.9	12.9	7.3	155.5	43.3	18.6	8.3	0.0	0.0
Serbia	2011	534.2	258.2	130.6	125.5	80.6	46.8	419.3	136.7	51.1	68.6	29.4	11.3

Continued

Table 2 Continued

Country	Year	Males						Females					
		CVD, total			CHD			CVD, total			CHD		
		All ages	<75 years	<65 years	All ages	<75 years	<65 years	All ages	<75 years	<65 years	All ages	<75 years	<65 years
Slovakia	2010	551.8	256.6	131.5	333.8	147.4	73.4	360.2	105.0	42.8	209.5	54.6	19.3
Slovenia	2010	269.2	107.5	54.4	94.9	48.6	27.0	178.0	38.7	15.7	40.5	11.3	3.6
Spain	2010	168.7	72.6	39.8	64.8	33.6	19.5	110.4	25.8	11.8	26.8	7.7	3.4
Sweden	2010	227.5	80.1	39.3	111.4	44.5	22.7	144.9	32.8	14.2	54.4	14.9	6.3
Switzerland	2010	181.2	64.2	32.5	80.4	32.6	17.2	115.9	23.9	10.6	38.4	8.2	3.2
TFYR Macedonia	2010	626.9	257.4	126.2	112.9	74.1	45.2	490.6	161.6	63.1	56.9	30.8	15.1
Tajikistan	2004	710.3	358.9	173.4	303.6	170.0	86.0	503.9	273.2	120.8	185.6	99.8	41.4
Turkmenistan	1998	1017.4	619.8	356.9	562.8	318.1	174.6	716.9	384.7	194.4	352.5	161.7	67.8
Ukraine	2011	890.0	506.6	268.5	610.1	340.3	166.1	549.4	213.6	87.6	366.0	138.8	49.2
UK	2010	205.2	95.4	52.2	111.1	57.8	32.2	129.0	40.8	19.6	49.4	17.4	7.7
Uzbekistan	2005	858.0	520.1	256.0	453.6	263.7	121.1	662.3	340.9	147.7	320.9	157.0	58.7

Age-standardized to the European Standard Population.
Notes: Rates not available for Monaco, Montenegro or Turkey due to missing population data. No mortality data available for Andorra.

recent improvements in mortality rates among men and women in all European countries.[1] Coronary heart disease mortality rates have been improving rapidly in the majority of western and northern European countries for several decades.[8] The most recent data, however, signal a welcome change, as central and eastern European countries, which had continued to experience increases in CHD mortality until relatively recently, are now also making progress.[1] Age-standardized CHD mortality rates for the last 10 years, by sex and country, are shown in Supplementary material online, *Table S1*. Recent analysis has also shown that, contrary to some concerns, improvements in CHD mortality rates have not generally occurred exclusively or predominantly in older age groups, at least in the EU. In most EU countries, CHD mortality rates have continued to decrease in younger adults at similar or greater rates when compared with older age groups, and younger age groups continue to show substantial annual percentage reductions in mortality.[2] In a small number of countries, however, these earlier decreases have slowed or reversed among some age groups, and this may herald a very high future burden of disease which will strain health systems' ability to respond.[2,9]

Case-fatality rates

The extent to which improvements in CVD mortality are due to reduced incidence (including improved primary prevention and risk factor management) or improved treatment and care (reduced case-fatality rates) remains unclear in many countries, although evidence from several countries has demonstrated that a substantial proportion of the observed reductions in CHD mortality in recent decades has been due to reductions in both incidence and case-fatality rates.[10–12]

Reported age-sex-standardized admission-based case-fatality rates in 21 European OECD countries show more than three-fold differences in acute myocardial infarction (AMI) case-fatality rates, from 2.3% in Denmark to 8.6% in Belgium.[1,5] Worldwide data show that although incidence of stroke has decreased in high income countries in recent decades, case-fatality rates have shown comparatively limited improvement.[13] In the same OECD countries, 30-day in-hospital fatalities for ischaemic stroke varied between 2.6% in Denmark and 9.7% in Slovenia. Case-fatality rates for haemorrhagic stroke were substantially higher and more varied, ranging from 6.5% in Finland to 38.6% in Belgium. The median age–sex-standardized admission-based case-fatality rates reported for AMI, ischaemic stroke and haemorrhagic stroke, respectively, were 4.7, 4.4, and 18.7%. Importantly, total case-fatality rates in the population are substantially higher, as these rates are limited to those cases admitted to hospitals, and therefore exclude all sudden deaths outside of hospital.[10]

Morbidity

In addition to being the largest contributor to mortality in Europe, CVD also makes a very substantial contribution to morbidity among Europeans. Although morbidity from CVD may be described using a number of different indicators, including hospital discharge rates, prevalence and incidence rates, high-quality Europe-wide data for each of these measures remain limited, and comparability

of many estimates is relatively low. A major important limitation to our understanding of trends in the epidemiology of CVD in Europe, and to interpretation of mortality trends, is the lack of high quality and comparable community-based incidence data for CVD and CHD.

Hospital discharge rates for cardiovascular diseases in Europe show very large variation between countries, which do not necessarily reflect the same patterns as mortality rates. These data provide an indication of the rates at which individuals are hospitalized for CVD and an indirect approximation of morbidity; however, they do not provide a true measure of incidence, and differences may also be accounted for by variation between countries in healthcare system structures as well as rates of sudden death without hospital admission. The WHO European Region's Health for All Database shows that the annual rate of discharges for CVD in Europe in 2010 was just over 2500 per 100 000 population,[4] although up to date data are not available for all countries. Ten years earlier, the rate was 2234 per 100 000. Europe-wide discharge rates for CVD, and for CHD and stroke individually, appear to have stabilized since the early 2000s, after substantial increases in the preceding two decades.[1,4] The discharge rates for CHD in Europe have remained at slightly over 800 per 100 000 population since 2006, and discharges related to stroke have been consistently between 440 and 450 per 100 000 population since 2004.[4] As these rates are not age-standardized, the apparent stability may be a reflection of decreasing age-specific rates of hospital admissions within an ageing population.

Treatment

Reported rates of surgical procedures for CVD vary widely across Europe and it appears that data collection and quality also vary substantially. The comparability across countries of data compiled in international databases is limited by variability in the way in which health care provision is organized in countries and the information that is collected for national statistics—for instance in some countries, data do not include private hospitals. In data for selected procedures in 25 countries provided by the European Commission 'Eurostat' database, there were no consistent geographical patterns in rates of surgical interventions for CVD.[6] The median rate of transluminal coronary angioplasty for the most recent year of data was 180.9 inpatients per 100 000 population (range 12.1 to 622). Reported rates for this surgery were lowest in Cyprus, Portugal, and Finland, and highest in Germany, where the rate was more than double that in Austria and Estonia, which had the next highest rates. For heart bypass anastomosis surgery, rates were highest in Switzerland, Germany, and Estonia, and lowest in Finland, Romania, and Slovakia (median 44.6, range 3.8 to 115.5).

The European Society of Cardiology EUROASPIRE project has collected, among other things, data on drug prescriptions for patients with diagnosed cardiovascular conditions in hospitals in several European countries. While not necessarily representative of national prescribing patterns, these data do give some indication of the scale of drug treatment and adherence to guidelines across Europe.[1,14,15] The EUROASPIRE III survey, in 2006/07, showed that the use of drugs for secondary prevention in CHD patients varied considerably across survey populations.[14] Anti-platelet drugs (including aspirin) were the most widely used drugs, which were used by between 88 and 99% of patients in the countries studied. There was wide variation in the use of statins (from 38% of patients in Lithuania to 96% of patients in Finland), ACE inhibitors (from 46% of patients in Belgium to 90% of patients in Poland) and anti-coagulant drugs (from $<5\%$ of patients in half of the 22 countries, to 36% of patients in Germany).[14] Comparable data are now available on eight countries that have taken part in all three EUROASPIRE surveys to date,[15] and these data track large shifts in prescribing patterns, with substantial increases in the rates of prescription for lipid-lowering drugs and ACE inhibitors between 1995–96 and 2006–07.

Summary and discussion

Monitoring the epidemiology of CVD is an important component to addressing the burden that it imposes on Europe. Despite continued improvements, CVD remains the leading cause of death in Europe, and is responsible for close to 4.1 million deaths per year. Mortality data provide the most complete and up to date indicators of the burden of CVD in Europe; however, these still do not cover all countries for recent years, and there are limitations to availability, comparability, and quality even of this most basic indicator of population health. There are delays or omissions in data submissions by some countries, and the WHO notes that variation between countries in coverage of vital registration systems and in coding practices for causes of death must be considered when comparisons are made between countries.[3]

Beyond its contribution to mortality, CVD also causes a very substantial burden of morbidity, and it is clear that there are substantial inequalities between countries in rates of hospitalization for CVD. Europe-wide data to clearly understand rates of CVD morbidity and treatment, including differences between countries and trends over time, are however, limited, and there is a clear place for further initiatives to standardize data collection and promote consistent collation of existing national-level data sources. In particular, a lack of high quality and comparable incidence data across Europe limits our ability to interpret trends and patterns in mortality data or to prioritize prevention and treatment actions.

The EUROASPIRE surveys provide valuable snapshots of medication use for secondary prevention of CVD in selected countries; however, data on medication use more broadly, including for primary prevention of CVD, remain very limited. A recent study in France has demonstrated that only a small proportion of CVD prevention and risk factor management medications are prescribed for secondary prevention.[16] Stronger tracking and reporting of prescriptions for CVD across the spectrum of prevention and management is a potential area for improved surveillance, and could strengthen evaluation of both the implementation and effectiveness of aspects of the European Guidelines on CVD Prevention in Clinical Practice at the European level.[17]

Collection of comprehensive population-based morbidity and treatment data, and prescribing patterns, presents many more challenges than mortality and hospitalization statistics, but there is an urgent need for these data, consistently collected and centrally collated. Furthermore, comparable and comprehensive data on important risk and protective factors for CVD, particularly diet and physical activity, are generally even more limited, and it is extremely difficult to

draw valid comparisons between countries or over time about these behaviours.[1]

Mortality and morbidity from CVD continue to have a major social and economic impact in Europe, and significant inequalities are evident between countries. Continued progress towards reducing CVD and creating a healthier and more equitable Europe will require not only improvements in treatment and care for those with CVD, but also a clear policy focus on reducing the risk factors associated with CVD. This will require the development of improved methods and standards for collecting comparable data on all issues related to CVD. Data that are collected using consistent and representative methods are necessary to inform valuable cross-country comparisons and coordinated European efforts to address CVD. This will allow us to estimate more effectively the burden of CVD across Europe and support the development of effective service planning and quality of care for patients.

Supplementary material

Supplementary material is available at *European Heart Journal* online.

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