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REVIEW

Cardiovascular disease in Europe: epidemiological update 2016

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Introduction

This is the fourth in a series of papers describing the burden of cardiovascular disease (CVD) within Europe.[1–3] CVD remains the most common cause of death worldwide, with the 2013 Global Burden of Disease (GBD) study estimating that CVD caused 17.3 million deaths globally. It accounted for 31.5% of all deaths and 45% of all non-communicable disease deaths, more than twice that caused by cancer, as well as more than all communicable, maternal, neonatal and nutritional disorders combined. The 2013 GBD also reported that CVD caused a greater number of deaths and was responsible for a greater percentage of all deaths than in 1990 when 12.3 million deaths were attributed to CVD, corresponding to 25.9% of total deaths.[4] Previous publications in this series have reported that despite the decreases in CVD mortality in Europe more than 4 million people die from CVD across the continent every year, with more than 1.4 million dying prematurely, before the age of 75 years.[1–3] In this article we present an updated overview of the burden of CVD in Europe, including new statistics for mortality, morbidity, and treatment. Where possible we provide statistics for all CVD and for coronary heart disease (CHD) and stroke in particular. All data included here are updated from previous publications and we present prevalence statistics for the first time. This series of publications describing the current burden and distribution of CVD and CHD in Europe has been based on the European Cardiovascular Disease Statistics 2012 report,[5] the fourth in a series of Europe-wide compendia, which was published jointly by the European Heart Network and the European Society of Cardiology.

Methods

Throughout this article, we present statistics from a number of data sources chosen with consideration of data quality, date of most recent update, and coverage of the European region. Rather than collected data from individual countries we utilized major data sources which make their statistics publically available. Specifically, we aimed to obtain data for as many European countries as possible from as recently as possible. In order to present data on CVD throughout Europe, with a particular focus on the two most common forms of CVD: CHD and stroke, we identified international sources that collect and report comparable data for a number of countries. Commonly, such sources are updated through routine and administrative data collections and provide an overview of the burden and distribution of CVD in Europe through the mortality, morbidity, and treatment associated with CVD across the continent. However, these data sources generally rely on individual countries to provide the data they collate, this means that in some cases the data that we obtain from a central source, in order to be consistent and comparable between countries and across Europe, may not be as up to date as could be obtained from some individual countries' own databases.

In this article, we define Europe as the 53 member states of the World Health Organization (WHO) European region. There were no 'ideal' data sources that provided complete, up-to-date, high-quality, and representative information for all 53 countries for any topic in this overview and comparability and quality of the data varies by topic. We also present data for EU-15 countries, those in the European Union (EU) prior to the accession of 10 candidate countries on 1 May 2004: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, UK, and the EU-28 countries which include these 15 countries and the 13 additional countries which have subsequently joined

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the EU: Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia.

Mortality data come from the WHO Mortality Database using the most recent (25 November 2015) update of age- and cause-specific mortality data, and age-specific population data, by country.[6] All analyses, interpretations, and conclusions are those of the authors, not the WHO, which is responsible only for the provision of the original information. The WHO database collates data reported by national authorities based on their civil registration systems and contains data for 52 of 53 European countries, with no data available for Andorra. Age-standardized rates can only be calculated where data on the absolute number of an outcome and the population are available in comparable age-specific aggregates. Where rates are presented for the 'most recent year', this relates to the most recent data for which both mortality and population data were available. Mortality data for Turkmenistan, for example, are now available for 2013, but the most recent population data come from 1998, hence rates for this country are from the earlier year. For one country (Monaco), although mortality data were available, no population data were. These could not, therefore, be used in the presentation of age-standardized death rates (ASDRs) but were included in the calculations for total number of deaths and premature deaths in Europe.

In order to calculate rates, population data from the same database were applied to these mortality data and were standardized using the 2013 European Standard Population (ESP). The 2013 ESP was developed by the European Commission for the EU27 + European Free Trade Association countries as an update to the 1976 ESP, to reflect the current age structure of the present European population.[7] On average, when using the same data, CHD ASDRs for European countries calculated using the 2013 ESP are around twice as large as those calculated using the previous (1976) ESP.[8] This means that although comparisons can be made within this study between countries in which ASDRs have been calculated using the same 2016 ESP, comparisons cannot be made to other studies, including earlier papers from this series, which have used the 1976 ESP to calculate standardized rates.

WHO mortality and population data are relatively up to date, with the most recent data for only 11 of the 52 countries dating from 2010 or before; however, data from five countries were not available for any years more recent than 2005: Albania (2004), San Marino (2005), Tajikistan (2004), Turkmenistan (1998), and Uzbekistan (2005). Mortality rates are presented for CVD and CHD for all ages and for those under the ages of 65 and 75 years separately; deaths before these ages are often described as premature or preventable.

Morbidity data come from the WHO[9] and the European Social Survey.[10] Disability-adjusted life years (DALYs) are available for the entire WHO European Region from the WHO's Health Statistics and Information Systems[11] and allow for a comparison of disease burden between both countries and conditions. One DALY is equivalent to 1 year of healthy life lost and is a composite measure of years of life lost due to death from a condition and years lived with disability due to a condition. The WHO has calculated DALYs for all conditions and all countries using estimates that draw on the methods used by the GBD project.[9]

Prevalence data come from the European Social Survey.[10] This is a European Commission-funded cross-sectional survey that is repeated every 2 years with face-to-face data collection. Using random probability methods, samples are drawn from each participating country and aim to be representative of all people aged 15 and over in that country. Data are only available for selected countries that participated in the 2014 survey. The question relating to CVD prevalence was included in 2014 in the 'health inequalities' module and asked people to recall if they had had any health problems listed on a showcard in the last 12 months; with heart or circulation problems as an option.

Hospital discharge data come from the WHO European Region's Health for All Database.[12] Data are sourced from the national registries of each country and provide an indication of the burden of CVD on health services within European countries. In addition to discharge data, the average length of stay in hospitals (ALOS) is often regarded as a good indicator of health service efficiency. The Organization for Economic Co-operation and Development (OECD) presents the ALOS as the mean number of days that patients spend in hospital.[13] ALOS is generally measured by dividing the total number of days stayed by all patients during a year by cause-specific admissions or discharges. The data cover all inpatient cases with the exception of the Netherlands where data refer to curative acute care only, resulting in an under estimation.

The OECD also presents 30-day case-fatality rate as a percentage of people aged 45 and over who die within 30 days following admission to hospital for acute myocardial infarction (AMI) and ischaemic stroke (IS), which represents around 85% of all cerebrovascular disease cases. The OECD presents case fatality through 'admission-based' and 'patient-based' data.[13] Admission-based data refer to deaths occurring in the same hospital as the initial admission. Rates based on patient data refer to a death occurring in the same hospital, a different hospital, or out of hospital. This indicator is more robust because it captures fatalities more comprehensively. More countries can report the same-hospital 'admission-based' measure, with 'patient-based' data requiring a unique patient identifier and linked data which are not currently available in all countries. Admissions resulting in a transfer were excluded for some countries. This exclusion generally increases the case-fatality rate compared with those countries which do not exclude these transfers.[13]

Results

Mortality

Using the latest available data, CVD causes more than 4 million deaths each year across Europe, accounting for 45% of all deaths. CHD and cerebrovascular disease were the most common causes of CVD deaths, accounting for 1.8 million and 1.0 million deaths, respectively. The number of deaths from CVD is higher in women (2.2 million) than men (1.8 million), with CVD accounting for 49% of all deaths in women and 40% of all deaths in men. With similar numbers of men and women dying from CHD, these sex differences arise from a greater number of women dying from cerebrovascular disease and 'other cardiovascular diseases' (*Table 1*, *Figure 1*).

Premature mortality

Although more than three-fifths of all CVD deaths occur in those over the age of 75 years, 1.4 million people under the age of 75 and just under 700 000 under the age of 65 die from CVD in Europe each year. More men (0.9 million) than women (0.5 million) die from CVD before the age of 75, however due to the greater number of total premature deaths in men CVD accounts for a similar proportion of deaths before 75 years in both sexes. The observed sex differences in number of deaths are greater at younger ages, with more than twice as many men than women dying from CVD under the age of 65. The greatest differences between the sexes in number of premature deaths are found for CHD, despite similar numbers of CHD deaths for all ages in men and women (*Table 1*).

Table 1 Number and percentage of deaths from CVDs in Europe—latest available year[a]

	Cardiovascular disease (total)		Coronary heart disease		Cerebrovascular disease		Other cardiovascular diseases	
	n	%	*n*	%	*n*	%	*n*	%
Males								
Total deaths (all ages)	1 829 496	40	874 920	19	417 113	9	537 463	12
Premature deaths—before age 75	899 415	35	465 842	18	191 819	8	241 754	9
Premature deaths—before age 65	490 221	31	252 427	16	93 131	6	144 663	8
Females								
Total deaths (all ages)	2 173 136	49	892 297	20	599 380	14	681 459	15
Premature deaths—before age 75	507 625	36	227 140	16	146 142	10	134 343	9
Premature deaths—before age 65	193 143	26	77 629	10	53 424	7	62 090	8
Total								
Total deaths (all ages)	4 002 632	45	1 767 217	20	1 016 493	11	1 218 922	14
Premature deaths—before age 75	140 7040	35	692 982	17	337 961	9	376 097	9
Premature deaths—before age 65	683 364	29	330 056	14	146 555	6	206 753	9

Latest available years for each country are the same as those presented in *Table 2*, except for: Albania (2009), Lithuania (2013), Monaco (1987), Slovakia (2014), Tajikistan (2005), and Turkmenistan (2013).
[a]No data are available for Andorra.
Source: WHO Mortality Database.

Mortality rates across European countries

Large differences in the burden of CVD between countries in the European Region remain. Of the 3.8 million total deaths in the EU-15 countries, 33% of these were caused by CVD (1.3 million), compared with 38% of deaths in the EU-28 countries (1.9 million) and 54% of deaths in non-EU member countries (2.1 million). In countries of the EU-15, ASDRs for CVD in men, calculated using the 2013 ESP (ESP13), ranged from 275.2/100 000 men in France to 480.7/100 000 in Finland and amongst women from 174.1/100 000 women in France to 391.3/100 000 in Greece. In the EU-28, additional countries to the EU-15 ASDRs ranged from 407.7/100 000 men in Malta to 1299.5/100 000 men in Bulgaria and in women from 317.0/100 000 women in Malta to 959.6/100 000 in Bulgaria. Countries outside of the EU (restricted to those which had data from 2010 or later) had the largest range of rates. CVD ASDRs for men in these countries ranged from 255.0/100 000 in Israel to 1544.9/100 000 in Ukraine. For women, CVD ASDRs in non-EU countries ranged from 194.9/100 000 in Israel to 1087.4/100 000 in Kyrgyzstan. All seven countries for which data from 2010 onwards were not available were from outside the EU (*Table 2*).

Similar between-country inequalities in rates were found for premature mortality. In the EU-15, 21.4% of deaths under the age of 75 years were from CVD (0.25 million deaths), with ASDRs for this age group in men ranging from 72.8/100 000 men in France to 146.5/100 000 in Greece and in women ranging from 26.4/100 000 women in France to 56.6/100 000 in Greece. In the EU-28, 26.0% of deaths under the age of 75 years were from CVD (0.45 million deaths), with ASDRs from additional countries to the EU-15 ranging from 105.9/100 000 men in Malta to 467.2/100 000 men in Latvia and from 39.2/100 000 women in Cyprus to 206.5/100 000 women in Bulgaria. In non-EU countries, 35.8% of deaths under the age of 75 (1.3 million deaths) were from CVD, with ASDRs (from countries which had data from 2010 or later) ranging from 66.7/100 000 men in Israel to 697.4/100 000 in Belarus. For women CVD ASDRs in non-EU countries ranged from 27.9/100 000 women in Switzerland to 278.3/100 000 in the Republic of Moldova (see Supplementary material online, *Table S1*). CVD mortality rates under 65 years showed similar patterns but at lower rates (see Supplementary material online, *Table S2*).

Trends in mortality

Comparing ASDRs calculated for the most recent year to those for 10 years earlier, as a percentage increase of the earlier year, most of the countries in the European region experienced substantial decreases in ASDRs for CVD and CHD from 2003 onwards (see Supplementary material online, *Table S3*). The exceptions were Kyrgyzstan, which reported an increase in CHD ASDRs over 10 years for both sexes and the Czech Republic that saw a small increase in female CHD ASDRs. Although other countries reported apparent increases in rates for both CVD and CHD these were within countries without recent data, i.e. latest available year of data was before 2010, such as Tajikistan. The proportional decreases in ASDRs over 10 years varied between countries. In the EU-15, 10-year decreases (to the latest year available) in CVD ASDRs in men ranged from 25.2% in Austria to 49.7% in Luxembourg and in women from 25.3% in Italy to 42.9% in Portugal. In the EU-28, decreases in CVD from additional countries to the EU-15 ranged from 13.1% in Slovakia to 34.4% in Croatia and in women from 15.5% in Slovakia to 43.0% in the Czech Republic. In non-EU countries, CVD decreases ranged from 1.3% in Kyrgyzstan to 56.5% in Kazakhstan, and in women from 6.3% in Kyrgyzstan to 65.6% in Kazakhstan.

CVD vs. cancer

As a result of the observed decreases in CVD, a number of countries now record a greater number of deaths from cancer than from CVD annually, despite cancer accounting for less than half the number of deaths than CVD in Europe as a whole. According to the most recent

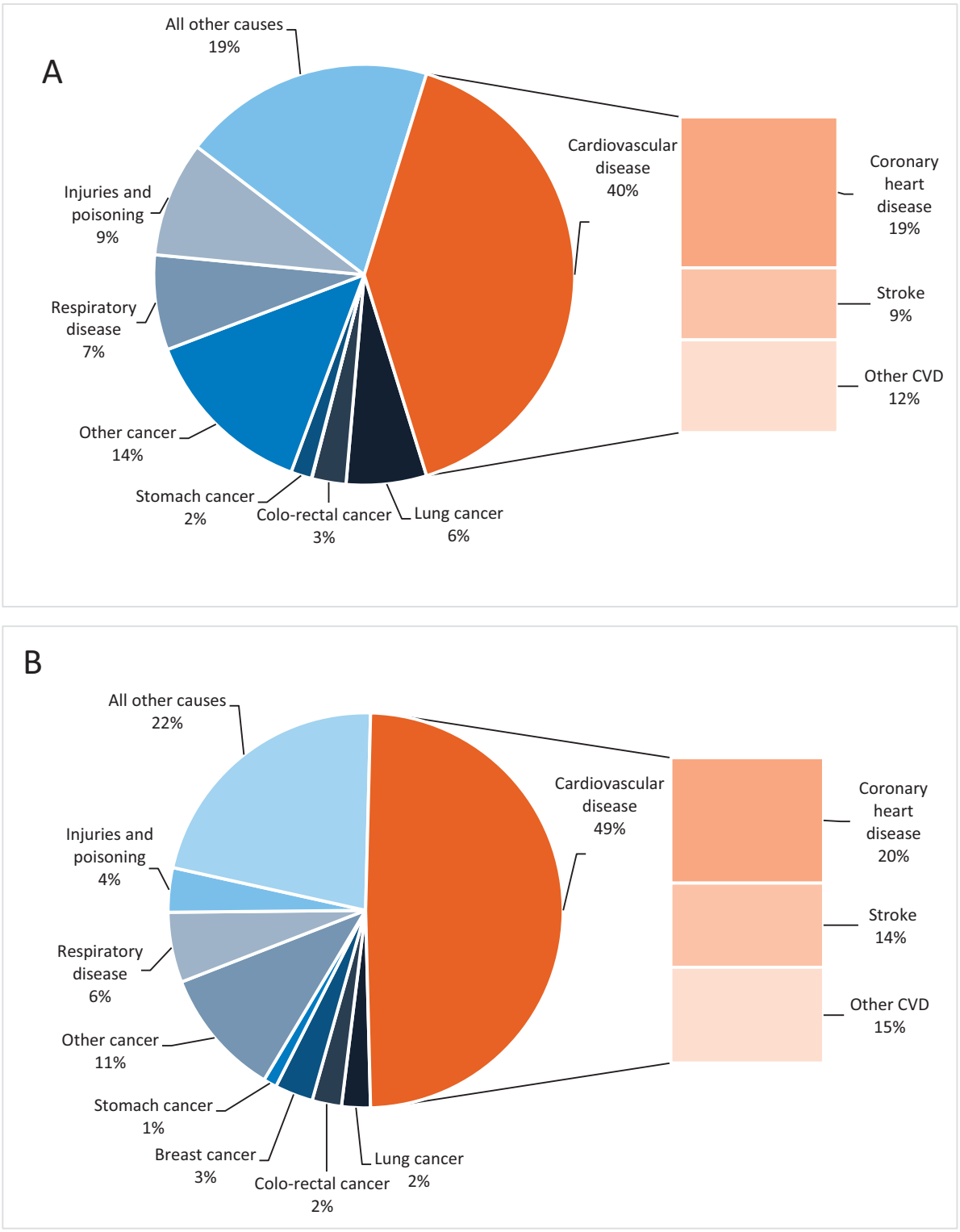

Figure 1 Proportion of all deaths due to major causes in Europe, latest available year, among men (*A*) and women (*B*). Note: No data are available for Andorra. Source: WHO Mortality Database.

Table 2 ASDRs from CVD and CHD by country and sex (per 100 000 population); rate for most recent year of data and percentage change in rates over 10 years

Country	Latest year	Males				Females			
		CVD—total		CHD		CVD—total		CHD	
		Age-standardized mortality rate	10-Year change in mortality rate (%)	Age-standardized mortality rate	10-Year change in mortality rate (%)	Age-standardized mortality rate	10-Year change in mortality rate (%)	Age-standardized mortality rate	10-Year change in mortality rate (%)
Albania	2004	950.7	20.5	278.5	85.9	724.5	50.2	175.4	143.5
Armenia	2012	946.5	−30.8	621.6	−30.1	743.9	−33.1	445.3	−33.8
Austria	2014	457.1	−25.2	226.4	−25.2	348.0	−25.7	132.4	−33.0
Azerbaijan	2007	1078.1	−14.6	250.1	−72.5	944.7	6.5	178.1	−69.3
Belarus	2011	1448.0	−9.3	1060.7	−5.2	726.9	−26.8	498.4	−23.6
Belgium	2012	357.1	−34.3	119.6	−42.8	252.9	−34.1	53.6	−49.0
Bosnia and Herzegovina	2011	918.6	NA	159.19	NA	805.2	NA	107.3	NA
Bulgaria	2012	1299.5	−18.4	271.0	−40.1	959.6	−20.5	165.8	−45.2
Croatia	2013	761.4	−34.3	357.6	−6.0	581.2	−35.2	246.4	−20.2
Cyprus	2012	428.8	NA	161.9	NA	343.9	NA	70.9	NA
Czech Republic	2013	747.6	−32.4	425.3	−4.1	538.2	−43.0	279.6	0.13
Denmark	2012	337.6	−43.9	123.9	−52.6	229.9	−42.3	67.3	−55.1
Estonia	2012	920.3	−30.3	480.6	−42.1	572.4	−35.1	259.8	−48.4
Finland	2013	480.7	−27.7	281.3	−32.9	295.6	−30.4	145.1	−38.8
France	2011	275.2	−34.0	83.6	−37.3	174.1	−35.2	34.7	−44.6
Georgia[a]	2014	891.6	−40.1	266.3	−68.6	608.7	−42.2	169.5	−70.6
Germany	2013	477.2	−29.7	204.1	−35.2	362.1	−29.9	111.2	−41.4
Greece	2012	485.0	−31.3	145.3	−28.3	391.3	−38.6	67.7	−39.0
Hungary	2013	921.3	−21.9	488.3	−11.8	646.3	−22.6	319.2	−12.4
Iceland	2009	441.6	−29.3	238.2	−36.8	297.5	−30.8	125.0	−40.0
Ireland	2012	420.5	−37.7	236.4	−37.0	290.2	−35.4	124.4	−41.7
Israel	2013	255.0	−37.8	115.4	−46.4	194.9	−37.4	66.5	−41.8
Italy	2012	393.8	−27.9	148.0	−23.8	290.0	−25.3	82.7	−25.5
Kazakhstan	2012	779.9	−56.5	290.2	−71.7	437.5	−65.6	139.3	−78.9
Kyrgyzstan	2013	1443.9	−1.3	983.7	13.6	1087.4	−6.3	746.6	15.2
Latvia	2012	1156.8	−18.2	632.3	−15.5	718.6	−21.6	362.7	−13.1
Lithuania	2012	1096.9	−15.3	740.4	−14.4	706.4	−20.3	450.4	−18.4
Luxembourg	2013	332.7	−49.7	109.9	−55.4	254.9	−42.5	64.6	−51.5
Malta	2014	407.7	−29.2	240.4	−27.1	317.0	−33.1	162.7	−27.0
Montenegro	2009	922.3	NA	137.6	NA	829.4	NA	72.2	NA
The Netherlands	2013	332.0	−39.2	90.1	−53.8	233.5	−31.9	45.1	−52.0
Norway	2013	334.7	−38.9	136.8	−49.0	235.1	−35.8	73.4	−48.3

continued

Table 2 *Continued*

Country	Latest year	Males				Females			
		CVD—total		CHD		CVD—total		CHD	
		Age-standardized mortality rate	10-Year change in mortality rate (%)	Age-standardized mortality rate	10-Year change in mortality rate (%)	Age-standardized mortality rate	10-Year change in mortality rate (%)	Age-standardized mortality rate	10-Year change in mortality rate (%)
Poland	2013	756.0	−23.9	190.8	−39.0	505.6	−26.5	99.0	−58.2
Portugal	2013	347.0	−40.1	88.6	−39.5	259.7	−42.9	48.0	−46.9
Republic of Moldova	2013	1380.2	−27.7	936.5	−31.8	1071.6	−28.0	706.4	−33.2
Romania	2012	1143.9	−25.2	400.3	−23.9	903.9	−25.8	284.1	−24.5
Russian Federation	2011	1423.1	−19.0	790.3	−10.4	914.0	−23.9	465.6	−9.1
San Marino	2005	516.6	−28.5	56.8	−51.0	322.0	−11.2	18.9	−71.0
Serbia	2013	990.9	−22.0	198.6	−27.8	836.4	−26.0	122.8	−34.3
Slovakia	2010	1048.1	−13.1	643.6	−4.8	758.5	−15.5	450.3	−7.6
Slovenia	2010	532.9	−30.6	175.2	−35.0	390.6	−26.3	86.2	−45.6
Spain	2013	292.4	−33.2	104.0	−35.8	221.5	−33.1	47.3	−41.9
Sweden	2013	414.8	−30.6	185.7	−40.6	292.3	−25.9	99.3	−38.7
Switzerland	2013	339.2	−30.0	141.0	−36.4	242.0	−27.7	74.4	−40.8
Tajikistan	2004	1332.5	4.8	550.3	−9.0	920.0	−12.8	340.4	−25.4
TFYR Macedonia	2010	1228.8	−6.3	187.6	−21.7	1012.5	−8.5	103.1	−21.5
Turkey	2013	582.7	NA	244.1	NA	458.2	NA	144.6	NA
Turkmenistan	1998	1748.3	17.5	1001.4	4.3	1300.0	15.5	677.4	3.2
Ukraine	2012	1544.9	−15.5	1077.4	−12.5	1065.8	−15.7	721.2	−9.8
UK	2013	334.3	−42.2	177.2	−44.3	227.9	−42.8	86.5	−48.7
Uzbekistan	2005	1492.4	−7.9	803.2	−23.0	1225.1	−7.4	604.8	−26.7

Rates are not available for Monaco due to missing population data. No mortality data are available for Andorra.
Age-standardized to the 2013 European Standard Population.
NA, not available.
[a]Change in rates for Georgia is over 11 years due to missing data for the year 10 years previous.
Source: WHO Mortality Database.

data more men die from cancer than CVD in 12 countries and in two countries for women. All of these countries are in Western Europe as defined by the GBD Study (2015),[14] with 9 of the 12 countries from the EU-15. This transition from CVD to cancer as the most common cause of death for men was first seen in France in 1998, with Spain (1999) the only other country to experience it before the year 2000. There were two countries in which cancer killed more individuals than CVD for both sexes, with this change occurring in the same year in Denmark (2010) and 3 years apart in Israel (*Table 3*). Those countries in which cancer overtook CVD as the most common cause of death earliest also now have higher ratios of cancer to CVD deaths, suggesting that trends of an increasing burden of cancer mortality compared with CVD mortality continue after this transition *Figure 2*.

Morbidity

Disability-adjusted life years

Disability-adjusted life years are a composite measure of years of life lost due to death from a condition and years lived with disability due to a condition. One DALY is therefore equivalent to 1 year of healthy life lost. Crude rates of WHO estimates for the number of DALYs attributable to CVD in 2012 for European countries were highest in

Table 3 European countries where the number of cancer deaths exceeds the number of deaths from CVD for men and women

Country	Latest year	Men *N* of deaths		Year of change	Women *N* of deaths		Year of change
		Cancer	CVD		Cancer	CVD	
Belgium	2012	15 920	14 299	2006			
Denmark	2012	8226	6442	2010	7613	6654	2010
France	2011	92 375	64 659	1988			
Italy	2012	99 794	99 661	2012			
Israel	2013	5455	4819	2009	5507	5217	2012
Luxembourg	2013	566	523	2010			
The Netherlands	2013	23 766	18 026	2004			
Norway	2013	5788	5630	2013			
Portugal	2013	15 746	13 981	2009			
Slovenia	2010	3245	3071	2007			
Spain	2013	67 711	53 487	1999			
UK	2013	87 511	79 935	2011			

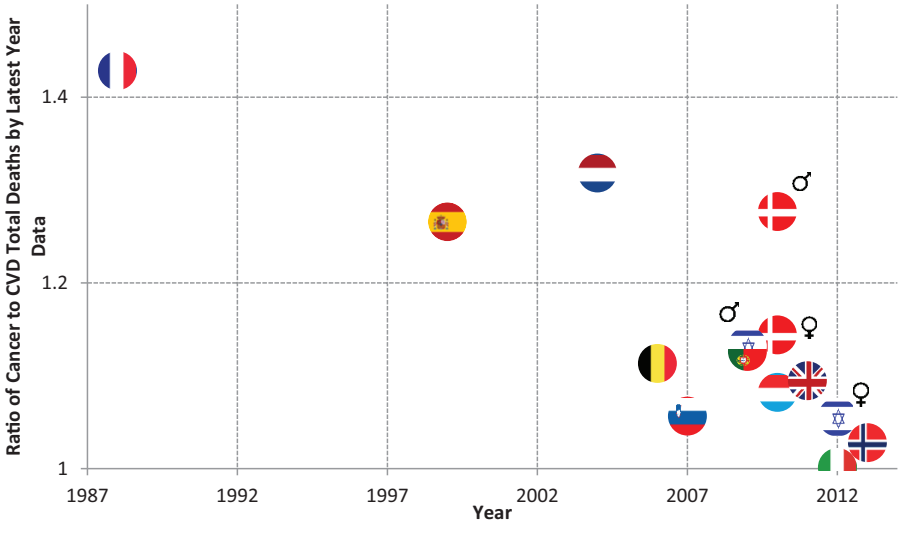

Figure 2 The year the higher absolute number of deaths changed from CVD to cancer by ratio of cancer to CVD deaths, by sex and European country. Note: Male Portugal and male Israel same year and similar ratio. Gender symbols are only included for countries in which the number of deaths from cancer is greater than the number of deaths from CVD for women as well as men: Israel and Portugal. Data for all other countries, i.e. those without a gender symbol, are for men only. Source: WHO Mortality Database.

Table 4 Estimated DALYs per 1000 population by cause and sex, WHO European Region 2012

	Cardiovascular diseases			Ischaemic heart disease			Stroke		
	All	Men	Women	All	Men	Women	All	Men	Women
Albania	100	102	98	43	49	38	39	36	42
Austria	61	63	58	29	34	23	10	9	10
Azerbaijan	75	85	65	44	52	35	19	19	19
Belarus	163	194	136	114	138	92	36	38	35
Belgium	51	56	46	21	27	15	11	11	11
Bosnia and Herzegovina	100	109	92	45	55	36	41	38	43
Bulgaria	167	187	149	74	87	62	58	58	57
Croatia	95	102	87	47	56	40	27	28	27
Cyprus	37	42	31	18	25	11	6	6	6
Czech Republic	85	94	76	47	56	38	15	15	16
Denmark	43	49	37	16	21	12	11	11	11
Estonia	110	126	95	52	64	41	15	16	14
Finland	63	76	51	33	43	24	13	13	13
France	40	44	36	12	15	8	9	9	9
Georgia	144	159	130	73	85	62	46	46	46
Germany	67	72	62	27	34	21	12	11	12
Greece	77	85	69	38	46	29	27	26	28
Hungary	114	128	102	61	71	51	23	25	22
Iceland	32	35	28	15	19	11	7	7	8
Ireland	35	40	29	20	25	15	7	7	8
Israel	26	28	23	10	13	8	6	6	5
Italy	54	57	51	21	25	16	13	13	14
Kazakhstan	124	146	103	71	86	57	36	35	36
Kyrgyzstan	76	89	64	44	51	37	22	25	20
Latvia	153	177	134	83	99	69	36	35	36
Lithuania	120	137	105	69	81	59	28	26	30
Luxembourg	39	41	36	12	16	9	9	9	10
Malta	51	58	44	31	38	24	11	12	10
Montenegro	112	114	110	40	57	23	32	39	26
The Netherlands	42	46	38	14	17	10	9	8	10
Norway	42	46	38	18	22	14	10	9	10
Poland	90	106	74	44	56	32	28	30	27
Portugal	47	52	43	15	19	11	18	19	17
Republic of Moldova	143	155	131	89	98	80	40	42	39
Romania	125	139	111	49	59	38	37	38	35
Russian Federation	181	217	150	107	136	82	58	59	57
Serbia	118	125	111	36	46	26	31	30	32
Slovakia	94	107	81	59	69	49	23	24	21
Slovenia	55	58	53	20	26	15	17	17	17
Spain	43	48	39	16	21	11	10	10	10
Sweden	55	60	50	24	29	19	12	11	13
Switzerland	41	44	37	16	21	12	8	7	8
Tajikistan	55	52	57	30	30	29	18	15	21
Turkey	62	72	53	29	36	22	19	21	17
Turkmenistan	127	150	104	80	99	62	29	30	28
Ukraine	194	214	177	135	151	121	46	45	46
UK	46	53	39	21	29	15	11	10	12
Uzbekistan	81	89	74	50	58	43	23	23	23

Source: World Health Organization, Health Statistics and Information Systems http://www.who.int/healthinfo/global_burden_disease/estimates/en/index2.html (accessed April 2016).[11]

Figure 3 Estimated DALYs per 1000 population for all cardiovascular diseases, coronary heart disease and stroke, WHO European Region 2012. Source: World Health Organization, Health Statistics and Information Systems: http://www.who.int/healthinfo/global_burden_disease/estimates/en/index2.html (accessed April 2016).

Table 5 Percentage of population reporting heart or circulation problems in the last 12 months, by country and sex 2014

	Male (%)	Female (%)	Both (%)
Austria	10.4	9.7	10.0
Belgium	8.3	9.3	8.8
Switzerland	7.4	6.7	7.0
Czech Republic	5.5	4.4	5.0
Germany	11.6	14.1	12.8
Denmark	8.6	7.3	8.0
Finland	13.0	10.9	11.9
France	7.6	7.7	7.6
Ireland	5.1	3.7	4.3
The Netherlands	12.4	7.5	9.7
Norway	7.5	5.8	6.7
Poland	14.7	20.2	17.7
Sweden	7.5	8.1	7.8
Slovenia	9.9	13.6	11.9
Total	9.2	9.2	9.2

Note: Percentages weighted to correct for unequal probabilities for selection. Source: ESS Round 7: European Social Survey Round 7 Data (2014). Data file edition 1.0. Norwegian Social Science Data Services, Norway—Data Archive and distributor of ESS data for ESS ERIC.

the Ukraine, with only five countries suffering CVD DALYs per 1000 population of more than 150: Ukraine (194/1000), Russian Federation (181/1000), Bulgaria (167/1000), Belarus (163/1000), and Lativa (153/1000). Five countries had DALYs attributed to CVD of <40/1000 individuals: Luxembourg (39/1000), Cyprus (37/1000), Ireland (35/1000), Iceland (32/1000), and Israel (26/1000). More DALYs were attributed to CVD and CHD in men than women in almost all countries, with Tajikistan the only country in which women suffered greater DALYs due to CVD than men. No country reported more DALYs for women than men for CHD; however this trend did not hold for stroke, with similar number of countries suffering higher DALYs for each of the sexes (*Table 4*, *Figure 3*).

Prevalence

Total prevalence of people reporting heart or circulation problems in the last 12 months in the European Social Survey, for all countries combined, was the same for both sexes at 9.2%. There were five countries in which more than 10% of men reported having heart or circulation problems: Poland (14.7%), Finland (13.0%), the Netherlands (12.4%), Germany (11.6%), and Austria (10.4%). This was the case for women in four countries: Poland (20.2%), Germany (14.1%), Slovenia (13.6%), and Finland (10.9%). Two countries reported a prevalence below 6% for men, Ireland (5.1%) and the Czech Republic (5.5%), and three for women, Ireland (3.7%), the Czech Republic (4.4%) and Norway (5.8%) (*Table 5*, *Figure 4*).

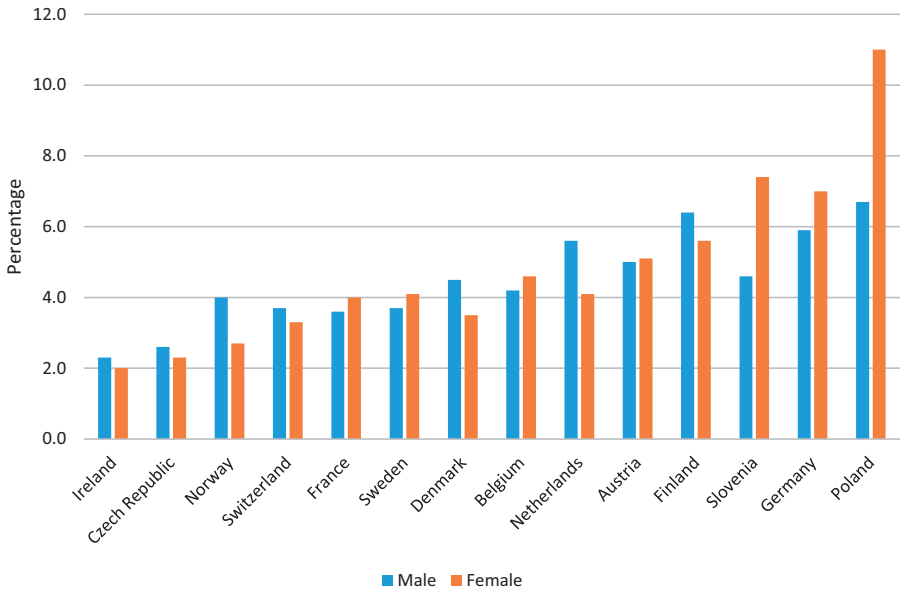

Figure 4 Percentage of population reporting heart or circulation problems in the last 12 months, by country and sex 2014. Note: Percentages weighted to correct for unequal probabilities for selection. Source: ESS Round 7: European Social Survey Round 7 Data (2014). Data file edition 1.0. Norwegian Social Science Data Services, Norway—Data Archive and distributor of ESS data for ESS ERIC.

Treatment

Hospital discharges

The WHO collates data on rates of hospital discharges for CVD, CHD, and stroke. The highest rates of hospitalization were in Belarus (last available year 2013) with 6276 hospital discharges for CVD per 100 000 population; this represented a 27% increase from 2000. The majority of countries had an increase in hospitalization rates from the year 2000 (*Table 6*). For CHD, the pattern was less clear with around half of countries demonstrating an increase in hospitalization rates and the other half experiencing a decrease. For stroke, 35 of the 52 countries experienced increases in hospitalization rates. It should be noted that the data are not age-standardized; therefore, changes in rates over time and differences between countries could be due to differences and changes in population age distributions.

Case fatality

Latvia had the highest case fatalities, age–sex standardized to the 2010 OECD population aged 45+, for both AMI and IS, measured through admission-based and patient-based outcomes. Although patient-based outcomes were greater than admission-based ones for all countries and both disease types, seven countries did not provide patient-based data and one country did not present any IS data (Poland). The lowest admission-based case fatalities for AMI were found in Sweden (4.5%) and Poland (4.7%), and the highest was found in Latvia (15.4%). Only two other countries had an admission-based case fatality for AMI >10%: Austria (10.0%) and Estonia (11.5%). Finland (5.1%) and Norway (5.4%) were the only countries to have admission-based case fatality for IS <6%; Estonia (13%), Slovenia (13.2%), and Latvia (18.4%) all reported IS case fatalities above 11%. On average, case fatality was lower for AMI than IS. However, six countries had admission-based case fatalities that were greater for AMI than IS: the Netherlands, Israel, UK, Norway, Spain, Finland, Germany, and Austria (*Table 7*).

Length of stay

Amongst OECD European countries the average length of stay (ALOS) following AMI was 6.7 days, with the shortest ALOS found in Denmark (3.9), Norway (4.0) and Sweden (4.7), with Slovakia the only other country to report an ALOS shorter than 5 days (4.9). ALOS following AMI was longest in Germany, the only country to report an ALOS of more than 10 days (10.3). Austria (8.1), Estonia (9.1), and Finland (8.3) were the only other countries to report ALOS of longer than 8 days (*Table 8*).

Summary and discussion

Mortality statistics show that CVD remains the most common cause of death in Europe, accounting for 45% of all deaths; 49% of deaths among women and 40% among men. More than 4 million people die from CVD across Europe every year, with 1.4 million of these deaths before the age of 75 years.

There remains evidence of wide inequalities across Europe in the burden of CVD mortality and the changes in rates of death from these diseases. In this article we demonstrate that along with the higher rates found in Eastern Europe, as discussed in the 2015 update,[8] EU member countries, on average, suffer a lesser burden from CVD mortality, with EU-15 countries that have been members of the EU the longest, on average experiencing the lowest burden. In addition the 12 countries in which the mortality burden from CVD decreased sufficiently, such that the number of deaths from CVD is less

Table 6 Hospital discharges for CVD, CHD, and cerebrovascular disease per 100 000 population, by country, 2000 to latest year

		Cardiovascular disease		Coronary heart disease		Cerebrovascular disease	
	Years available	2000[a]	Last available year	2000[a]	Last available year	2000[a]	Last available year
Albania	2000–12	540	929	157	202	80	155
Andorra	2000–13	586	824	126[b]	172	107[b]	123
Armenia	2000–13	639	1737	282	710	130	257
Austria	2000–09	3674	3697	757	881	679	565
Azerbaijan	2000–13	472	708	154	289	45	87
Belarus	2000–13	4577	6276	2212	3171	896	1236
Belgium	2000–08	2356	2173	736	616	390	353
Bulgaria	2000–10	1869	3617	542	1196	426	589
Croatia	2000–10	1760	1847	495	488	411	393
Cyprus	2000–08	818	672	332	198	140	120
Czech Republic	2000–10	3261	3086	1041	715	619	547
Denmark	2000–10	2543	2634	790	720	452	363
Estonia	2000–09	3176	3327	1095	900	492	714
Finland	2000–07	3785	2913	1160	791	658	550
France	2000–09	2307	2282	503	498	222	228
Georgia	2000–13	454	1341	194	559	74	193
Germany	2000–09	3267	3500	1060	890	462	530
Greece	2000–07	2309	2786	777	951	404	449
Hungary	2000–10	4239	3678	1113	716	832	995
Iceland	2000–09	1863	1440	724	525	237	179
Ireland	2000–10	1420	1154	457	352	250	163
Israel	2000–08	1911	1482	823	501	259	235
Italy	2000–09	2582	2120	600	503	489	432
Kazakhstan	2000–13	1314	2044	419	732	210	494
Kyrgyzstan	2000–13	1041	1451	322	689	153	290
Latvia	2000–10	3151	3078	1266	1066	640	642
Lithuania	2000–10	4102	4765	1415	1469	780	968
Luxembourg	2000–07	2610	2172	818	606	232	168
Malta	2000–10	666	1346	184	350	79	158
Monaco	2012 only	4004	4004	385	385	338	338
Montenegro	2000–13	1400	1705	421	555	169	280
The Netherlands	2000–09	1403	1694	523	528	184	239
Norway	2000–10	2349	2368	876	880	320	306
Poland	2003–09	2880	2885	958	811	370	336
Portugal	2000–10	1118	1307	275	299	334	290
Republic of Moldova	2000–13	1315	2516	419	710	271	607
Romania	2000–10	2422	2982	752	330	328	575
Russian Federation	2000–13	2763	3653	1103	1331	595	871
San Marino	2011–13	1642	1521	284	272	256	336
Serbia	2000–12	1455	2199	373	670	338	439
Slovakia	2000–10	2443	2689	955	749	452	461
Slovenia	2000–09	1685	1976	366	411	230	232
Spain	2000–09	1333	1295	363	289	213	221
Sweden	2000–09	2630	2334	890	621	506	429
Switzerland	2002–09	1699	1729	518	469	212	222
Tajikistan	2000–12	533	1072	122	306	38	90
TFYR Macedonia	2000–10	1267	1722	480	551[c]	218	261[c]
Turkey	2000–10	954	1502	216	666	155	149
Turkmenistan	2000–13	1405	1984	416	733	132	258

continued

Table 6 *Continued*

	Years available	Cardiovascular disease		Coronary heart disease		Cerebrovascular disease	
		2000[a]	Last available year	2000[a]	Last available year	2000[a]	Last available year
Ukraine	2000–13	2612	3913	1197	1905	540	949
UK	2000–10	1422	1291	523	403	204	225
Uzbekistan	2000–13	959	1688	300	553	79	143

'Years available' column refers to Cardiovascular disease data only.
[b]From 2001 and [c]until 2007, correspond to CHD and cerebrovascular disease data only.
[a]Some countries start from later years.
[b]From 2001.
[c]Until 2007.
Source: World Health Organization Regional Office for Europe. European Health for All Database.[12]

Table 7 **Case-fatality rates after AMI and stroke, latest year, by country**

Country	Year	Case fatality after acute myocardial infarction		Case fatality after ischaemic stroke	
		Admission based	Patient based	Admission based	Patient based
Austria	2013	10.0	—	6.4	—
Belgium[a]	2013	7.3	—	9.3	—
Czech Republic	2013	6.7	10.5	9.6	13.0
Denmark[a]	2013	5.7	8.3	9.1	10.2
Estonia	2013	11.5	13.1	13.0	13.2
Finland	2013	6.5	8.5	5.1	6.8
France	2013	7.2	—	7.9	—
Germany	2013	8.7	—	6.4	—
Iceland	2013	6.9	—	8.0	—
Ireland[a]	2013	6.4	—	9.7	—
Israel[a]	2013	6.7	8.8	6.0	8.1
Italy	2013	5.5	7.5	6.2	9.0
Latvia	2013	15.4	19.1	18.4	27.0
Luxembourg[a]	2012	7.0	10.5	9.1	11.1
The Netherlands[a]	2011	7.6	7.7	7.1	9.6
Norway	2013	6.7	7.6	5.4	8.4
Poland	2013	4.7	8.2	—	—
Portugal	2013	9.4	10.4	10.2	10.8
Slovak Republic[a]	2012	7.2	—	10.8	—
Slovenia	2013	5.2	9.0	13.2	14.9
Spain	2013	7.8	8.2	9.7	9.9
Sweden[a]	2013	4.5	8.3	6.4	9.6
Switzerland	2013	7.7	8.9	6.9	8.2
UK[a]	2013	7.6	9.1	9.2	10.6

Case-fatality rate measures the percentage of people aged 45 and over who die within 30 days following admission to hospital for a specific acute condition.
Total rates have been age–sex standardized to the 2010 OECD population (45+).
Admission-based rates refer to death occurring in the same hospital as the initial admission.
Patient-based rates refer to death occurring in the same hospital as the initial admission, a different hospital, or out of hospital.
Three-year average for Iceland and Luxembourg.
[a]Admissions resulting in a transfer are included.
Source: OECD Health Statistics 2015, http://dx.doi.org/10.1787/health-data-en.

than that from cancer in men, along with the two countries in which this has happened in women, are all found in Western Europe.

Although death rates for all countries were age-standardized for between-country and across time comparability, it should be noted that these rates are only standardized for the age structure of the population and do not standardize other aspects of these populations. For example, migration and other features of population structure may vary between countries and across the years of data

Table 8 Average length of hospital stay following AMI, latest year, by country

Country	Year	Average length of stay
Austria	2013	8.1
Belgium	2012	6.9
Czech Republic	2013	6.1
Denmark	2010	3.9
Estonia	2013	9.1
Finland	2013	8.3
France	2013	6.0
Germany	2013	10.3
Greece	2010	6.1
Hungary	2012	7.9
Iceland	2013	5.5
Ireland	2013	7.1
Israel	2013	6.0
Italy	2013	7.8
Luxembourg	2013	6.9
The Netherlands[a]	2012	5.6
Norway	2010	4.0
Poland	2013	6.2
Portugal	2009	7.9
Slovakia	2012	4.9
Slovenia	2013	7.4
Spain	2013	7.3
Sweden	2010	4.7
Switzerland	2012	7.3
UK	2013	7.1

Average length of stay (ALOS) provides the mean number of days the patients spend in hospital.
Excluding day cases.
Data cover all inpatient cases with the exception of the Netherlands.
[a]Only curative/acute admission cases are considered, not all inpatient cases.
Source: OECD Health Statistics 2015, http://dx.doi.org/10.1787/health-data-en.

presented here, but these changes are not accounted for when standardizing using the ESP13.

The burden of CVD in Europe is not confined to mortality and this is the first time in this series of papers that we present data on DALYs and prevalence. DALYs, presented here as crude population rates, were higher in Eastern European countries; however, as these rates are not standardized for age or sex, some differences may be due to different population distributions between countries. The European Social Survey collects self-reported data from individuals on whether they have suffered heart or circulation problems and once again show large inequalities in prevalence between countries. It should be noted that self-reported prevalence estimates can be subject to recall and reporting bias. An apparently higher prevalence may also be an indication of more efficient identification and diagnosis of these conditions in the population, such that it does not account for undiagnosed CVD, which may cause a large hidden burden to countries. In addition, although the European Social Survey asks participants to report whether they have suffered these problems in the past 12 months, it may not account for individuals who have ever suffered CVD problems, which would provide a more meaningful measure of prevalence, i.e. those who have recovered from heart or circulation problems, or who are having it controlled, may report that they do not currently suffer such problems. In addition, as there is no measure of whether the problems started in the preceding 12 months or earlier, this cannot be used as a measure of incidence. With such prevalence and incidence data unavailable from a central source the survey provides the best cross-European data we have identified.

Increasing hospitalization rates demonstrate an increasing burden of CVD in health systems despite decreasing mortality rates. Differences between countries in rates of discharge may be a reflection of health service access and efficiency as well as CVD burden. It is influenced by not only the quality of care provided in hospitals but also differences in hospital transfers, average length of stay, and severity of condition on admission.[15] A number of factors can help to reduce case-fatality, including access to high-quality acute care, timely transportation of patients, evidence-based medical interventions, and high-quality specialized health facilities for AMI and stroke.[15]

Several factors can explain differences between countries in length of stay following CVD events. In addition to the clinical need of the patient, these variations are also likely to reflect differences in clinical practices and payment systems. In order to encourage shorter ALOS many countries have adopted a number of options, including increased uptake of less invasive surgical procedures, changes in hospital payment methods, and support for hospitals to improve the coordination of care across diagnosis, treatment and follow-up.[15] The average length of stay (ALOS) in hospitals is often regarded as a good indicator of health system efficiency as shorter stays should result in a smaller financial burden on the health service of that country. However, although a correlation has been found between average hospital costs and ALOS following AMI, too short an ALOS could also cause adverse effects on health outcomes, meaning that costs per episode of illness may fall only slightly, or even rise.[16,17] In addition, a life-threatening illness such as AMI can have a profound psychological effect on patients and they may not be emotionally prepared for discharge at 72 h even if no complications have occurred.[18]

In addition to the limitations of the data described in the Methods and Discussion, the main limitation of this article is that it aims to be a descriptive piece compiling data on CVD in Europe, to provide an overview of the burden of CVD across the continent. It cannot, therefore, explain some of the patterns in CVD that are presented throughout it. In addition, as the study does not have access to the raw data on many occasions, we are not able to present measures on the robustness of all the statistics we present here. In addition, where we do report data and standardize them using crude or age-standardized population rates, we cannot account for migration, non-citizens, and other features of population structure.

This latest update on the epidemiology of CVD within Europe presents new evidence on the inequality in CVD burden, described through mortality, morbidity, and treatment throughout Europe. This supports calls for more research into improved outcomes in Western and EU countries and the collection of improved data to make comparisons on mortality and morbidity between countries, in order that interventions can be better targeted to combat inequalities. In particular incidence and prevalence data across Europe are

weak in comparison to mortality statistics and these along with data on the hidden burden of CVD, i.e. CVD conditions that are currently not identified by health services or within national statistics, would be invaluable to epidemiologists and those working in public health.

Supplementary material

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

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