



**THE STATE OF  
CARDIOVASCULAR  
DISEASE IN G20+  
COUNTRIES**

**PREPARED BY**  
HEALTH SYSTEMS INNOVATION LAB  
AT HARVARD UNIVERSITY



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# Acknowledgements

## About the Report

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## 1.0 Cardiovascular Disease: the silent pandemic

### **Cardiovascular Disease is the #1 cause of deaths globally**

Cardiovascular Disease (CVD) is #1 cause of death globally and in 2019 led to 18.6 million deaths worldwide.

Worldwide, the number of years of life lost to CVD has increased since 2010, reaching 81.6 million years of life (YLL) lost in China, 14.8 million YLL in the United States (US) and 8.1 million YLL in Indonesia.

In G20+, CVD is #1 cause of mortality in 40% of the countries, #2 cause in 55% of countries.

Among the G20+, the top 10 countries with the highest CVD mortality rates are the Russian Federation, European Union, Indonesia, Saudi Arabia, China, India, South Africa, Turkey, Argentina, and Brazil.

After a period of decline from 1990-2010, CVD mortality rates have increased in most G20+ countries.

### **Cardiovascular Disease is #1 cause of morbidity globally**

From 1990 to 2019, the worldwide prevalence of CVD increased from 271 million people to reach a staggering 523 million people.

In G20+, CVD is #1 cause of morbidity in 40% of the countries, #2 cause in 55% of countries, and #3 in the remaining 5% of countries.

Worldwide, the CVD burden in 2019 was 393 million disability-adjusted life years (DALYs) and in G20+ amounted to 220 million DALYs, accounting for 91.9 million DALYs in China, 17.3 million, DALYs in the US and 16.5 million DALYs in Indonesia.



### **Direct cost of CVD in G20+ health systems exceeds \$600 billions each year**

CVD cost more than \$600 billion to G20+ health systems each year: \$244.8 billion in the United States, \$54.4 billion in Germany and \$49.5 billion in Japan.

The direct cost of CVD as a proportion of total health system expenditure ranges from 11% to 15%. Economic costs (direct healthcare cost plus the indirect cost of illness, e.g., those due to loss in productivity and human capital) are even higher and amounted to US\$402.2 billion in the US and Japan US\$109.6 billion in Japan.

### **G20+ health systems are struggling to effectively address CVD**

Many G20+ countries have achieved reductions in amenable mortality with France achieving the lowest amenable mortality rate due to CVD (19 per 100,000), but in others such as China amenable mortality rates have risen.

In G20+, on average, only 48% of patients at risk of CVD are prescribed primary preventive medications. In some G20+ countries, this figure is just 26.5%.

In G20+ just 26-90% of CVD patients were prescribed at least one secondary preventive medication, despite the recommendations that 4+ medications are needed.

In G20+ countries, there are wide inequalities in the prevention of CVD risk, access to CVD care and CVD outcomes.

### **CVD is a major driver of COVID-19 hospitalisations and deaths worldwide**

COVID-19 pandemic has severely undermined the fight against CVD: patients with CVD could not use health systems that were overwhelmed with COVID-19: ischaemic heart disease-related admission fell 18.9% in Germany and 59.9% in Argentina, but those who could access health services presented with higher severity of CVD.

The majority of severe COVID-19 occurs in individuals with CVD. Individuals with CVD and COVID-19 also have a 4-fold higher risk of death from COVID-19.

## 2.0 Cardiovascular Disease: the silent pandemic

Cardiovascular disease (CVD) is the commonest cause of death globally. In 2019, the latest year for which figures are available, 18.6 million people died from CVD globally. Cardiovascular disease is also the commonest cause of death in G20+ countries<sup>1</sup>, the focus of this report. We do not report separately on EU member countries that are not individually a member of the G20+, but instead include an average for the EU as a constituent member of G20+.

CVD, which includes, among others, Ischaemic Heart Disease, Stroke and Hypertensive Heart Disease, is the leading cause of disease in the G20+ countries and ranks number 1 or 2 in terms of prevalence. Most individuals with CVD die prematurely, and many with CVD suffer from its ill effects – creating a major health, social and economic burden for individuals, households, communities and countries. Yet, most of these CVD deaths are preventable and CVD deaths and disease burden could be reduced substantially if existing cost-effective interventions for prevention and treatment were used widely in health systems. However, most health systems in the G20+ countries have struggled to scale-up these interventions to effectively manage CVD.

This report uses the latest data (2019 or the nearest year) from the Organization for Economic Cooperation Development (OECD), Institute for Health Metrics and Evaluation (IHME), and four literature searches (See appendix A for methodology), to provide a comprehensive overview of CVD in G20+ countries. The report presents an analysis in relation to incidence and prevalence, burden of disease, mortality levels, cost of CVD to health systems, economic cost of CVD, health system performance in responding to the challenge of the silent pandemic, and the effect of COVID-19 on the trajectory of CVD. The report identifies examples of G20+ countries that have been relatively more successful in the fight against CVD and those where the burden of disease and mortality from CVD have continued to rise.

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<sup>1</sup> G20+ includes Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom, the United States, the European Union and Spain.

## 2.1 Cardiovascular Disease Prevalence

In G20+ CVD prevalence (Figure 2.1a) was highest in the European Union (11,646.7 per 100,000 population), Saudi Arabia (7,917 per 100,000) and the United States (7,617 per 100,000), and lowest in Korea (4,518 per 100,000), Mexico (4,977 per 100,000), and Spain (5,029 per 100,000). Italy, the Russian Federation, Canada, South Africa, Australia, Turkey, and China were ranked in the top 10 for CVD prevalence (Appendix B Table 1).

The prevalence of Ischaemic Heart Disease (IHD) (Figure 2.1b), the most common CVD, was highest in Saudi Arabia (5,229 per 100,000), European Union (3,998 per 100,000), and Russia (3,577 per 100,000). Korea, Argentina, and Japan had the lowest IHD prevalence (950, 1,058, and 1,084 per 100,000 respectively) (Appendix B Table 2).

By contrast, the prevalence of Stroke (Figure 2.1c), the second most common CVD, was highest in Indonesia (2,097 per 100,000), Saudi Arabia (1,968 per 100,000), and China (1,469 per 100,000) (Appendix B Table 3). The lowest stroke prevalence was in Italy (633 per 100,000), France (635 per 100,000), and Australia (651 per 100,000).

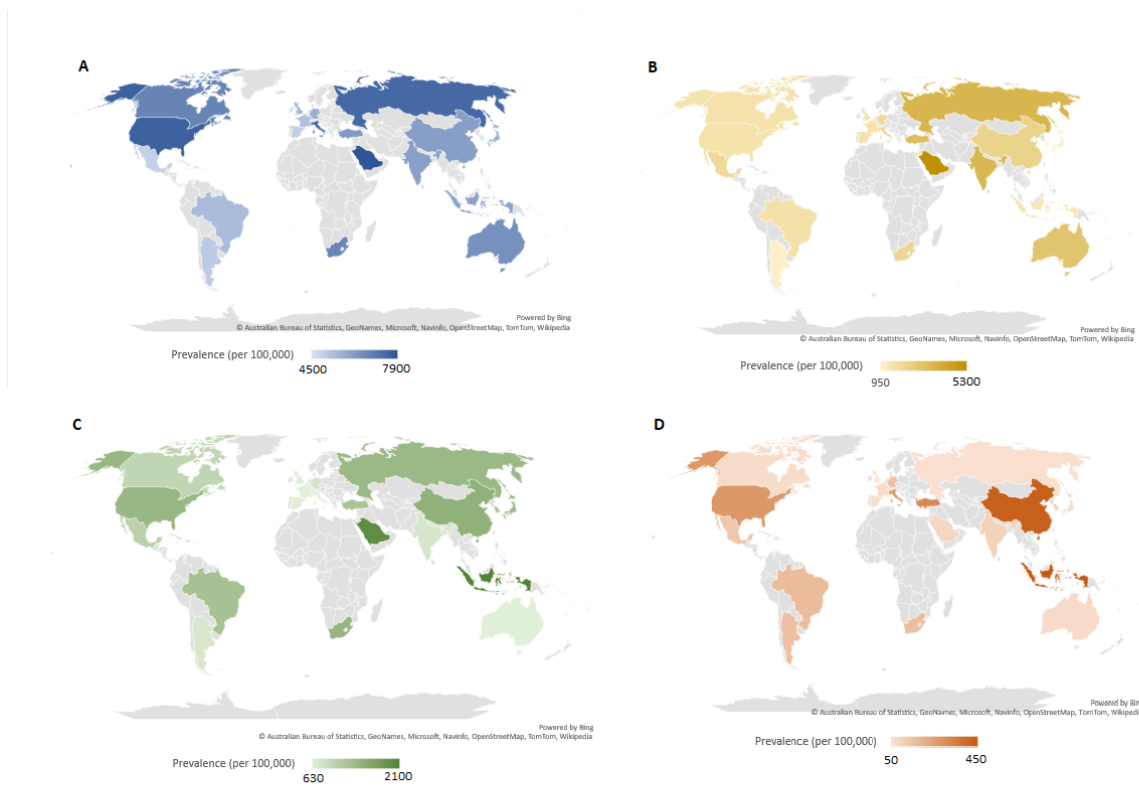
The prevalence of Hypertensive Heart Disease (HHD) (Figure 2.1d), the third most common CVD was highest in Indonesia (452 per 100,000), China (434 per 100,000), and the European Union (319 per 100,000) (Appendix B Table 4), with the lowest levels observed in the United Kingdom (53 per 100,000), the Russian Federation (71 per 100,000), and Spain (72 per 100,000).

Figure 2.1a Age-standardised Prevalence of Cardiovascular Disease in 2019 by G20+ Country, 2019

Figure 2.1b Age-standardised Prevalence of Ischaemic Heart Disease in 2019 by G20+ Country, 2019

Figure 2.1c Age-standardised Prevalence of Stroke in 2019 by G20+ Country, 2019

Figure 2.1d Age-standardised Prevalence of Hypertensive Heart Disease in 2019 by G20+ Country, 2019



Source: Global Burden of Disease, 2019

## 2.2 Cardiovascular Disease Incidence

CVD incidence rates vary greatly in G20+ countries (Figure 2.2a). European Union has the highest incidence (1,149 per 100,000 respectively), followed by Russia and Saudi Arabia (987 and 978 per 100,000 respectively). Korea, Brazil, and Mexico have the lowest incidence rate (424, 475, and 482 per 100,000 respectively). The remaining top 10 countries with highest incidence rates included India, Australia, Italy, United States, South Africa, Turkey, and China (Appendix B Table 5).

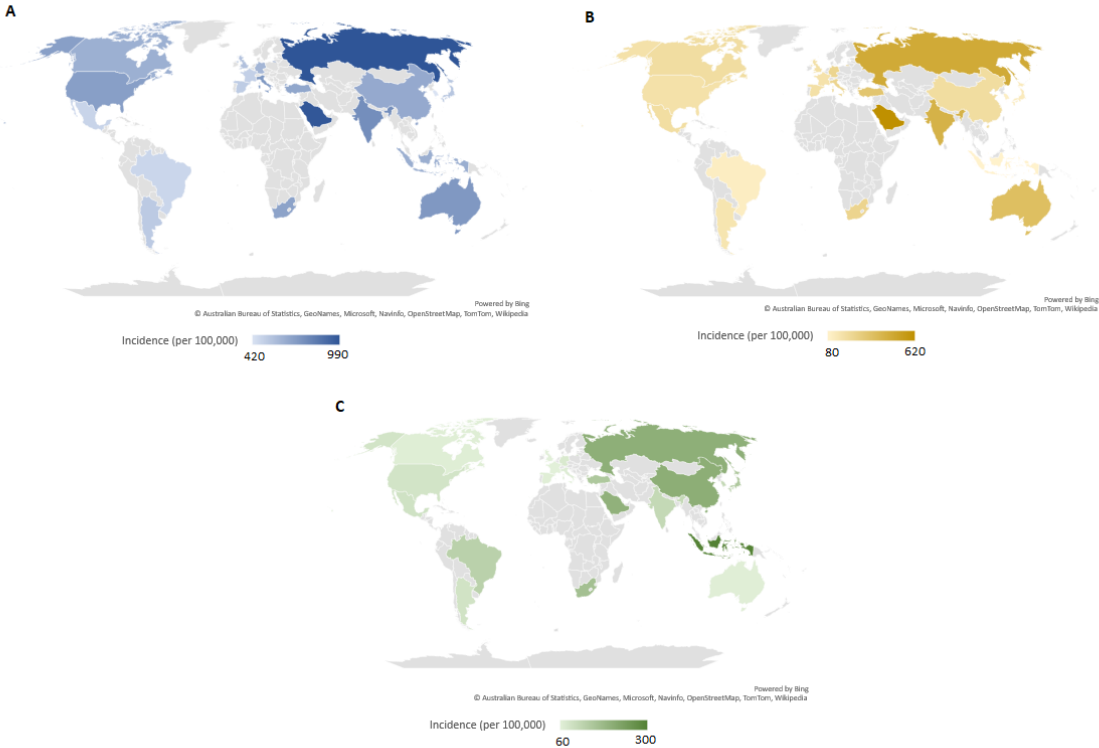
Similarly, the incidence rate of ischaemic heart disease (Figure 2.2b) is highest in Saudi Arabia (613 per 100,000 respectively, followed by the Russian Federation and the European Union (470 and 433 per 100,000 respectively). Indonesia, Korea, and Brazil have the lowest incidence rates (84, 106, and 110 per 100,000 respectively).

The incidence rates for stroke (Figure 2.2c) are highest in Indonesia (293 per 100,000) China (201 per 100,000), and the Russian Federation (198 per 100,000), and lowest in France, the United Kingdom, and Australia (61, 63, and 65 per 100,000 respectively).

Figure 2.2a Age-standardised Incidence of Cardiovascular Disease in 2019 by G20+ Country, 2019

Figure 2.2b Age-standardised Incidence of Ischaemic Heart Disease in 2019 by G20+ Country, 2019

Figure 2.2c Age-standardised Incidence of Stroke in 2019 by G20+ Country, 2019



Source: Global Burden of Disease, 2019

## 2.3 Cardiovascular Disease Mortality

In G20+, there were more than 14 million CVD deaths in 2019. The Russian Federation, European Union, and Indonesia have the highest CVD mortality rates (433, 389, and 383 per 100,000, respectively) (Figure 2.3a). Japan, France, and Korea have the lowest mortality rates (77, 91, 95 per 100,000, respectively). The remaining countries with the 10 highest mortality rates include Saudi Arabia, China, India, South Africa, Turkey, Argentina, and Brazil (Appendix B Table 8).

In G20+, in 2019, almost 7 million of the overall CVD-related deaths were due to ischaemic heart disease (IHD). The highest mortality rates for IHD (Figure 2.3b) were in the Russian Federation, Saudi Arabia, and the European Union (241, 206, and 189 per 100,000, respectively). The lowest mortality rates for IHD were in Japan (30 per 100,000), Korea (35 per 100,000), and France (38 per 100,000 respectively). The remaining top 10 countries with highest incidence rates included India, Indonesia, Turkey, China, Mexico, the United States, and Argentina (Appendix B Table 9).

Just over 5 million of the overall CVD-related deaths were due to stroke in G20+ in 2019. The highest mortality rates for stroke (Figure 2.3c) were in Indonesia (197 per 100,000), the Russian Federation (140 per 100,000), and China (127 per 100,000). The lowest mortality rates were observed in Canada (24 per 100,000), France (25 per 100,000) and Australia (26 per 100,000). The top 10 countries with the highest mortality rates from stroke included the European Union, Saudi Arabia, South Africa, India, Turkey, Brazil, and Argentina (Appendix B Table 10).

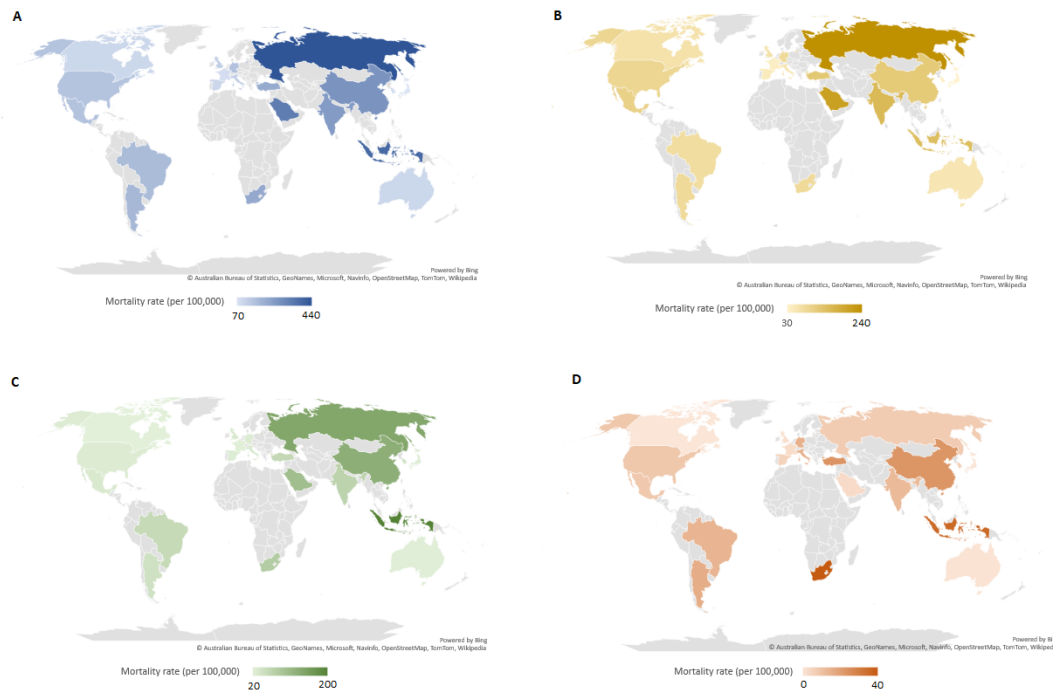
Approximately 880,000 of the overall CVD-related deaths were due specifically to hypertensive heart disease (HHD) in G20+. The highest mortality rates for HHD (Figure 2.3d) occurred in South Africa (34 per 100,000), Indonesia (31 per 100,000), and the European Union (28 per 100,000). The lowest mortality rates were observed in Canada and Japan (2 per 100,000 for both), followed by Australia (3 per 100,000). Countries with the highest mortality rates included Turkey, China, Argentina, Germany, Italy, Brazil, and India (Appendix B Table 11).

Figure 2.3a Age-standardised Mortality Rate of Cardiovascular Disease in 2019 by G20+ Country, 2019

Figure 2.3b Age-standardised Mortality Rate of Ischaemic Heart Disease in 2019 by G20+ Country, 2019

Figure 2.3c Age-standardised Mortality Rate of Stroke in 2019 by G20+ Country, 2019

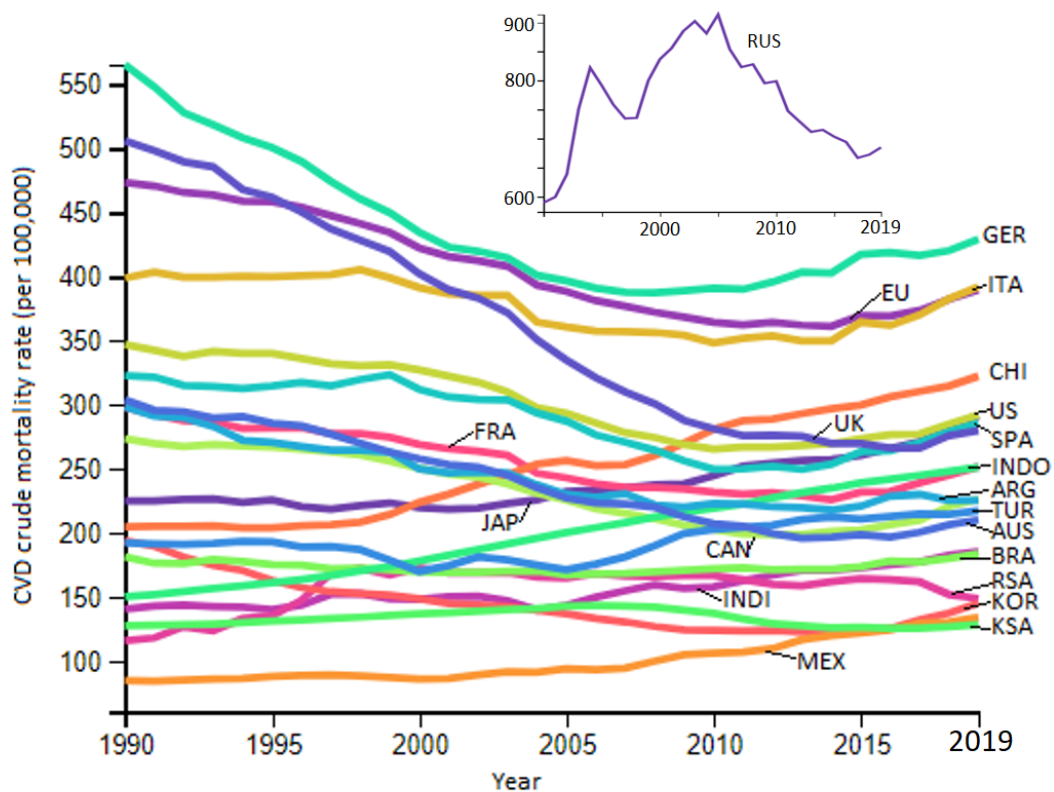
Figure 2.3d Age-standardised Mortality Rate of Hypertensive Heart Disease in 2019 by G20+ Country, 2019



Source: Global Burden of Disease, 2019

In terms of crude CVD mortality rates, from 2000 to 2019, among the G20+, the Russian Federation had the largest decline in CVD mortality rate over time (from 837 to 685 per 100,000), followed by the United Kingdom (from 402 to 280 per 100,000), and Australia (from 258 to 210 per 100,000). By contrast, China, Indonesia, and Japan experienced the greatest increase in CVD mortality rates over this time period (from 224 to 322 per 100,000, from 178 to 251 per 100,000, and from 220 to 291 per 100,000, respectively) (Figure 2.4). After a period of decline from 1990-2010, and plateauing rates in 2010-15, between 2015 and 2019 almost all G20+ countries experienced an increase in CVD mortality rate (Figure 2.4).

Figure 2.4 Cardiovascular Disease Mortality rates for G20 + Countries from 1990 to 2019



Note: CVD: Cardiovascular disease; ARG: Argentina; AUS: Australia; BRA: Brazil; CAN: Canada; CHI: China; EU: European Union; FRA: France; GER: Germany; INDI: India; INDO: Indonesia; ITA: Italy; JAP: Japan; KOR: Korea; KSA: Saudi Arabia; MEX: Mexico; RSA: South Africa; RUS: the Russian Federation; SPA: Spain; TUR: Turkey; UK: United Kingdom; US: United States

Source: Global Burden of Disease, 1990 to 2019

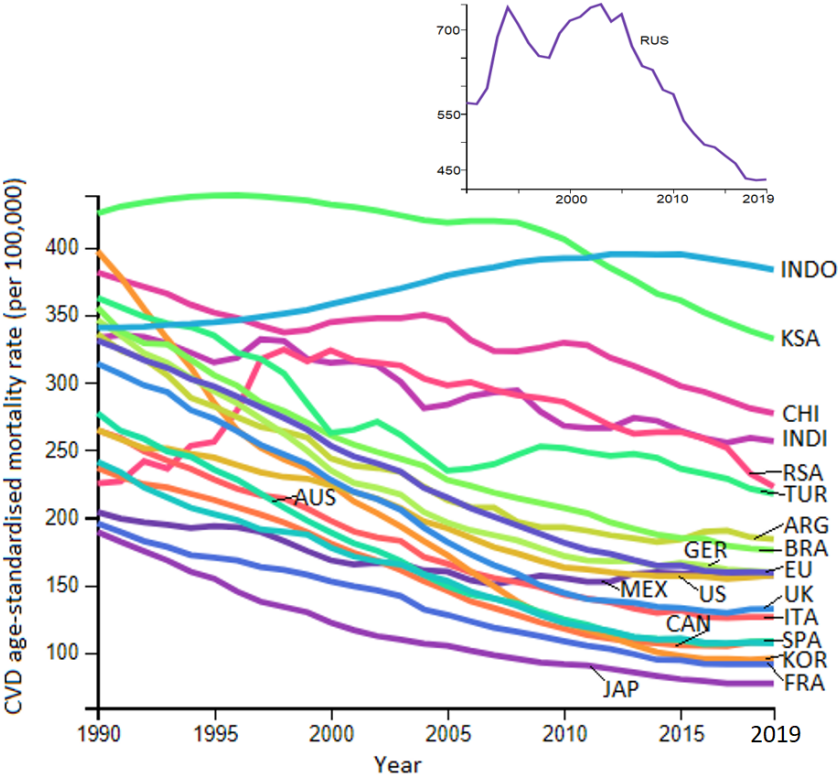
In terms of age-standardised<sup>2</sup> CVD mortality rates, from 2000 to 2019, among G20+ countries, the Russian Federation experienced the largest decline in CVD mortality rate (from 718 to 433

<sup>2</sup> Age-standardised values define as “a weighted average of the age-specific rates, where the weights are the proportions of a standard population in the corresponding age groups”. (Lopez AD, Mathers CD, Ezzati M, et al., editors. Global Burden of Disease and Risk Factors. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2006. Glossary. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK11818/> Co-published by Oxford University Press, New York.)



per 100,000), followed by Korea (from 225 to 95 per 100,000) and South Africa (from 324 to 223 per 100,000). Between 2000 and 2019, among the G20+ countries, only Indonesia experienced an increasing trend in age-standardised CVD mortality rates over time (from 358 to 383 per 100,000). Between 2015 and 2019, the decline in age-standardised CVD mortality in G20+ countries had plateaued (Figure 2.5). When compared with the crude rates, the age-standardised values in the United Kingdom and Australia did not show large declines.

Figure 2.5 Age standardised Cardiovascular Disease Mortality rates: G20 + Countries, 1990- 2019



Note: CVD: Cardiovascular disease; ARG: Argentina; AUS: Australia; BRA: Brazil; CAN: Canada; CHI: China; EU: European Union; FRA: France; GER: Germany; INDI: India; INDO: Indonesia; ITA: Italy; JAP: Japan; KOR: Korea; KSA: Saudi Arabia; MEX: Mexico; RSA: South Africa; RUS: Russia; SPA: Spain; TUR: Turkey; UK: United Kingdom; US: United States

Source: Global Burden of Disease, 1990 to 2019

## 2.2 Disease Burden

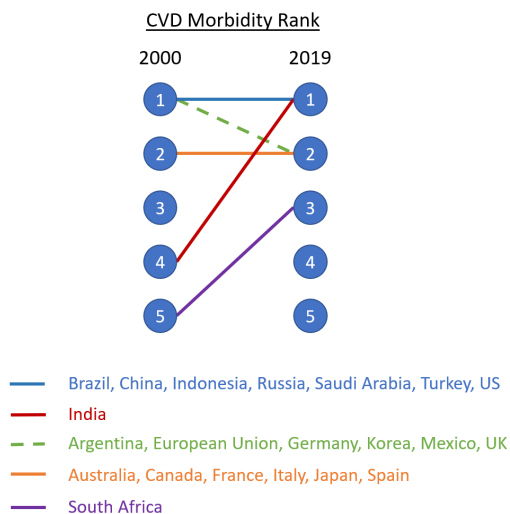
Disease burden is a combined measure of the adverse effects of a disease on the quality of life and the loss of life due to that condition. It is measured using the composite metric disability-adjusted life years (DALYs). More DALYs are expected in absolute terms in more populous countries.

### 2.2.1 Morbidity Rank

Morbidity Rank, in DALYs, is a way to understand which diseases cause the greatest morbidity in a country. For most of the G20+ countries, cardiovascular disease and neoplasms are either the number one or number two ranked causes of morbidity.

For the G20+ countries, CVD was the number one ranked cause of morbidity in 11 countries in 2000 (55%), and 8 countries in 2019 (40%). Whereas, while CVD was the number two ranked cause of morbidity in 6 countries in 2000 (30%) by 2019 it had increased to 11 countries (55%). Overall, in G20+ countries CVD has remained the number one or two ranked cause of morbidity in at least 95% of the countries over the past 20 years (Figure 2.6).

Figure 2.6 Change in Morbidity Rank from 2000 to 2019



Source: Institute for Health Metrics and Evaluation (IHME). GBD Compare. Seattle, WA: IHME, University of Washington, 2015. Available from <http://vizhub.healthdata.org/gbd-compare>. (Accessed January 10, 2022)

## 2.2.2 Disability Adjusted Life Years

In G20+, CVD was responsible for 285 million DALYs in 2019. The highest number of DALYs were in China (91,933,122), India (64,946,470.44), and the Russian Federation (19,129,124). As expected, the highest number of DALYs occurred in countries with large populations. The lowest number of DALYs occurred in Australia (786,856), Canada (1,402,599), and Korea (1,409,203).

Of the 285 million DALYs for CVD, 131 million DALYs (46%) were due to ischaemic heart disease. The highest number occurred in India (37,233,847), China (34,685,806), and the Russian Federation (9,935,306). The lowest number of DALYs were in Australia (372,504), Korea (440,565), and South Africa (648,992).

58 million (37%) of the overall CVD-related DALYs were due to stroke. The highest number of DALYs occurred in China (45,949,134), India (17,332,326), and Indonesia (8,407,229). The lowest number of DALYs occurred in Australia (188,907), Canada (328,851), and Saudi Arabia (417,599).

Approximately 13 million (5.1%) of the DALYs were directly attributable to hypertensive heart disease. The highest DALYs were in China (5,594,910), India (2,255,792), and Indonesia (1,798,343). The lowest number of DALYs occurred in Australia (17,007), Saudi Arabia (21,505), and Canada (26,072).

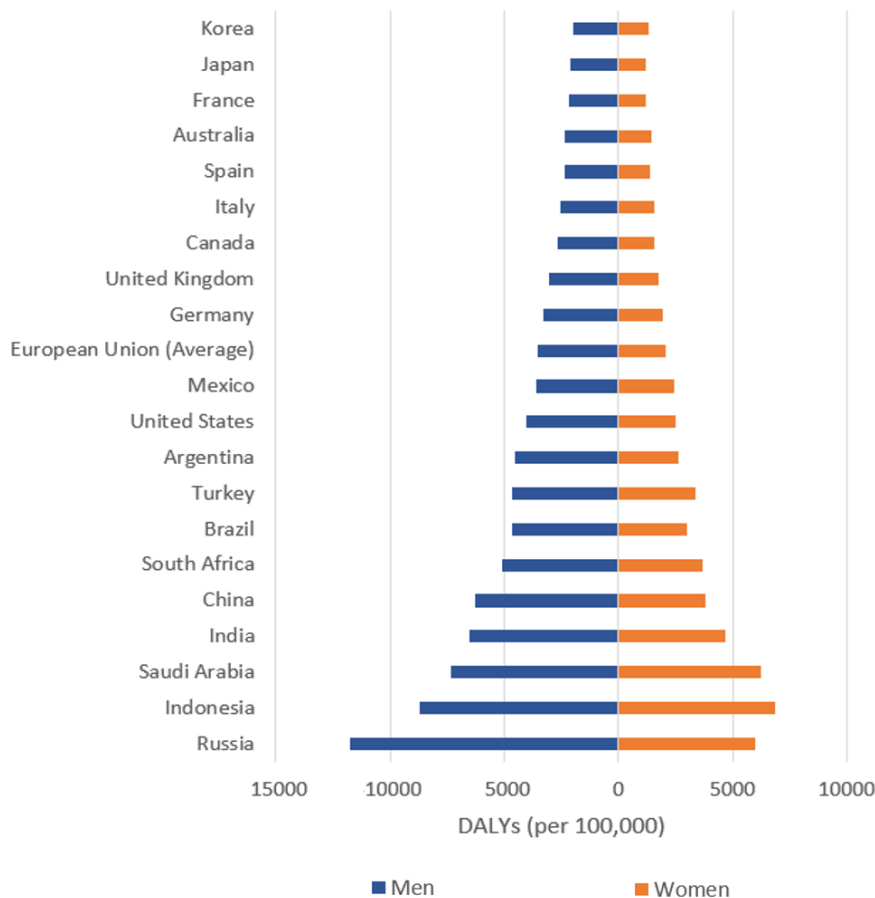
The rate of age-standardised CVD-related DALYs per 100,000 people enables comparison between countries of different population sizes and age structures (Figure 2.7). The highest rate of CVD-related DALYs was observed in the Russian Federation (8,477 per 100,000) and Indonesia (7,778 per 100,000), followed by Saudi Arabia (6,899 per 100,000). The lowest rate of DALYs due to CVD were in Japan (1,620 per 100,000), France (1,628 per 100,000), and Korea (2,639 per 100,000) (Fig 2.7).

For ischaemic heart disease, the highest rate of DALYs occurred in the Russian Federation (4,301 per 100,000) and Saudi Arabia (4,222 per 100,000), followed by India (3,201 per 100,000) (Fig 2.8). The lowest rate of DALYs were observed in Korea (518 per 100,000), Japan (529 per 100,000) and France (634 per 100,000) (Fig 2.8).

For stroke, the highest rate of DALYs were in Indonesia (4,008 per 100,000), the Russian Federation (2,601 per 100,000), and China (3,231 per 100,000) (Fig 2.8). The lowest rate of DALYs were in Australia (445 per 100,000) and France (454 per 100,000), followed by Canada (486 per 100,000) (Fig 2.8).

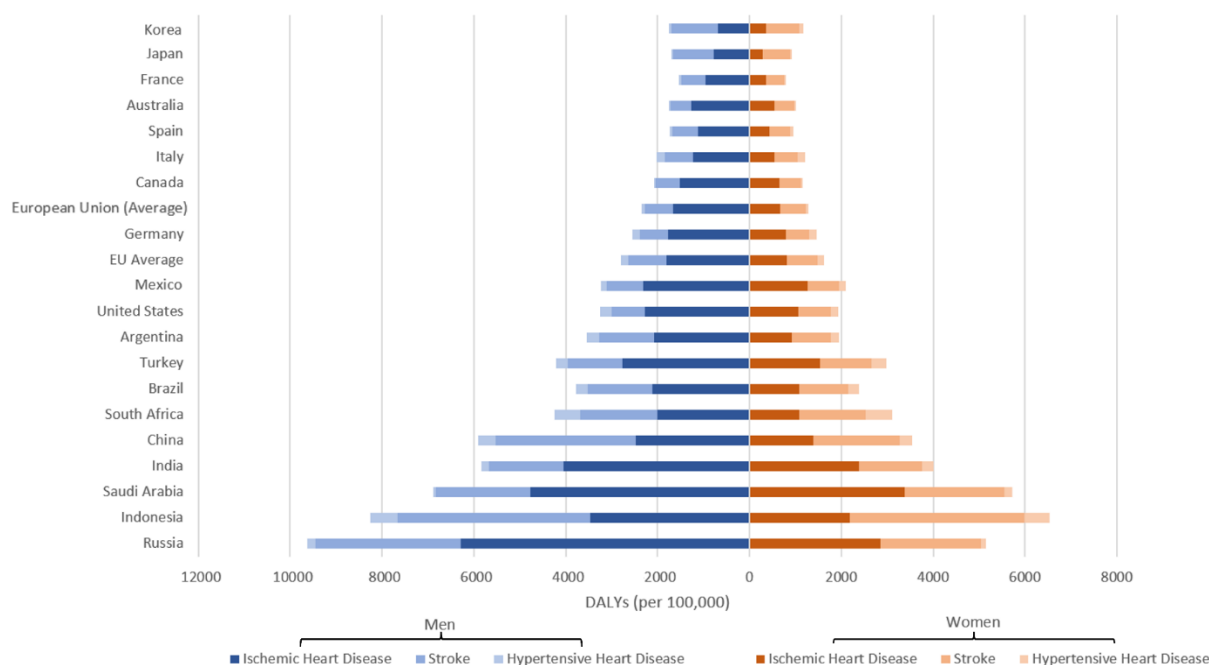
For hypertensive heart disease, the highest rate of DALYs occurred in Indonesia (576 per 100,000) and South Africa (574 per 100,000), followed by China (313 per 100,000) (Fig 2.8). The lowest rate of DALYs were in Japan (35 per 100,000) and Australia (38 per 100,000), followed by Canada (39 per 100,000) (Fig 2.8).

Figure 2.7 Age-standardised DALYs due to Cardiovascular Disease in G20+ countries by Gender, 2019



Source: Institute for Health Metrics and Evaluation (IHME). GBD Compare. Seattle, WA: IHME, University of Washington, 2015. Available from <http://vizhub.healthdata.org/gbd-compare>. (Accessed January 10, 2022)

Figure 2.8 Age-standardised DALYs Due by Type of Cardiovascular Disease in G20+ countries by Gender, 2019



Source: Institute for Health Metrics and Evaluation (IHME). GBD Compare. Seattle, WA: IHME, University of Washington, 2015. Available from <http://vizhub.healthdata.org/gbd-compare>. (Accessed January 10, 2022)

### 2.2.3 Years of Life Lost

Years of Life Lost (YLLs) quantifies untimely death due to a disease. Amongst the G20+ countries, CVD was responsible for 231 million YLLs in 2019. The highest number of YLLs occurred in China (81,549,231), India (61,529,937), and the Russian Federation (18,056,207). The lowest, amount of YLLs occurred in Australia (664,373), Canada (1,152,533), and Korea (1,152,673).

113 million YLLs (49%) were due specifically to ischaemic heart disease. The highest number of YLLs occurred in India (36,643,170), China (32,850,320), and the Russian Federation (9,739,969). The lowest number of YLLs occurred in Australia (351,804), Korea (422,625), and South Africa (626,707).

83 million of the overall CVD-related YLLs (36%) were due specifically to stroke. The highest number of YLLs occurred in China (39,877,559), India (15,902,537), and Indonesia (7,428,459). The lowest number of YLLs occurred in Australia (150,349), Canada (232,053), and Saudi Arabia (348,685).

Approximately 12 million of the YLLs (5%) are directly attributable to hypertensive heart disease. The highest number occurred in China (4,946,373), India (2,173,554), and Indonesia (1,094,127). The lowest number of YLLs occurred in Australia (14,115), Saudi Arabia (20,069), and Canada (21,792).

China, India, and Indonesia have the highest number of YLLs for overall CVD, as well as hypertensive heart disease, ischaemic heart disease, and stroke. This correlates with the large populations in each of these countries as well as high CVD mortality rates.

Age-standardised YLLs per 100,000 people are useful for comparison between countries. The highest rate of CVD-associated YLLs occurred in Russia (8,003 per 100,000), Indonesia (7,144 per 100,000), and Saudi Arabia (6,410 per 100,000) (Fig 2.9a). The lowest rate of YLLs due to overall CVD occurred in Japan (1,266 per 100,000), France (1,349 per 100,000) and Korea (1,366 per 100,000) (Fig 2.9a).

For ischaemic heart disease, the highest rate of YLLs occurred in the Russian Federation (4,218 per 100,000), Saudi Arabia (4,119 per 100,000), and India (3,146 per 100,000) (Fig 2.9b). The lowest rate of YLLs occurred in Korea (497 per 100,000), Japan (503 per 100,000), and France (593 per 100,000) (Fig 2.9b).

For stroke, the highest rate of CVD-associated YLLs occurred in Indonesia (3,582 per 100,000), the Russian Federation (2,333 per 100,000), and China (2,098 per 100,000) (Fig 2.9c). The lowest rate of YLLs occurred in Canada (332 per 100,000), Australia (342 per 100,000) and France (357 per 100,000) (Fig 2.9c).

For hypertensive heart disease, the highest rate of YLLs occurred in South Africa (561 per 100,000), Indonesia (539 per 100,000), and China (278 per 100,000) (Fig 2.9d). The lowest rate of YLLs occurred in Japan (28 per 100,000) Australia (32 per 100,000) and Canada (33 per 100,000) (Fig 2.9d).

Figure 2.9a Age-standardised Years of Life Lost from Cardiovascular Disease in 2019 by G20+ Country, 2019

Figure 2.9b Age-standardised Years of Life Lost from Ischaemic Heart Disease in 2019 by G20+ Country, 2019

Figure 2.9c Age-standardised Years of Life Lost from Stroke in 2019 by G20+ Country, 2019

Figure 2.9d Age-standardised Years of Life Lost from Hypertensive Heart Disease in 2019 by G20+ Country, 2019

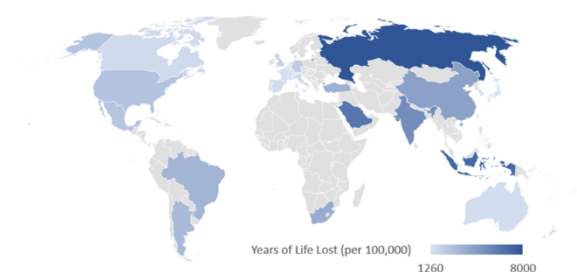


Figure 7A: Age-Standardized Years of Life Lost due to Cardiovascular Disease in 2019 by Country

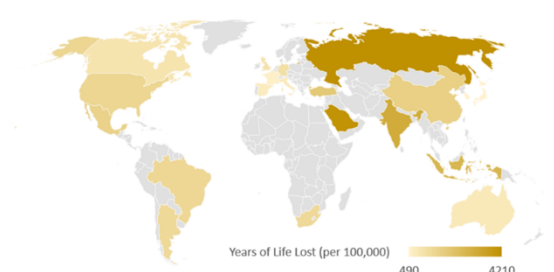


Figure 7B: Age-Standardized Years of Life Lost due to Ischemic Heart Disease in 2019 by Country

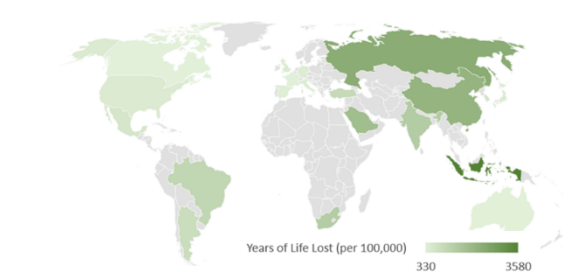


Figure 7C: Age-Standardized Years of Life Lost due to Stroke in 2019 by Country

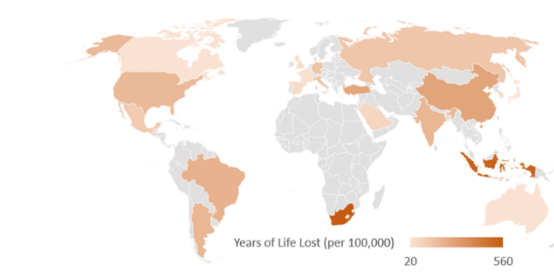
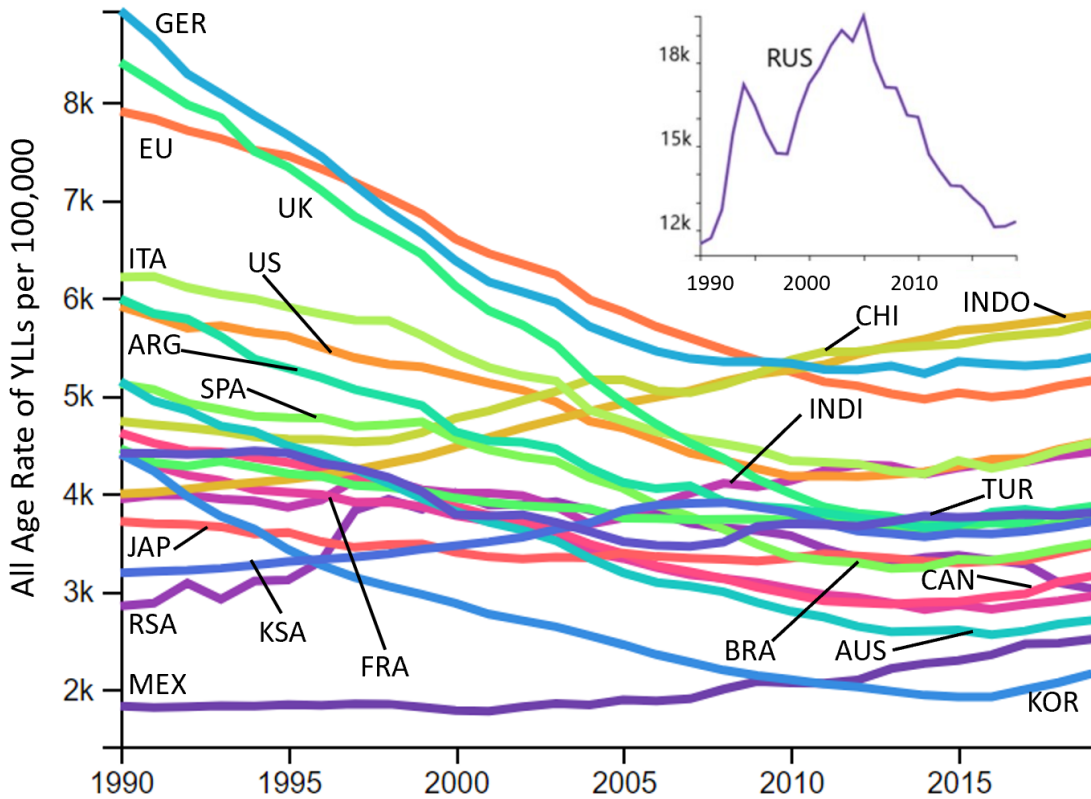


Figure 7D: Age-Standardized Years of Life Lost due to Hypertensive Heart Disease in 2019 by Country

Source: Global Burden of Disease, 2019

In terms of all age YLL rates due to CVD, from 1990-2019, among the G20+, the Russian Federation had the highest rate in YLL. Though Russia has experienced a major increase in YLLs from CVD in the early 2000s, levels have now stabilized to where they were in 1990. Many countries which started with high rates in 1990, such as Germany, the UK, and the EU average, have fallen substantially over the past 30 years. Indonesia and China began with somewhat average rates in 1990 but have steadily increased over the past 30 years. As a whole, the G20+ countries have improved slightly from 1990 to 2019 (Figure 2.10).

Figure 2.10 Trend in Crude Years of Life Lost (YLLs) due to Cardiovascular Disease for G20+ Countries 1990-2019



Note: CVD: Cardiovascular disease; ARG: Argentina; AUS: Australia; BRA: Brazil; CAN: Canada; CHI: China; EU: European Union; FRA: France; GER: Germany; INDI: India; INDO: Indonesia; ITA: Italy; JAP: Japan; KOR: Korea; KSA: Saudi Arabia; MEX: Mexico; RSA: South Africa; RUS: the Russian Federation; SPA: Spain; TUR: Turkey; UK: United Kingdom; US: United States

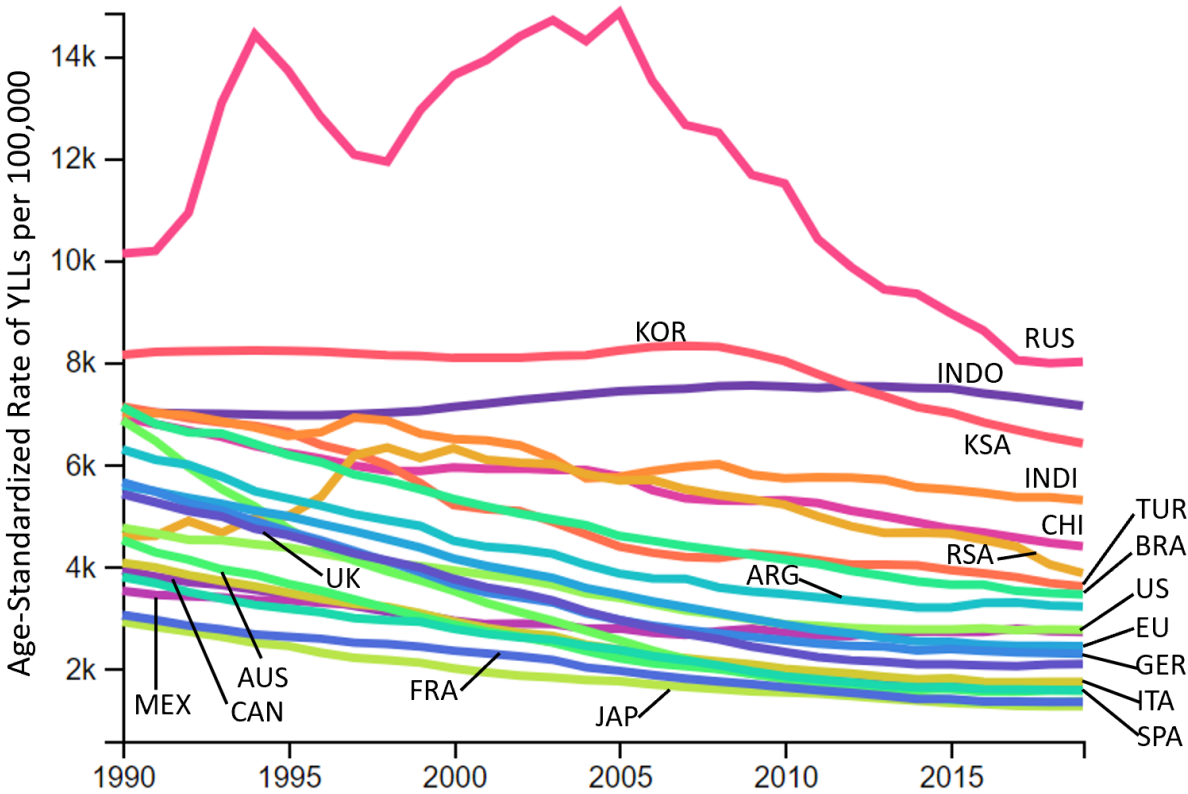
Source: Global Burden of Disease, 1990 to 2019

In terms of age-standardized YLL due to CVD, from 1990-2019, among the G20+, the Russian Federation experienced persistently the highest rate of YLLs from 1990-2019, though by 2010 it had improved past its rate in 1990. The remaining G20+ countries decreased slightly with the exception of Indonesia, where the rates have remained fairly flat over the 30 years, and South Africa, where the rates have increased slightly but then decreased by 2019. When compared



with the crude rates, the age-standardised values in the United Kingdom and Australia did not show large declines (Figure 2.11).

Figure 2.11 Trend in Age-standardised Years of Life Lost (YLLs) due to Cardiovascular Disease for G20+ Countries 1990-2019



Note: CVD: Cardiovascular disease; ARG: Argentina; AUS: Australia; BRA: Brazil; CAN: Canada; CHI: China; EU: European Union; FRA: France; GER: Germany; INDI: India; INDO: Indonesia; ITA: Italy; JAP: Japan; KOR: Korea; KSA: Saudi Arabia; MEX: Mexico; RSA: South Africa; RUS: the Russian Federation; SPA: Spain; TUR: Turkey; UK: United Kingdom; US: United States

Source: Global Burden of Disease, 1990 to 2019

## 2.2.4 Years Lived with Disability

Years Lived with Disability (YLDs) is used to quantify disease morbidity. More YLDs are expected in countries with larger populations.

Amongst the G20+ countries, CVD was responsible for 24 million YLDs in 2019. The highest number of YLDs occurred in China (10,383,891), India (3,416,534), and the United States (2,433,883). The lowest, and therefore most favorable, amount of YLDs occurred in Saudi Arabia (105,564), Australia (122,483), and Argentina (147,091). The most YLDs were due to Stroke (53%), followed by IHD (16%) and HHD (4.7%).

12.67 million of the overall CVD-related YLDs (53%) were due specifically to stroke. The highest number of YLDs occurred in China (6,071,576), India (1,429,789), and the United States (1,087,035). The lowest number of YLDs occurred in Australia (38,558), Argentina (60,943), and Saudi Arabia (68,914).

3.88 million YLDs were due specifically to ischaemic heart disease. The highest number occurred in China (1,835,486), India (590,677), and the United States (8,948,089). The lowest number of YLDs occurred in Argentina (14,205), Saudi Arabia (17,790), and Korea (17,941).

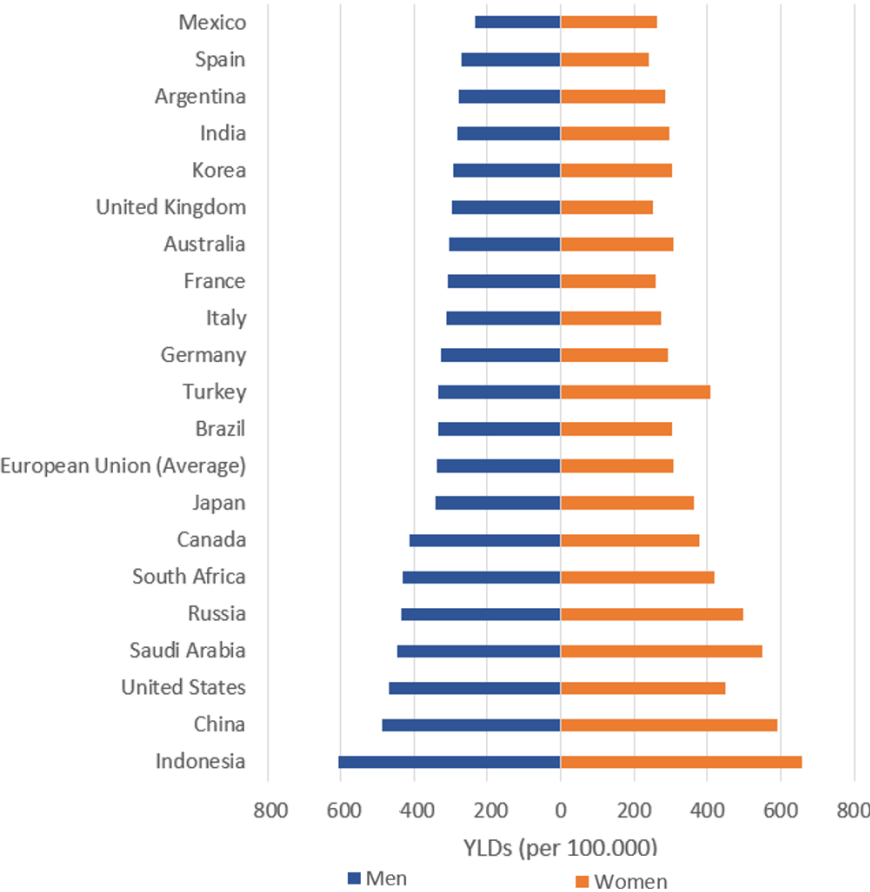
Approximately 1.14 million of the YLDs are directly attributable to hypertensive heart disease. The highest numbers of YLDs were in China (648,536), the United States (118,035), and India (82,238). The lowest number of YLDs occurred in Saudi Arabia (1,436), Australia (2,891), and Canada (4,280).

China, India, and the United States account for the highest number of YLDs for overall CVD, as well as for hypertensive heart disease, ischaemic heart disease, and stroke. This correlates with the large populations seen in each of these countries. Japan, Germany and Italy had high numbers of YLDs for many of the subcategories.

Age-standardised YLDs per 100,000 people can be used to compare countries of different population sizes and age structures. The highest rate of YLDs for general CVD occurred in Indonesia (633 per 100,000), China (545 per 100,000), and Saudi Arabia (489 per 100,000). The

lowest rate of YLDs due to overall CVD occurred in Mexico (249 per 100,000), Spain (254 per 100,000), and the United Kingdom (272 per 100,000) (Fig 2.12).

Figure 2.12 Age-standardised Years Lived with Disability due to Cardiovascular Disease in G20+ countries by Gender, 2019



Source: Institute for Health Metrics and Evaluation (IHME). GBD Compare. Seattle, WA: IHME, University of Washington, 2015. Available from <http://vizhub.healthdata.org/gbd-compare>. (Accessed January 10, 2022)

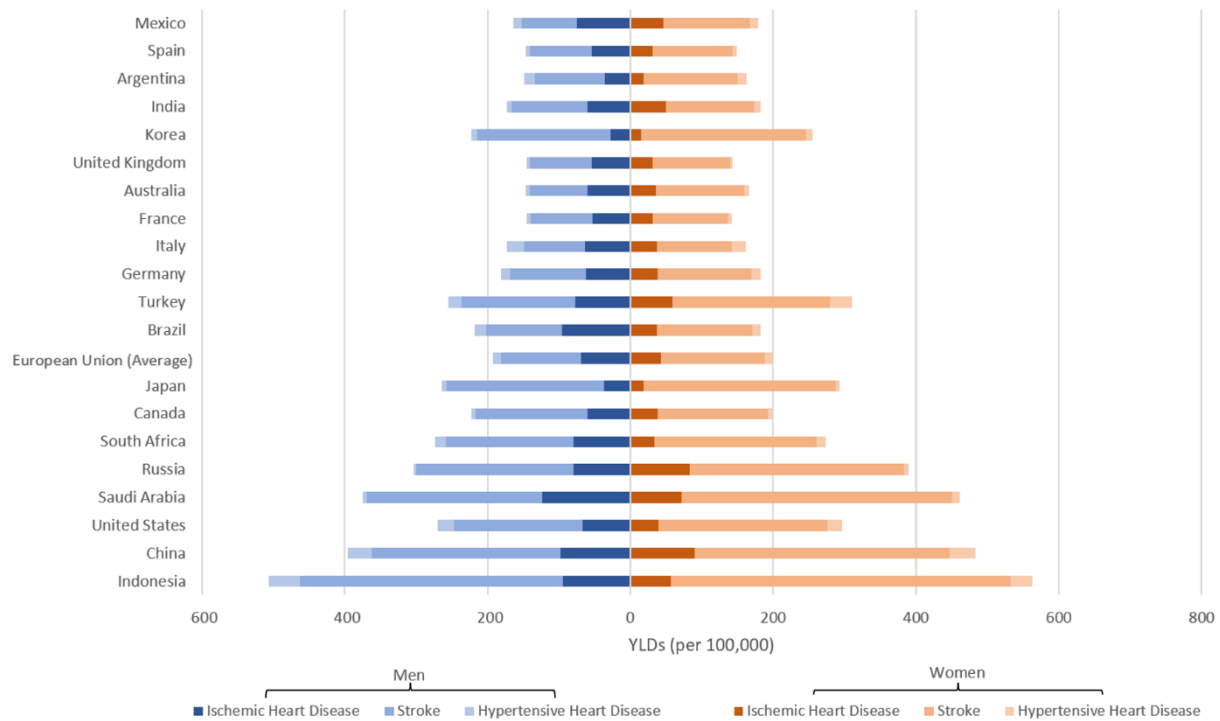
For ischaemic heart disease, the highest rate of age-standardised YLDs occurred in Saudi Arabia (103 per 100,000), China (94 per 100,000), and the Russian Federation (82 per 100,000) (Fig

2.13). The lowest rate of age-standardised YLDs occurred in Korea (20 per 100,000), Argentina (26 per 100,000) and Japan (27 per 100,000) (Fig 2.13).

For stroke, the highest rate of YLDs occurred in Indonesia (426 per 100,000), China (315 per 100,000), and Saudi Arabia (299 per 100,000) (Fig 2.13). The lowest rate of YLDs occurred in Italy (95.9 per 100,000), France (96.4 per 100,000), and the United Kingdom (98 per 100,000) (Fig 2.13).

For hypertensive heart disease, the highest rate of YLDs occurred in Indonesia (37 per 100,000), China (35 per 100,000), and Turkey (25 per 100,000) (Fig 2.13). The lowest rate of YLDs occurred in the United Kingdom (4.3 per 100,000), the Russian Federation (5.7 per 100,000), and Spain (5.9 per 100,000) (Fig 2.13).

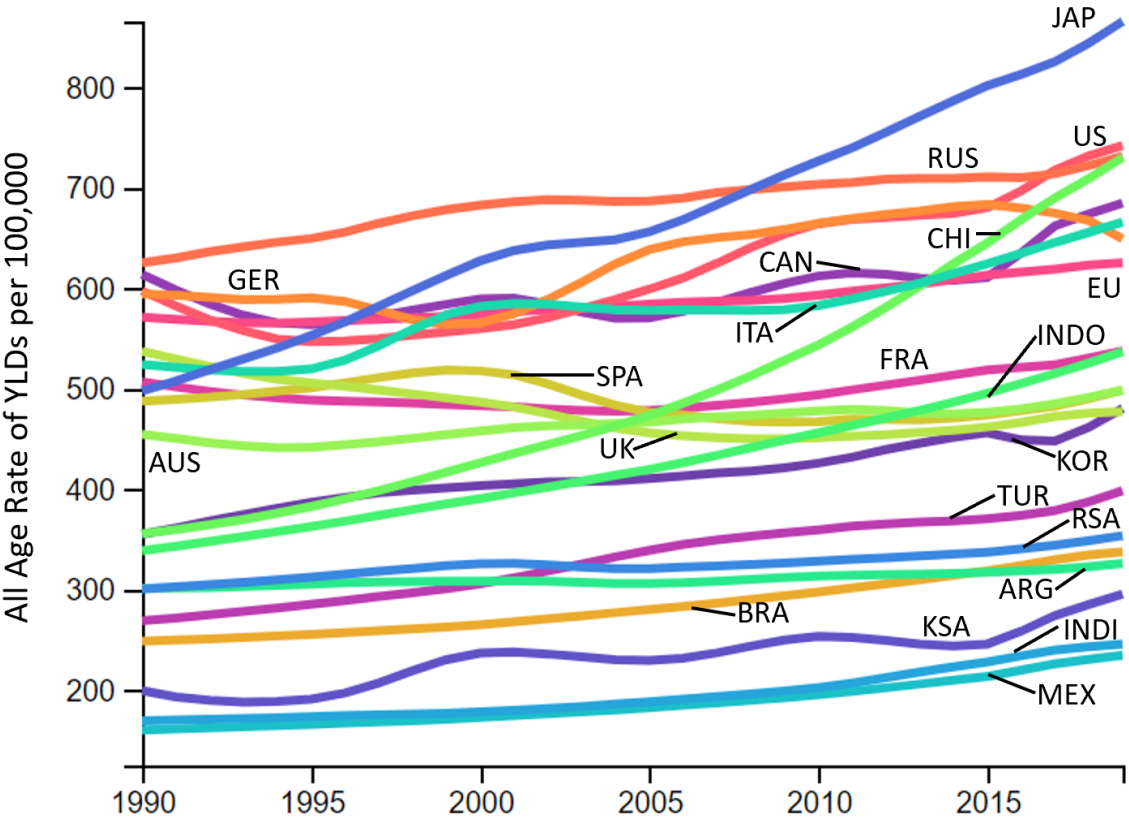
Figure 2.13 Age-standardised Years Lived with Disability by Type of Cardiovascular Disease in G20+ countries by Gender, 2019



Source: Institute for Health Metrics and Evaluation (IHME). GBD Compare. Seattle, WA: IHME, University of Washington, 2015. Available from <http://vizhub.healthdata.org/gbd-compare>. (Accessed January 10, 2022)

In terms of all age YLD due to CVD, from 1990-2019, there has been a general increase among the G20+ countries. Overall, the increases have been mild to moderate (Figure 2.14). China, Japan, and Indonesia are notable for demonstrating the greatest increases, with China up 106%, Japan up 74%, and Indonesia up 58% by 2019. Only Spain and the United Kingdom have fallen in their rate of all age YLD over the past 30 years. Those decreases were minimal.

Figure 2.14 Trends in Crude Rates of All Ages Years Lived with Disability for G20+ Countries from 1990-2019

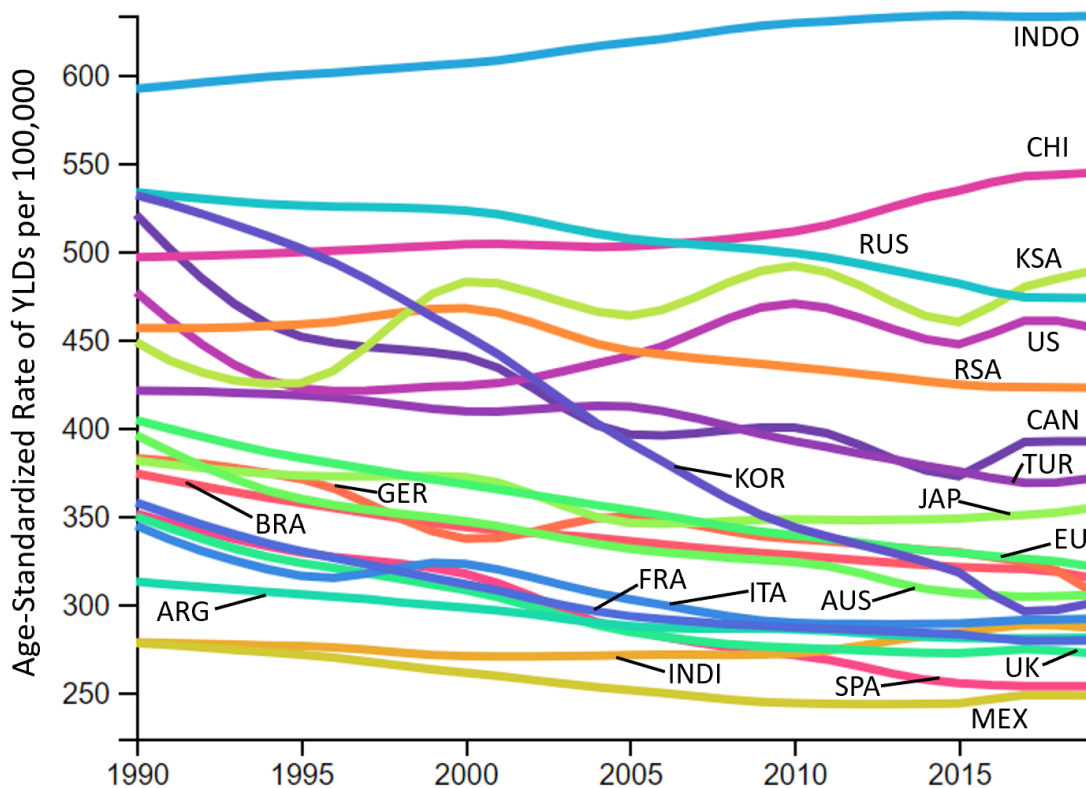


Note: CVD: Cardiovascular disease; ARG: Argentina; AUS: Australia; BRA: Brazil; CAN: Canada; CHI: China; FRA: France; GER: Germany; INDI: India; INDO: Indonesia; ITA: Italy; JAP: Japan; KOR: Korea; MEX: Mexico; RUS: the Russian Federation; SAU: Saudi Arabia; SOU: South Africa; SPA: Spain; TUR: Turkey; UK: United Kingdom; US: United States

Source: Global Burden of Disease, 1990 to 2019

In terms of age-standardised YLD due to CVD, from 1990-2019, the G20+ were largely stable or decreased slightly (Figure 2.15). Indonesia is prominent as it has a higher rate of YLD for the entire duration while also demonstrating a small increase. China demonstrated a small increase as well, as did Saudi Arabia and the United States, though with much more fluctuating courses. Korea sustained an unusually large decrease, falling 56% over the past 30 years. All other G20+ countries demonstrated very light decreases, including the European Union average. When compared with the crude rates, the age-standardised values in the United Kingdom and Australia did not show large declines.

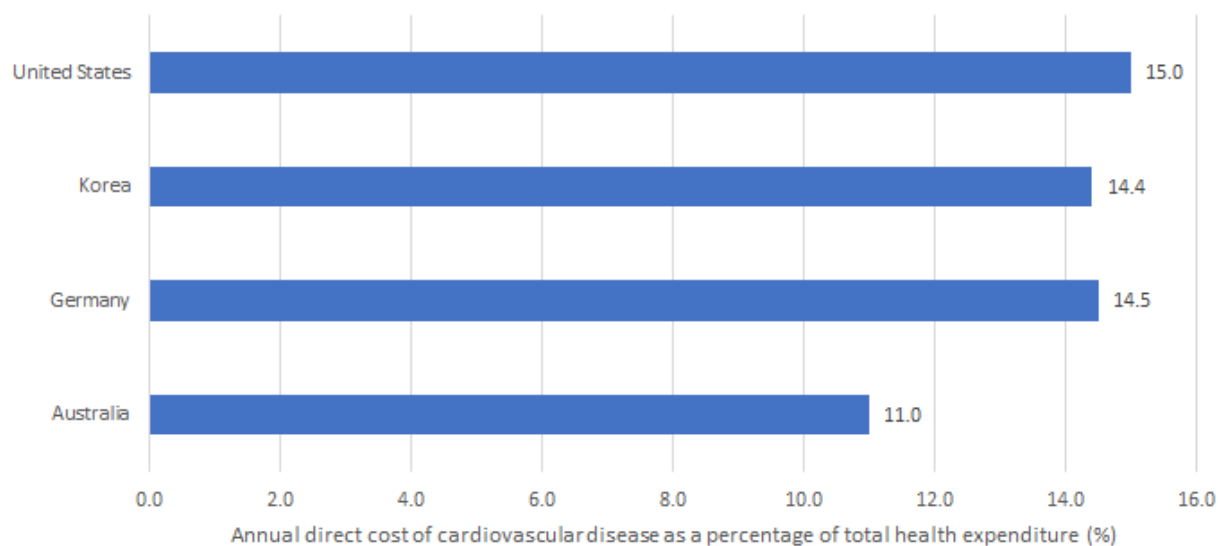
Figure 2.15 Trends in Age-standardised Rates of Age-Standardized Years Lived with Disability for G20+ Countries from 1990-2019



## 2.3 Direct Costs of Cardiovascular Disease

In this report, we examine the direct costs of CVD for G20+ countries for which data are available. We define direct costs as the current health expenditures (i.e., the final consumption of health care goods and services for CVD), which include personal health care for CVD (curative care, long-term care, medical goods, rehabilitative care, and ancillary services) and collective services for CVD (prevention and public health services and health administration), but excluding spending on investments for CVD. The number of studies on the direct cost of CVD as a proportion of total health expenditure in G20+ countries is surprisingly few. In the four studies identified, the direct costs for CVD are substantial and account for a large proportion of the total healthcare expenditures in G20+ countries, ranging from 11% in Australia<sup>1</sup> to 15% in the United States (Figure 2.16).<sup>2</sup>

Figure 2.16 Direct costs of cardiovascular disease as a Percentage of Total Health Expenditure, 2017 (or nearest year)



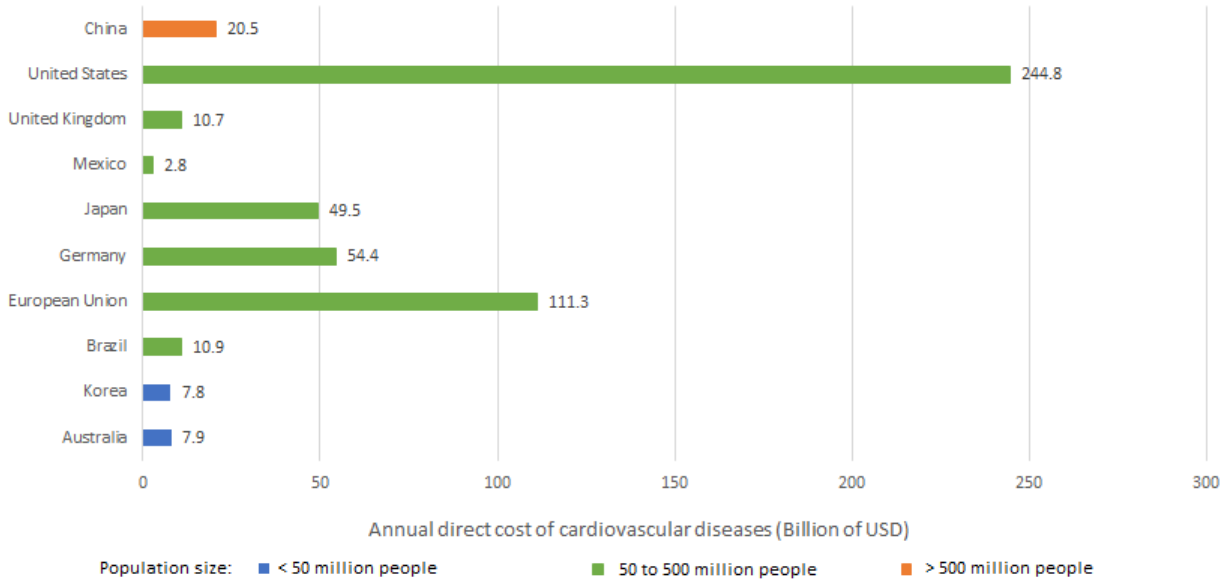
Note: Direct costs of cardiovascular disease (CVD) include personal health care for CVD (curative care, long-term care, medical goods, rehabilitative care, and ancillary services) and collective services for CVD (prevention and public health services and health administration). This definition applies to all countries, except for the United States, which includes only

personal health care. Data for 2008 for Australia, data for 2008 for Germany, data for 2009 for Korea, and data for 2019 for the United States of America.

Source: for Australia: Waters et al. (2013); for Germany and Korea: OECD Health Statistics 2020; for the United States of America: Benjamin EJ et al. (2019)

In terms of absolute amounts, across G20+, direct costs of CVD were highest in the United States at US\$244.8 billion<sup>2</sup>, followed by the European Union at US\$111.3 billion.<sup>3</sup> Across the European G20+ countries, direct costs were highest in Germany at USD 54.4 billion<sup>4</sup>, while in Asia-Pacific countries, Japan had the highest direct costs of CVD at US\$ 49.5 billion.<sup>2</sup> Direct costs in Australia, China, and Korea were estimated to be US\$7.9<sup>1</sup>, US\$20.5<sup>5</sup>, and US\$7.8 billion<sup>4</sup>, respectively. In South America, the cost of CVD in Brazil and Mexico were US\$10.9<sup>6</sup> and US\$2.8 billion<sup>7</sup>, respectively (Figure 2.17).

Figure 2.17 Direct costs of cardiovascular diseases, 2017 (or nearest year)



Note: Direct costs of cardiovascular disease include personal health care for CVD (curative care, long-term care, medical goods, rehabilitative care, and ancillary services) and collective services for CVD (prevention and public health services and health administration) for all countries, except for China, Japan, the European Union, Mexico, and the United States, which include only

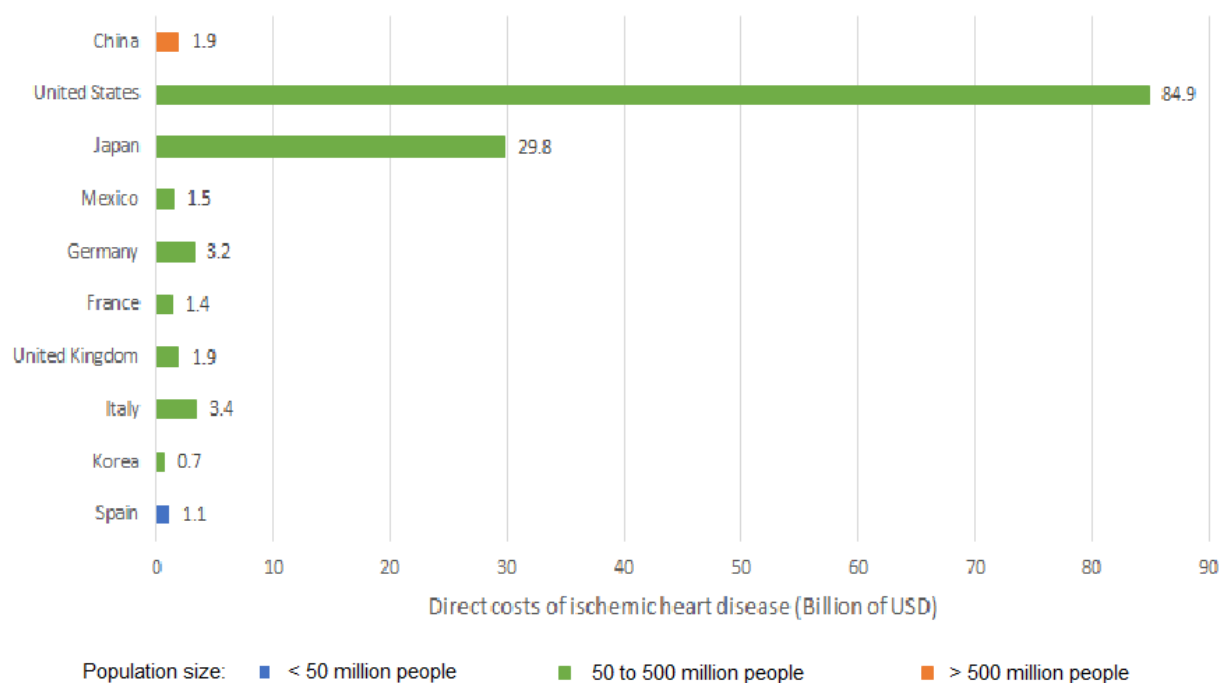


personal health care with various definition (appendix A). All costs were converted into USD using exchange rates of corresponding years available from the OECD data.<sup>8</sup> Data for 2008 for Australia, data for 2015 for Brazil, data for 2014 for China, data for 2015 for the European Union, data for 2008 for Germany, data for 2014 for Japan, data for 2015 for Mexico, data for 2009 for Korea, data for 2012 for the United Kingdom, and data for 2019 for the United States of America.

Source: OECD Health Statistics 2020; for Australia: Waters et al. (2013); for Brazil: Stevens et al. (2018A); for Mexico: Stevens et al. (2018B); for China: Zhai et al. (2006); for the European Union: OECD/The King's Fund (2020); for Japan: Matsumoto et al. (2017); for the United Kingdom: Bhatnagar et al. (2015); for the United States of America: Benjamin EJ et al. (2019).

Ischaemic heart disease accounted for the largest share of the direct CVD costs in most of the G20+ countries, ranging from US\$84.9 billion in the United States<sup>9</sup>, to US\$29.8 billion in Japan<sup>10</sup>, US\$1.9 billion in China<sup>5</sup> and US\$0.7 billion in Korea.<sup>11</sup> In the European G20+ countries, the direct cost of IHD ranged from US\$3.4 billion in Italy to US\$3.2 billion in Germany and US\$1.1 billion in Spain (Figure 2.18).<sup>12</sup>

Figure 2.18 Direct costs of Ischaemic Heart Disease, 2017 (or nearest year)



Note: Direct costs of ischaemic heart disease (IHD) include personal health care for CVD (treatment, hospitalization, laboratory investigations, and drugs) for all countries. Detailed definition of personal health care varies across countries (appendix A). All costs were converted into USD using exchange rates of corresponding years available from the OECD data.<sup>8</sup> Data for 2003 for China; data for 2004 for France, Germany, Italy, Spain, and the United Kingdom; data for 2016 for Japan, data for 2015 for Mexico, data for 2012 for Korea, data for 2016 for the United States of America.

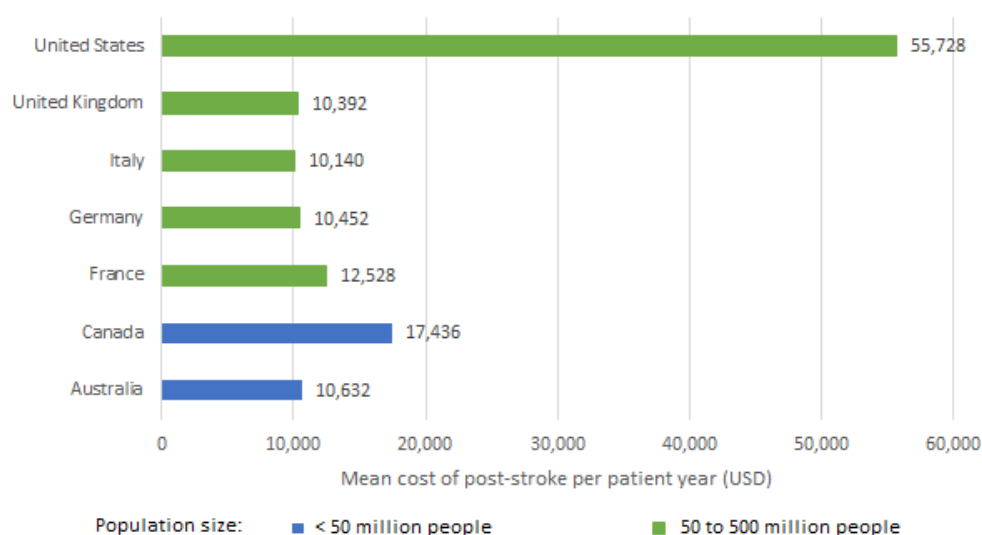
Source: Taylor et al. (2007); for China: Zhai et al. (2006); for Japan: Gochi et al. (2018); for Mexico: Stevens et al. (2018); for Korea: Seo et al. (2015); for the United States of America: Bishu et al. (2020)

### 2.3.1. Annual Direct Cost of Cardiovascular Disease Care Per Patient

The annual cost of CVD care per patient greatly varies across the G20+ countries, likely due to differences in case-mix, service access, care process and treatment and intensity of hospital use, but few data exist to make a meaningful comparison.

For ischaemic heart disease care, published data were available for just two G20+ countries, for Italy with an annual per patient cost of US\$16,858<sup>13</sup> and Saudi Arabia with a cost of US\$10,710.<sup>14-16</sup> For stroke care, amongst the countries that had comparable data, the mean cost of post-stroke care ranged from US\$55,728 per patient year in the United States, US\$17,436 per patient year in Canada, US\$12,528 per patient year in France, US\$10,632 per patient year in Australia, US\$10,452 per patient year in Germany<sup>17</sup>, US\$10,392 per patient year in the United Kingdom and US\$10,140 per patient year in Italy (Figure 2.19).<sup>17</sup>

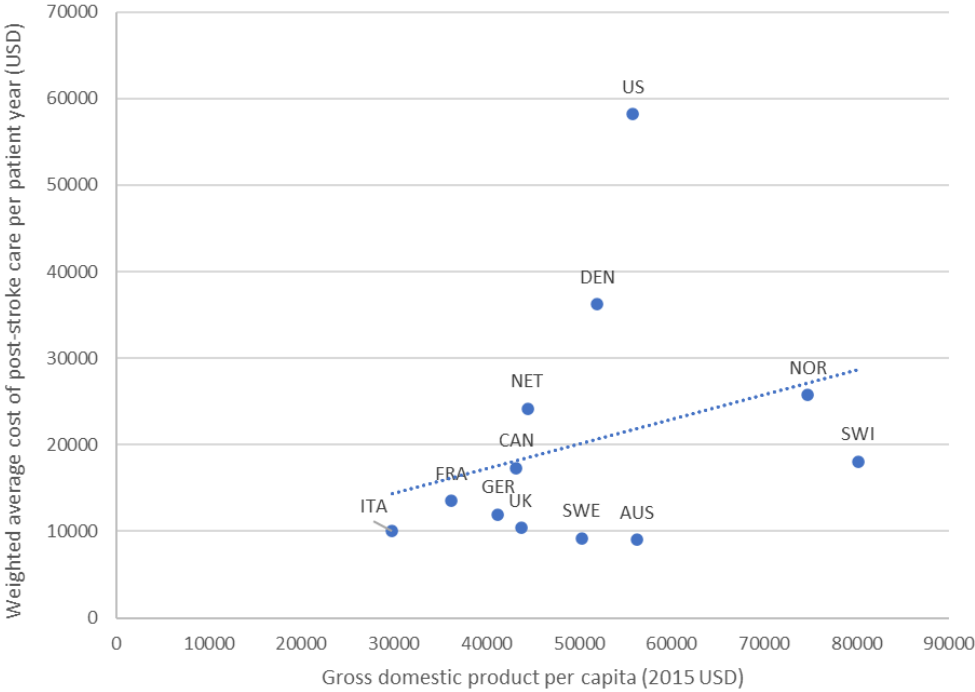
Figure 2.19 Mean Cost of Post-Stroke Care per Patient Year in G20+ countries in 2015



Note: The costs of post-stroke care include total costs of personal stroke care, excluding acute care (i.e., inpatient rehabilitation, home-based rehabilitation, nursing home, hospital readmission, mobile team and all health service cost). According to Rahsic et al. (2019), all costs were converted into 2015 USD using purchasing power parity rates available from the OECD data.<sup>8</sup> Source: Rahsic et al. (2019)

When comparing each country’s cost with the annual gross domestic product per capita (Figure 2.20), the highest cost of post-stroke care per patient occurred in the United States, and Italy, respectively. Among the published studies, the lowest cost of post-stroke care was in Australia. The United States was the only country where the weighted average cost of post-stroke care exceeded GDP per capita and where the major cost driver is rehabilitation services.<sup>17</sup>

Figure 2.20 Average Cost of Post-Stroke Care per Patient Year in G20+ countries and selected non-G20+ countries in 2015



Note: AUS: Australia; CAN: Canada; DEN: Denmark; FRA: France; GER: Germany; ITA: Italy; NET: Netherlands; NOR: Norway; SWE: Sweden; SWI: Switzerland; UK: the United Kingdom; US: the United States of America.

The costs of post-stroke care include total costs of personal stroke care, excluding acute care (i.e., inpatient rehabilitation, home-based rehabilitation, nursing home, hospital readmission, mobile team and all health service cost). The blue dotted line represents a best-fit line.

Source: Rahsic et al. (2019)

## 2.4 Health System Performance in Managing Cardiovascular Disease

At an individual level, health systems deliver medical care to patients at risk of CVD or with CVD in hospitals, primary healthcare setting, in the community or at their home. At a population level, health systems also deliver public health services, which include health education, promotion, protection and disease prevention services targeted to CVD.

The effectiveness, efficiency, equity and responsiveness of healthcare services provided in health systems influences costs, and health outcomes for CVD. Various metrics are used to measure health system performance in relation to CVD. These include, among others, length of hospital stay for CVD admission (efficiency), 30-Day Mortality for major CVD events (effectiveness), waiting times to see a cardiovascular specialist (responsiveness), out of pocket costs for care and differences in care by demographic characteristics (equity). These measures provide an insight into how country health systems perform in dealing with CVD, and reveal opportunities to improve CVD healthcare services and outcomes.

### 2.4.1 Effectiveness of G20+ health systems in managing Cardiovascular Disease

Effectiveness refers to the extent to which a desired health outcome is achieved when a cost-effective intervention is applied to a patient in a population group. This section examines the ability of health systems to deliver cost-effective and evidence-based CVD healthcare interventions to achieve desired outcomes by analyzing indicators for which comparable OECD data or published studies are available, namely: (i) primary prevention (statin therapy) (ii) secondary prevention (four-drug combination therapy) (iii) Acute Care (30-Day Mortality for major CVD events), and (iv) Long-term CVD care (amenable mortality and hospital admission rates following an acute CVD event, such as an Acute Myocardial Infarction (AMI) or a Cerebrovascular Accident (CVA)).

#### *2.4.1.1 Primary Preventive Care*

Primary prevention is a type of prevention that aims to prevent a disease before it occurs. For example, prescribing a statin to a 40-year-old man with cardiovascular risk factors, but no history of CVD, is an example of primary prevention. This type of healthcare service is typically delivered in a primary healthcare setting by community health workers, nurses, and physicians. In this context, there is no existing disease burden to be improved upon. Instead, the prevention is solely aimed at preventing the disease and the disease burden from occurring.

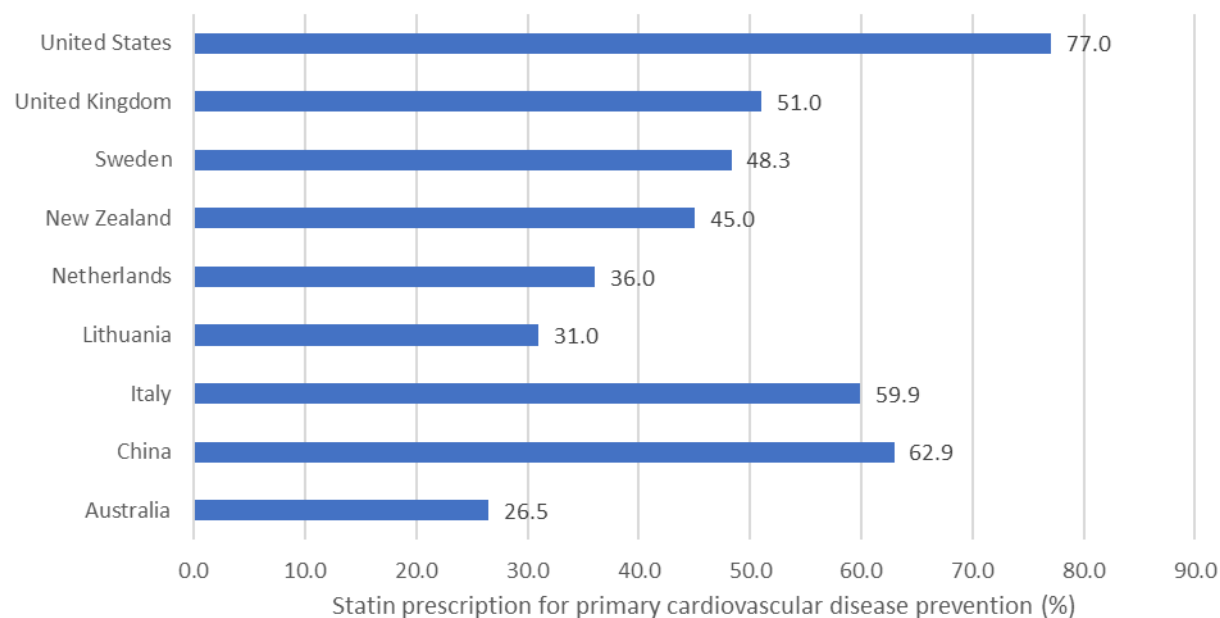
High blood cholesterol is one of the major risk factors for CVD,<sup>18</sup> and its reduction is important to prevent CVD and decrease the risk of developing a CVD event.

Statins, which are cholesterol-lowering drugs, become the first-choice treatments to prevent CVD both for healthy individuals aged 40 to 75 years with a high risk of CVD (primary prevention)<sup>19</sup> and individuals with a prior history of CVD (secondary prevention).<sup>20</sup> For primary prevention, evidence indicates that statins reduce the chance of a first CVD event while not increasing the risk of serious adverse effects<sup>21</sup>, and are very cost-effective.<sup>22</sup>

Despite the extensive evidence-based recommendations of statin use for primary prevention of CVD, in practice, statin utilization in individuals without established CVD, but who are at risk of CVD, is low. Among the G20+ countries, statin utilization for primary prevention of CVD was as low as 26.5% in Australia<sup>23</sup>, 51.0% in the UK<sup>24</sup>, 59.9% in Italy<sup>25</sup>, 62.9% in China<sup>26</sup>, and 49% to 77% in the United States (Figure 2.21).<sup>27,28</sup>

For primary CVD prevention specifically among patients with diabetes, analysis of OECD Health Data indicate that the percent of patients with diabetes who were prescribed at least one cholesterol-lowering medication ranged from 55.6% in Spain and 61.9% in Italy to 74.4% in Canada and 79.4% in Australia. Likewise, the percent of those who were prescribed their first-choice antihypertensive medication ranged from 78.6% in Korea and 83.5% in Spain to 88.4% in Australia to 89.1% in Canada.<sup>4</sup>

Figure 2.21 Percentage of Statin Prescription for Primary Prevention of Cardiovascular Disease, 2010/2015 (or nearest year) in G20+ countries and selected comparator countries for which data are available



Note: Data for 2012/2018 for China, Data for 2011 for Italy, Data for 2016/2017 for Lithuania, Data for 2011/2015 for the Netherlands, Data for < 2010 for New Zealand (non G20+ comparator country for which the exact year was not obtained), Data for 2014 for Sweden (non G20+ comparator country), Data for 2009/2013 for the United Kingdom, Data for 2003 to 2004 for the United States. Data were obtained from studies conducted in various settings and populations and, thus, comparisons across countries should be interpreted with care. The data are not nationally representative, except for Italy and the Netherlands. All countries conducted the studies in a primary care office-based setting, except for China, where it was in a university-affiliated hospital located in Shanghai. Study populations vary across countries. Most countries include both male and female participants with a mean age between 45 to 75 years and had high to very high CVD risks (Australia, China, Lithuania, and the United States). Italy, the Netherlands, and the United Kingdom include those with median age greater than 70 years and CVD risks. New Zealand included female participants with high CVD risks aged 40 to 74 years while Sweden participants with diabetes aged 18 or older with CVD risks.

Source: For Australia: Yiu et al. (2019), for China: Liu et al. (2020), for Italy: Maggioni et al. (2017), for Lithuania: Urbonas et al. (2020), for Netherlands: Kleipool et al. (2019), for New Zealand: Olivia et al. (2010), for Sweden: Karlsson et al. (2018), for United Kingdom: Turner et al. (2016), for United States: Kumar et al. (2009)

#### *2.4.1.2 Secondary Preventive Care*

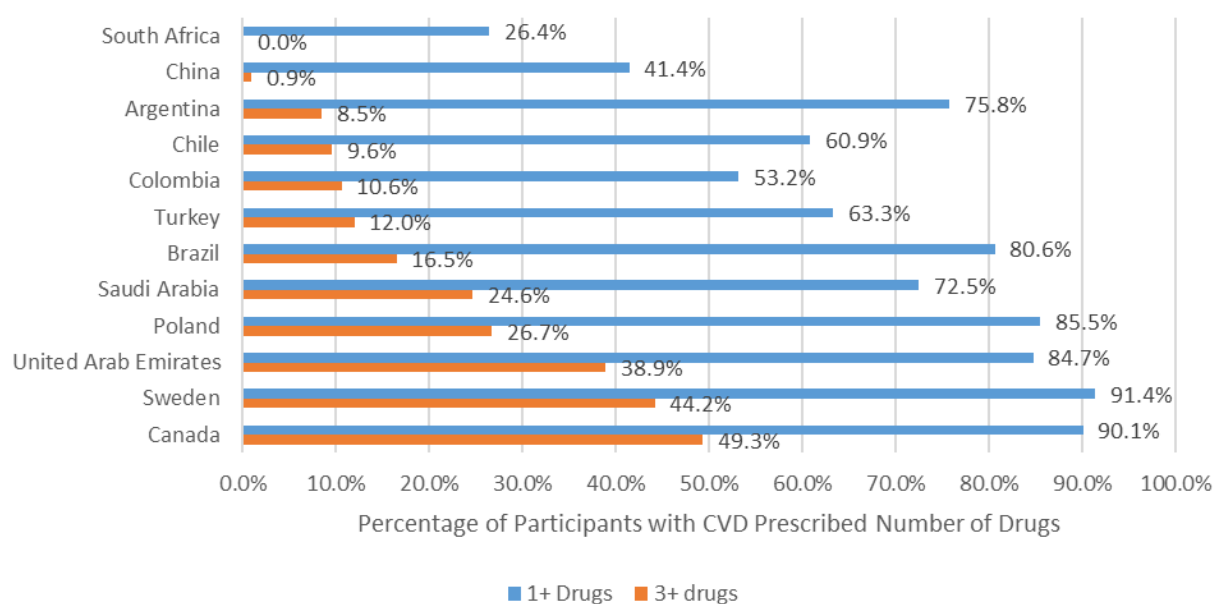
Secondary prevention aims to lessen or improve the burden of established disease. For example, prescribing an individual aspirin or an antiplatelet drug after they have experienced an acute myocardial infarction is secondary prevention, as aspirin helps to prevent future cardiovascular disease events, such as an acute myocardial infarction or an acute cerebrovascular stroke.

In the PURE study, which includes 21 countries, secondary prevention for cardiovascular disease is defined as the use of the optimal four-drug regimen, consisting of an antiplatelet drug (aspirin, clopidogrel, or other antiplatelets), cholesterol-lowering drug (statin, ezetimibe, or other cholesterol-lowering drug), a  $\beta$ -blocker, and an angiotensin-converting-enzyme inhibitor or angiotensin-receptor blocker.<sup>29</sup>

Few study participants adhere to the four-drug regimen, so the number of participants using one or more drugs in the regimen (minimal prevention) and three or more drugs in the regimen (moderate prevention) was also measured. Of the G20+ countries of interest included in the study, South Africa had both the lowest minimal prevention (26.4%) and the lowest moderate prevention (0.0%). Minimal (41.4%) and moderate (0.9%) prevention in China were the second lowest. Among the study countries, Canada had the highest moderate prevention (49.3%) followed by Sweden (44.2%), and the second highest minimal prevention (90.1%) after Sweden (91.4%). The range of prescription rates were quite wide for both minimal and moderate prevention among the study countries (Figure 2.22).



Figure 2.22 Percentage of Secondary Prevention Drugs Prescribed in G20+ countries and selected comparator countries for which data are available

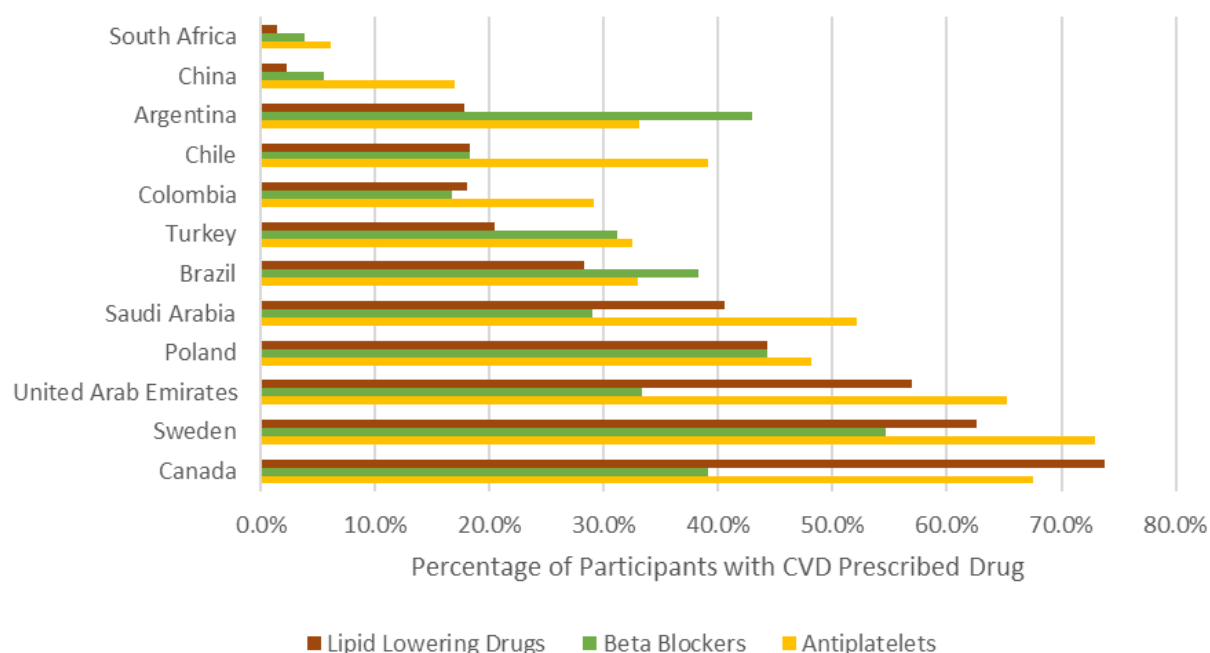


According to the PURE study<sup>29</sup>, ‘use of medicines was defined by patient responses to the question: “List all the medications you are currently consuming at least once a week for the last month”. Self-reports of medicines being used were verified by asking patients to show the field workers their prescriptions or medical documents.’

Source: Murphy, Adrianna, et al. "Inequalities in the use of secondary prevention of cardiovascular disease by socioeconomic status: evidence from the PURE observational study." *The Lancet Global Health* 6.3 (2018): e292-e301.

The pattern of which class of drug was prescribed most often varied between countries (Figure 2.23). Among those, lipid-lowering drugs were the most commonly prescribed drug only in Canada. Notably, Canada has high prescription rates for all three drug types when compared to the other countries. Beta-blockers were the most commonly prescribed drug in Argentina and Brazil. Antiplatelet drugs were the most commonly prescribed drugs in China, South Africa, Turkey, and Saudi Arabia (Figure 2.23).

Figure 2.23 Type of Secondary Prevention Drugs Prescribed in G20+ countries and selected comparator countries for which data are available



According to the PURE study<sup>29</sup>, ‘use of medicines was defined by patient responses to the question: “List all the medications you are currently consuming at least once a week for the last month”. Self-reports of medicines being used were verified by asking patients to show the field workers their prescriptions or medical documents.’

Source: Murphy, Adrianna, et al. The Lancet Global Health 6.3 (2018): e292-e301.

### 2.4.1.3 Acute Care

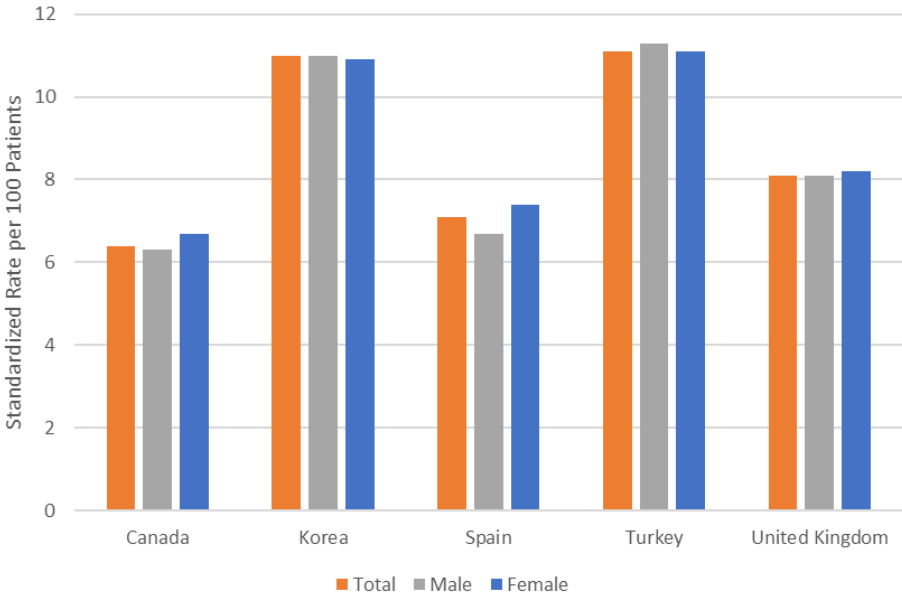
Cardiovascular diseases have both acute- and long-term consequences. Often the acute manifestations of CVD, such as cerebrovascular stroke or myocardial infarction, have a huge impact on the morbidity and mortality of individuals experiencing these acute CVD events. However, morbidity and mortality from these events can often be mitigated, provided health systems deliver effective and timely healthcare interventions and services. For example, acute myocardial infarctions can be assessed and diagnosed using widely available medical tests in the emergency department of hospitals or in primary care. With timely diagnosis, a cardiologist

can intervene to prevent serious injury and death due the acute CVD event. Similarly, the severe consequences of some cerebrovascular strokes can be mitigated by surgery or interventional radiology. However, those interventions must occur within a matter of hours in order to be effective.

**2.4.1.3.1 30-day Mortality for Acute Myocardial Infarction**

30-day mortality is a metric often used to assess the effectiveness of healthcare services provided to manage an acute myocardial infarction. As the largest burden of CVD is faced by older adults, we report 30-day mortality for persons over 45 years of age (the metric used by the OECD) from 2018-2020. Surprisingly, few G20+ countries had data for this metric and among them, the lowest 30-day mortality for acute myocardial infarction was in Canada (6.4 per 100 patients), followed by Spain and the United Kingdom (7.1 and 8.1 per 100 patients) (Figure 2.24). Among G20+ countries, Turkey had the highest 30-day mortality (11.1 per 100 patients), followed by Korea (11 per 100 patients) (Figure 2.24).

Figure 2.24 Acute Myocardial Infarction 30-Day Mortality in G20+ countries, 2019 (or nearest)



Data are admission-linked. Source: OECD Health Statistics. [https://www.oecd-ilibrary.org/social-issues-migration-health/data/oecd-health-statistics\\_health-data-en](https://www.oecd-ilibrary.org/social-issues-migration-health/data/oecd-health-statistics_health-data-en)

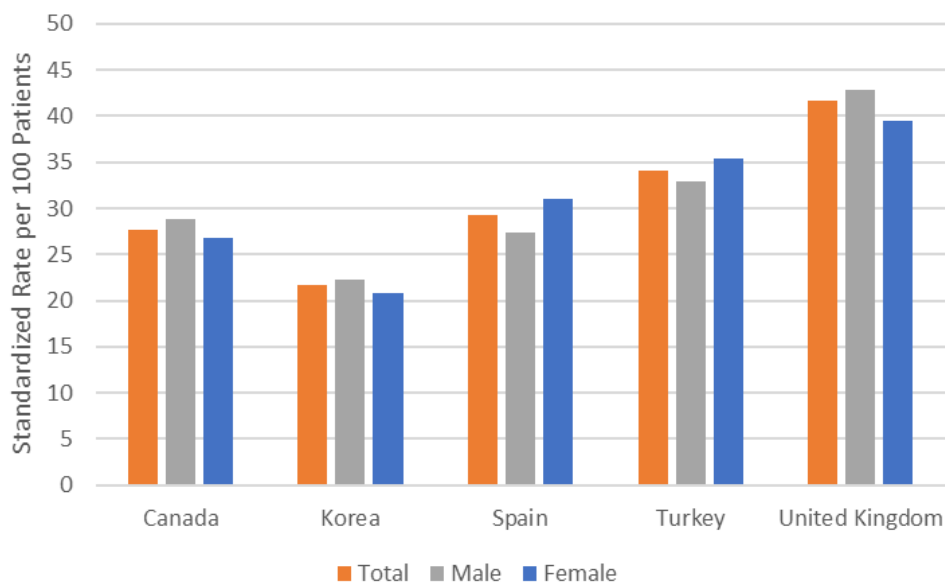
### 2.4.1.3.2 30-day Mortality for Hemorrhagic Stroke

30-day mortality for persons over 45 years of age can also be used to examine the effectiveness of acute care for CVD. In the OECD Health Database, just five G20+ countries had comparable data on this metric, namely, Canada, Korea, Spain, Turkey, and the UK. Of these countries, the United Kingdom had the highest 30-day mortality in total (41.7 per 100 patients), in males (42.9 per 100 patients) and females (39.5 per 100 patients) (Figure 2.25).

Of the G20+ countries with available data, Korea had the lowest 30-day mortality for acute hemorrhagic stroke in total (21.7 per 100 patients), in males (22.3 per 100 patients), and in females (20.8 per 100 patients) (Figure 2.25).

When compared with 30-day mortality from acute myocardial infarction, 30-day mortality from hemorrhagic stroke is much higher; this may be related to the availability of timely neurosurgical, vascular surgical or interventional radiological healthcare services and interventions.

Figure 2.25 30-Day Mortality for Hemorrhagic Stroke in G20+ countries, 2019 (or nearest)



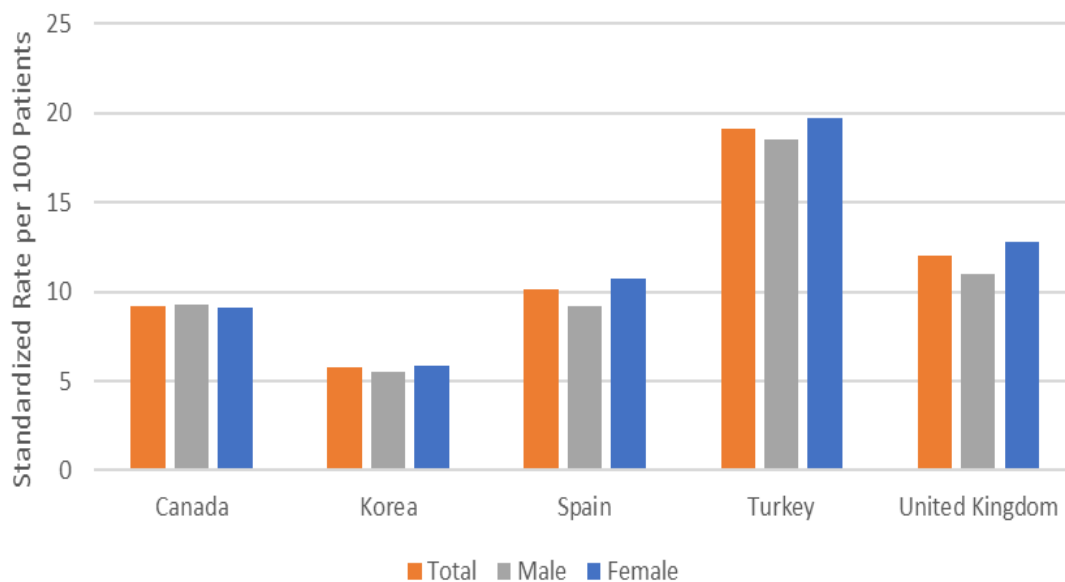
Data are admission-linked. Source: OECD Health Statistics. [https://www.oecd-ilibrary.org/social-issues-migration-health/data/oecd-health-statistics\\_health-data-en](https://www.oecd-ilibrary.org/social-issues-migration-health/data/oecd-health-statistics_health-data-en)

### 2.4.1.3.3 30-day Mortality for Ischaemic Stroke

30-day mortality for ischaemic stroke in persons over 45 years of age can also be used to examine the effectiveness of acute care for CVD.

In the OECD Health Data, just five G20+ countries had comparable data on 30-day mortality for ischaemic stroke, namely, Canada, Korea, Spain, Turkey, and the UK. Of these countries, Turkey had the highest 30-day mortality in total (19.1 per 100 patients), in males (18.5 per 100 patients), and in females (19.7 per 100 patients) (Figure 2.26). Whereas, among the G20+ countries with data, Korea had the lowest 30-day mortality in total (5.8 per 100 patients), in males (5.5 per 100 patients), and in females (5.9 per 100 patients) (Figure 2.26).

Figure 2.26 30-Day Mortality for Ischaemic Stroke in G20+ countries, 2019 (or nearest)



Data are admission-linked. Source: OECD Health Statistics. [https://www.oecd-ilibrary.org/social-issues-migration-health/data/oecd-health-statistics\\_health-data-en](https://www.oecd-ilibrary.org/social-issues-migration-health/data/oecd-health-statistics_health-data-en)

#### *2.4.1.4 Long-term Care*

Long-term care can be categorised as any care that occurs subsequent to a person's initial CVD diagnosis and management. For example, persons that have endured an acute myocardial infarction or an acute ischaemic or hemorrhagic stroke require regular visits with medical specialists and family practitioners to verify that their medications are correctly titrated and to manage their rehabilitation with a broader team of physiotherapists, speech therapists and occupational therapists, among others.

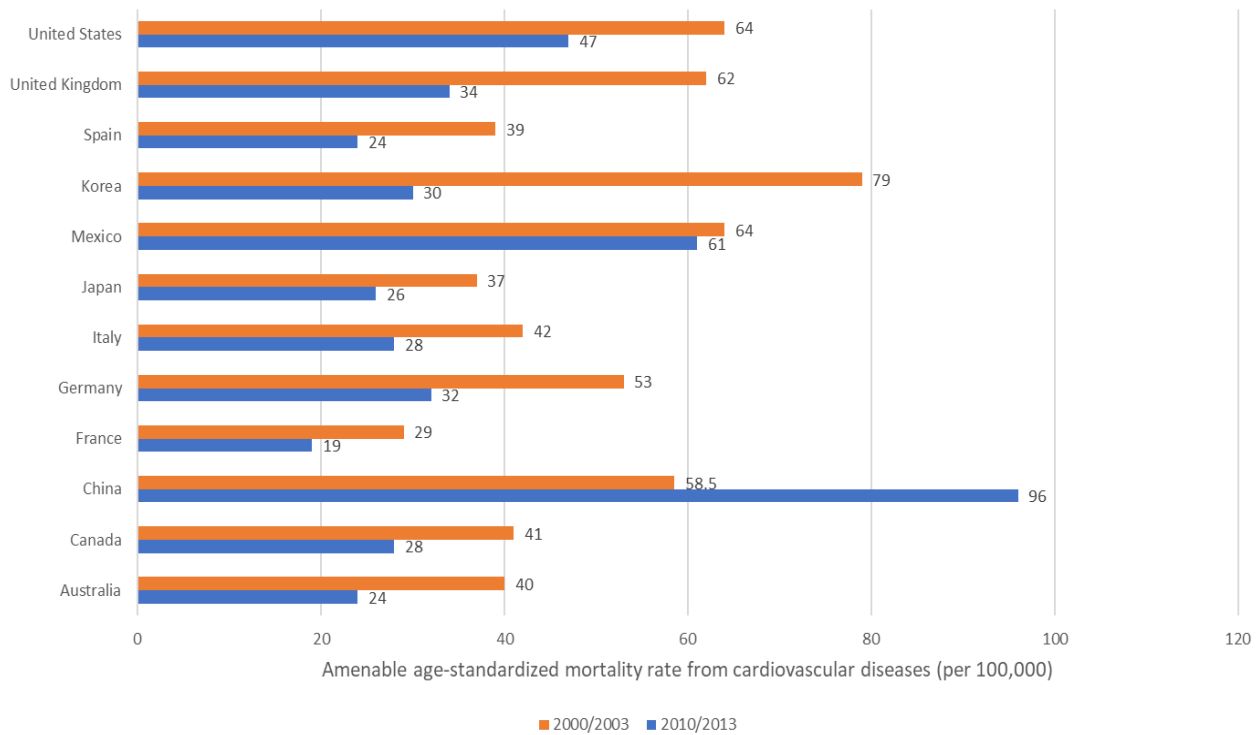
Though acute medical CVD events, like acute myocardial infarction or stroke, often receive much attention because they require immediate management, long-term CVD care is equally essential in reducing the disease burden of CVD. By improving long-term CVD care, it is possible to prevent repeat major acute events and thereby reduce adverse health consequences and financial risk for individuals and health systems.

##### **2.4.1.4.1 Amenable Mortality due to cardiovascular diseases**

Amenable mortality due to cardiovascular diseases (CVDs) provides an indication of the effectiveness of CVD care over the long term. It refers to the number of deaths from CVDs that are potentially preventable given timely and effective healthcare services. A higher amenable mortality rate implies less effective CVD healthcare services provided by a health system.

Amongst the G20+ countries with comparable data, Mexico (61 per 100,000), the United States (47 per 100,000), and the United Kingdom (34 per 100,000) had the highest amenable mortality rates of CVD.<sup>30</sup> China also had a relatively high rate of amenable mortality from ischaemic heart disease of 96 per 100,000 and 142 per 100,000 from stroke.<sup>31</sup> Of the G20+ countries for which data were available, the lowest amenable age-standardised mortality rates for CVD were in France (19 per 100,000), Spain (24 per 100,000) and Australia (24 per 100,000)<sup>30</sup> (Figure 2.27).

Figure 2.27 Amenable Age-Standardised Mortality Rates for Ages 0-74 from Cardiovascular Diseases (per 100,000) in G20+ countries, 2000/2003 and 2010/2013 (or nearest year)

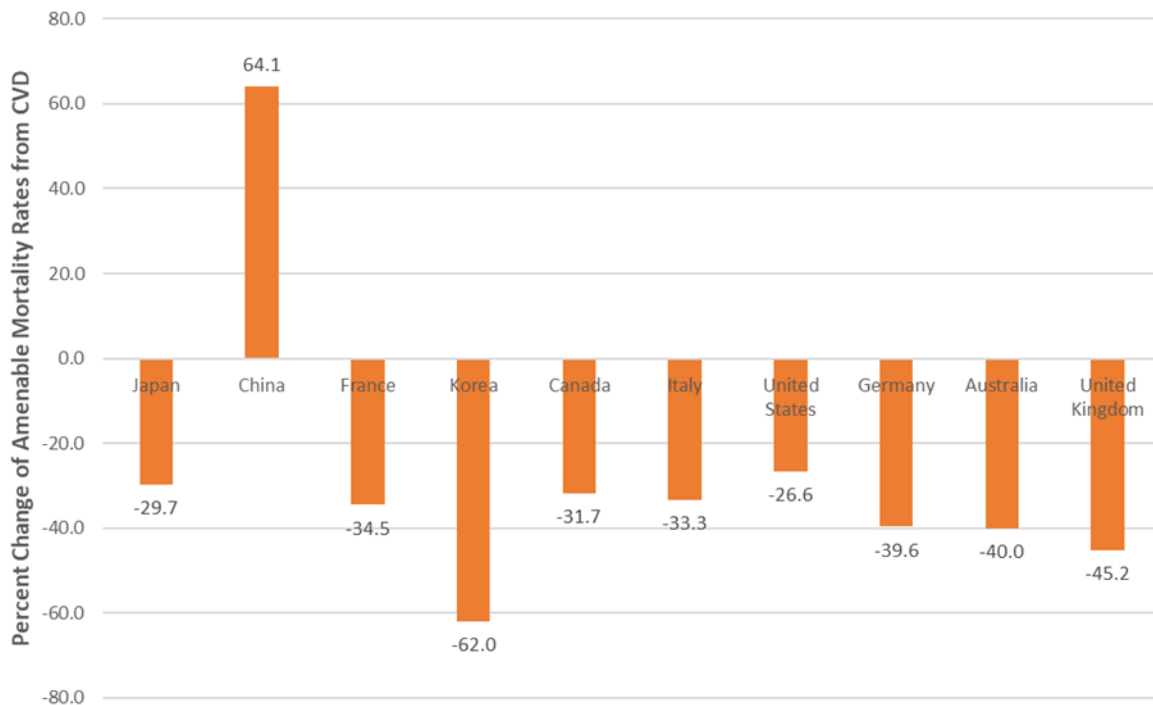


Note: Data for 2010/2012 for Italy. Data for 2006/2012 for China.

Source: Gianino et al. (2017), for China: Feng et al. (2016).

In terms of the CVD amenable mortality trend from 2000 to 2013, among G20+ countries with data, Korea had the largest decline in CVD amenable mortality rate over time (62% decreased), followed by the United Kingdom (45.2% decreased) and Australia (40% decreased). Conversely, China had the greatest increase in CVD amenable mortality rate over time (64%) (Figure 2.28).

Figure 2.28 Percent Change of Amenable Mortality Rates for Ages 0-74 from Cardiovascular Disease in G20+ countries from 2000/2003 to 2010/2013



Note: Data for 2006/2012 for China. The estimate for China is a percent change of amenable mortality rates for age 0 - 74 from ischaemic heart disease from 2006 to 2012.

Source: Gianino et al. (2017), for China: Feng et al. (2016).

#### 2.4.1.4.2 Avoidable Hospital Admissions

Avoidable hospital admissions is a metric that allows health systems to quantify the amount of hospital admissions due to a disease that exceed the number that would occur when high-quality, accessible primary care is available. In other words, these are hospital admissions that could be prevented with better health system performance.

In the context of CVD, there are studies that have evaluated avoidable hospital admissions for both congestive heart failure and hypertension. We chose not to report hypertension hospital admissions across G20+ due to concerns with inconsistency in ICD-10 code for hypertension



across countries (e.g., primary hypertension versus secondary hypertension), which could provide misleading findings of health system performance for CVD care.

#### **2.4.1.4.2.1 Congestive heart failure hospital admissions**

Most hospital admissions for congestive heart failure last at least three days. Patients often enter the hospital system through the emergency department and eventually are admitted to cardiology or internal medicine services. Multi-day admissions lead to higher costs for both the patient and their insurance, in addition to placing a greater burden on healthcare providers and health system resources.

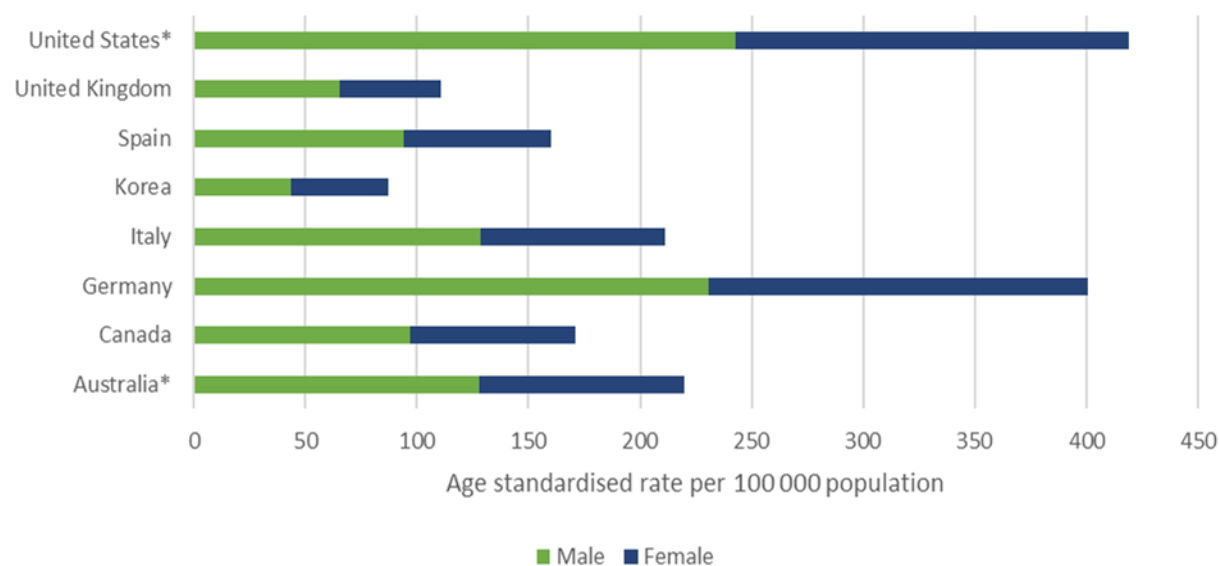
Congestive heart failure admissions can be compared between countries by examining the rate they occur per population. These estimates are calculated by summing congestive heart failure hospital admissions at all acute care hospitals per country and then dividing by the country's population.

Congestive heart failure hospital admissions are avoidable because congestive heart failure should, in theory, be effectively managed by a primary care team and should not require hospital admission for exacerbations.

Of the G20+ countries with data available in either 2018 or 2019, congestive heart failure admissions were highest in the United States (411.7 per 100,000), and Germany (393.8 per 100,000) and lowest in Korea (88.4 per 100,000) and the United Kingdom (107.8 per 100,000) (Figure 2.29). In the G20+ countries the majority of the congestive heart failure admissions were in men, with the exception of Korea, where the admission rates were 87.1 per 100,000 population in males and 87.7 per 100,000 population in females (Figure 2.29).

The OECD conducted trend analyses of improvements in one-year mortality and one-year readmission rates after hospital discharge due to congestive heart failure over a five-year period from 2013 to 2018. They found that many G20+ countries, such as Canada, Japan, and Italy showed a small improvement in those outcomes over the five years.<sup>32</sup>

Figure 2.29 Age-Standardised Rate of Congestive Heart Failure Hospital Admission in G20+ countries by Gender, 2018



Note: The relative contributions of males and females to the overall age standardised rate are reflected in this figure. The individual age standardised rate for either males or females as individual categories are not included here.

\*Data from 2018

Source: OECD Health Statistics. [https://www.oecd-ilibrary.org/social-issues-migration-health/data/oecd-health-statistics\\_health-data-en](https://www.oecd-ilibrary.org/social-issues-migration-health/data/oecd-health-statistics_health-data-en)

#### 2.4.2 Equity - Socioeconomic disparities in cardiovascular disease burden and care

Health systems in many G20+ countries have not been able to successfully address the disparities among different socio-economic population groups for CVD risk, provision of CVD healthcare services and CVD related health outcomes.

In terms of CVD burden, studies conducted in different G20+ countries, e.g., Australia, China, and the United States, found that there are widening disparities in CVD prevalence between the poorest and richest populations, with higher CVD prevalence reported in the lowest socioeconomic group.<sup>1,33,34</sup> Likewise, a study conducted in the United Kingdom has revealed substantial socioeconomic inequalities in CVD mortality.<sup>35</sup> In the European Union, evidence suggests that there is generally an approximately two-fold difference in CVD mortality between the upper and lower wealth quintiles, a difference which is much larger than that for cancer mortality.<sup>3</sup>

A similar pattern of inequality exists in relation to CVD risks. A longitudinal study conducted in the United States from 1999-2014 showed minimal improvement of any CVD risks (e.g., diabetes, systolic blood pressure, total cholesterol, and smoking status) over time in individuals with incomes less than the federal poverty line.<sup>36</sup> In the European Union, several studies indicate that many mediators contribute to inequalities in CVD risks, with percentage contributions up to 50%, which include socioeconomic status (e.g., housing conditions and living neighbourhood, working conditions, and access to care)<sup>3</sup>

Inequalities also exist for provision of CVD related healthcare services. Studies conducted in Canada and the United States found that individuals with lower socioeconomic status received fewer CVD procedures, e.g., coronary angiography and thrombolysis, than those with higher socioeconomic status.<sup>37,38</sup> In the United States, there were also disparities between racial groups, with lower access to CVD interventions reported in African American and Hispanic populations.<sup>38</sup>

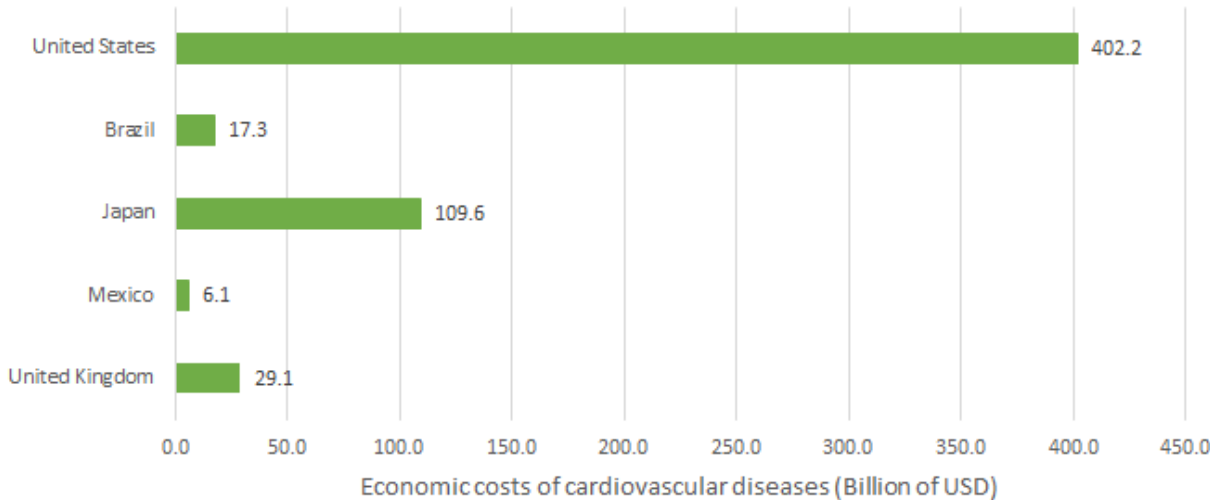
Disparities also exist in adherence to and long-term persistence with medications, with lower persistence with statins used for primary and secondary prevention in individuals with low socioeconomic status in Italy<sup>39</sup>, and in African Americans in the United States.<sup>40</sup>

### 2.4.3 Economic costs of Cardiovascular Disease

Economic cost of cardiovascular disease (CVD) refers to the direct healthcare cost plus the indirect cost of illness, e.g., those due to loss in productivity and human capital.

In the G20+ countries for which data were available the United States experienced the highest economic cost of CVD at US\$402.2 billion<sup>41</sup> in one year, followed by Japan (US\$109.6 billion)<sup>2</sup>, the United Kingdom (US\$29.1 billion)<sup>42</sup>, Brazil (US\$ 17.3 billion)<sup>2</sup>, and Mexico (US\$6.1 billion)<sup>2</sup> (Figure 2.30).

Figure 2.30 Direct Costs of Ischaemic Heart Disease in G20+ countries for which data are available, 2016 (or nearest year)



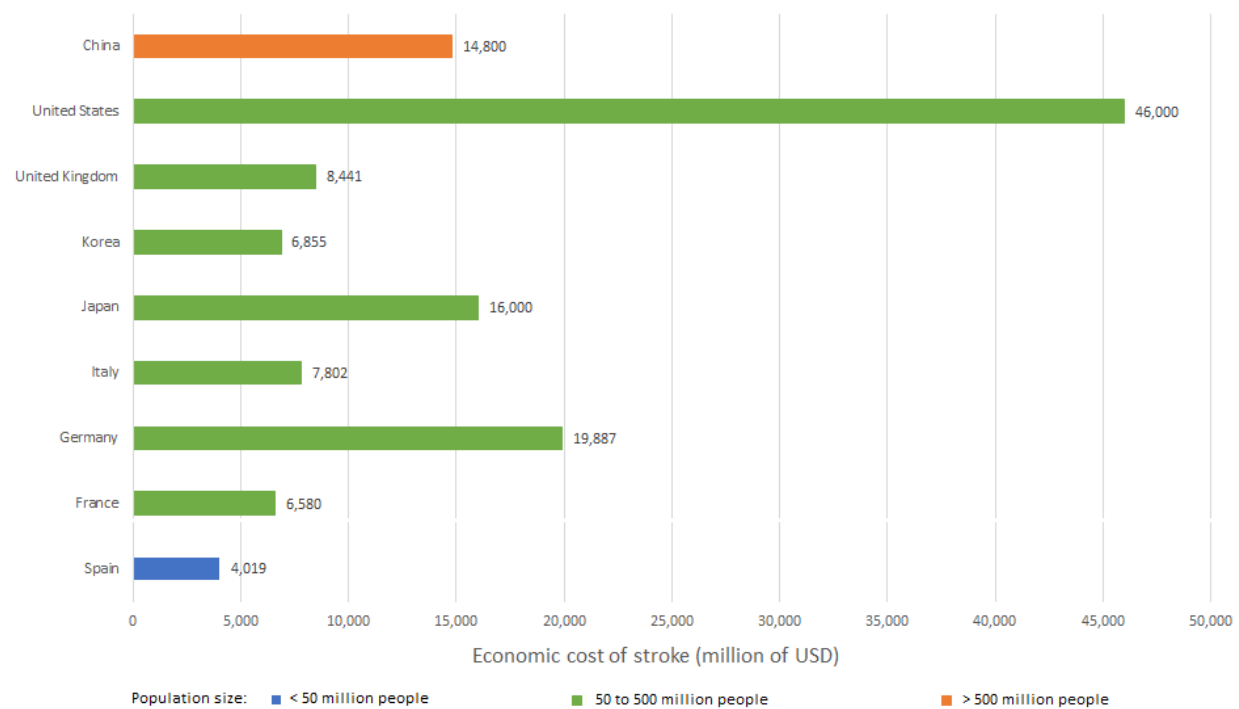
Note: For all countries, the economic cost of cardiovascular disease (CVD) refers to the direct healthcare cost plus the indirect cost of illness, e.g., those due to loss in productivity and human capital. All costs were converted into USD using exchange rates in corresponding years according to the OECD data.<sup>8</sup> Data for 2015 for Brazil, data for 2014 for Japan, data for 2015 for Mexico; data for 2004 for the United Kingdom, and data for 2019 for the United States of America.

Source: for Brazil, Japan and Mexico: Mendoza-Herrera (2019); for United Kingdom: Luengo-Fernández R et al. (2006); for United States of America: Benjamin EJ et al. (2019)

### 2.4.3.1 Economic cost of stroke and efficiency of stroke care

Stroke leads to major economic costs due to long-term morbidities. In the G20+ countries with available data, the annual economic cost of stroke ranged from US\$46 billion in the United States<sup>43</sup> to US\$19 billion in Germany<sup>44</sup>, US\$16 billion in Japan<sup>45</sup>, and US\$14.8 billion in China<sup>46</sup>. The economic cost was US\$8.4 billion in the United Kingdom<sup>44</sup>, US\$6.8 billion in Korea<sup>47</sup> and US\$0.9 in Australia<sup>48</sup> (Figure 2.31).

Figure 2.31 Economic Cost of Stroke in G20+ countries for which data are available, 2017 (or nearest year)



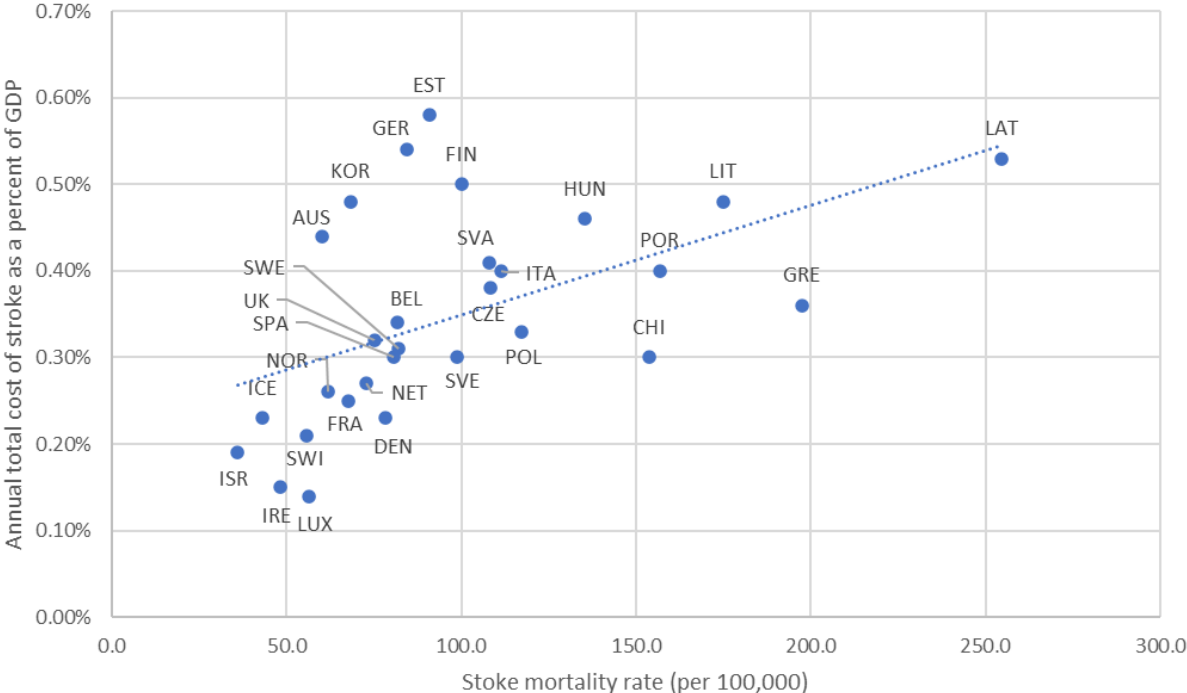
Note: Most countries, except China, define the economic costs of stroke as direct health care costs plus indirect costs. China includes only direct outpatient and inpatient costs while Japan does not clearly specify the definition of economic costs. However, the details of direct health care costs and indirect costs vary across countries. Most countries define direct healthcare costs (which include primary, accident and emergency, outpatient and hospital inpatient care, as well as medications) and indirect costs (which include social care costs, informal care costs from the opportunity cost of unpaid care, productivity costs due to mortality, and productivity

costs due to morbidity) (France, Germany, Italy, Spain, and the United Kingdom). The United States includes direct health care cost as the cost of physicians and other professionals, hospital services, prescribed medications, and home health care, but not the cost of nursing home care), and indirect costs as the lost future productivity attributed to premature mortality. Korea includes direct health care cost as inpatient costs, outpatient costs, transportation cost used for outpatient visits, and caregiver cost, and indirect costs as the loss of productivity and indirect cost-of-illness due to premature death. All costs were converted into USD using exchange rates of corresponding years available from the OECD data.<sup>8</sup> Data for 2008 for China; data for 2017 for Germany, France, Spain, Italy, and United Kingdom; data for 2016 for Japan; data for 2015 for Korea; data for 2014 for the United States.

Source: Luengo-Fernandez et al. (2020), for China: Lu et al. (2014), for Japan: Toyoda (2019), for Korea: Cha (2018), for the United States: Virani et al. (2020)

The economic loss due to stroke as a percent of Gross Domestic Product (GDP) ranged from 0.14% to 0.58% in G20+ countries and selected comparator countries for which data were available. Among the G20+ countries, the highest economic cost of stroke as a percent of GDP was in Germany (0.54%)<sup>44</sup>, and Korea (0.48%)<sup>47</sup>, and lowest in France (0.25% of GDP)<sup>44</sup>, and Spain (0.30%)<sup>44</sup> (Figure 2.32).

Figure 2.32 Mortality Rate of Stroke and Annual Total Cost of Stroke in G20+ countries and selected comparator countries for which data are available, 2017 (or nearest year)



Note: All countries, except China, define economic costs of stroke as direct health care costs plus indirect costs. China includes only direct outpatient and inpatient costs. For all countries, except Korea, direct healthcare costs include primary, accident and emergency, outpatient and hospital inpatient care, as well as medications; indirect costs include social care costs, informal care costs from the opportunity cost of unpaid care, productivity costs due to mortality, and productivity costs due to morbidity (France, Germany, Italy, Spain, and the United Kingdom). Korea includes direct health care cost as inpatient costs, outpatient costs, transportation cost used for outpatient visits, and caregiver cost; and indirect costs as the loss of productivity and indirect cost-of-illness due to premature death. All costs were converted into USD using exchange rates of corresponding years available from the OECD data.<sup>8</sup> Data for 2017 for all countries, except China and Korea. Data for 2008 for China; data for 2015 for Korea. The blue dotted line represents a best-fit line.

Source: Luengo-Fernandez et al. (2020), for China: Lu et al. (2014), and for Korea: Cha (2018)

Inefficiency of CVD care in G20+ countries is potentially attributable to i) high avoidable hospital admission due to CVD, ii) inefficient care coordination processes between multiple units and across multiple professions within hospitals, and iii) delays in discharging patients with CVD from hospitals due to inefficient processes within hospitals, poor-quality care and errors, and poor care coordination between different parts of the health system. In 2014, the average length of stay in hospitals across different G20+ countries ranged from 4 days to over 15 days.

#### *2.4.3.3 Cost-related Adherence to Medication*

Adherence to medication, which means the ability to take the appropriate amount of medication at the appropriate time, is a challenge for both patients and health systems.

As most medications for CVD need to be taken at least once per day, adherence to medication is a major component in disease management. Unfortunately, patients often face numerous barriers which prevent them from achieving good adherence to medication. Cost of medication is frequently cited by patients as one of the more difficult barriers to overcome. The range in support for medication costs varies greatly among G20+ countries, as do the costs related to medical adherence.

In Australia, patients who paid full price for lipid-lowering medicines, statins, were 60% more likely to fail to adhere to their treatment regimen than patients who had access to discounted medications.<sup>49</sup> In China, medication affordability and health services were the second most commonly reported barrier to adherence for stroke medication.<sup>50</sup> However, out of pocket costs for stroke declined 60% between 2001 and 2016, which indicates a favourable trajectory for patients.<sup>50</sup>

In Canada, a minority of patients described general CVD medication affordability as a significant factor that prevented them from taking their medication,<sup>51</sup> whereas in India patients reported that general CVD medication affordability was the largest barrier to medication adherence.<sup>51</sup>

A comparative study in Spain and the United States, which examined disparities in cost-related medical adherence, indicated that approximately 20% of patients experience financial barriers



to medication, and younger patients, regardless of sex, encountered financial barriers more often than their older counterparts.<sup>52</sup>

A four-year study of approximately 14,000 patients in the United States revealed that 12.5% of patients with CVD described an inability to adhere to medications because of the financial cost.<sup>53</sup> The authors estimate that this represents ~1.5 million patients who miss doses, ~1.6 million who take doses that are lower than prescribed, and ~1.9 million who purposefully delay filling medication to save costs.

#### 2.4.4. Responsiveness

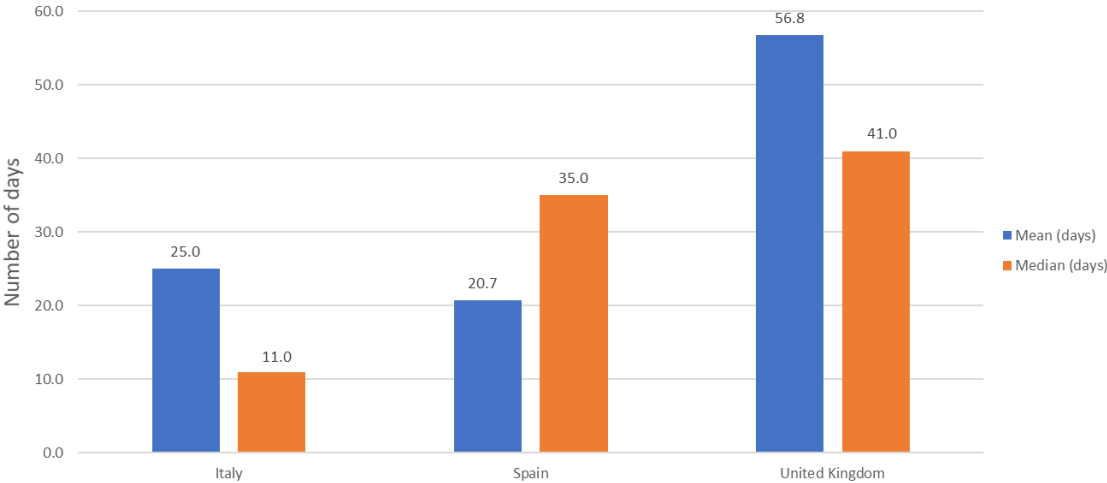
Responsiveness examines how well health systems meet the expectations of patients with CVD or who are at risk of developing CVD. While expectations may vary from person to person, they are closely related to accessibility, timely access and provision of services, trust, and the perceived quality and experience of healthcare services provided to patients with CVD by the health system. Several indicators can be used to examine responsiveness, including waiting times for accessing services when needed.

##### *2.4.4.1 Waiting times from specialist assessment to treatment*

Waiting times from specialist assessment to emergency or elective interventions for CVD enable examination of the timeliness of healthcare services and interventions. The OECD uses this indicator to measure the duration from when a specialist includes a patient on the procedure waiting list to the time the patient undergoes the procedure. Long waiting times suggest suboptimal responsiveness as delays to care increase the risks of deterioration of the condition and lower the quality of life in those with CVD. This indicator is reported in mean and median waiting times and percentage of all patients waiting more than three months for a set of tracer interventions commonly used to manage CVD. Given the possibility of outliers (i.e., some patients may have to wait for a significantly longer period of time to receive the treatment), the median is potentially a better measure than the mean for this indicator.

Percutaneous Transluminal Coronary Angioplasty (PTCA) is a minimally invasive medical procedure used for patients experiencing a heart attack to relieve a blockage of coronary arteries.<sup>54</sup> It can be done as an emergency intervention for acute MI or as an elective procedure. For G20+ countries, in the OECD Health Data, comparable data were available in just three countries, namely, Italy, Spain and the United Kingdom, where the waiting times ranged from 11 days in Italy to 35 and 41 days, respectively in Spain and the UK (Figure 2.33).

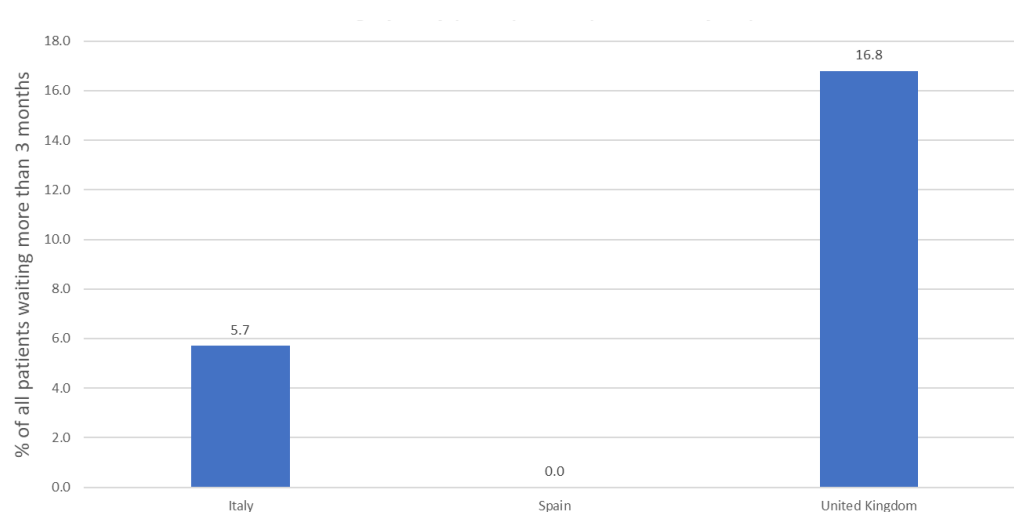
Figure 2.33 Waiting Times from Specialist Assessment to Percutaneous Transluminal Coronary Angioplasty (PTCA) reported in number of days in G20+ countries for which data are available, 2020 (or nearest year)



Source: OECD Health Statistics 2020.

In the three G20+ countries, the proportion of patients requiring PTCA who waited more than three months to receive the intervention ranged from 0% in Spain to 5.7% in Italy to 16.8% in the United Kingdom (Figure 2.34).

Figure 2.34 Waiting Times from Specialist Assessment to Percutaneous Transluminal Coronary Angioplasty (PTCA) reported in percentage of all patients waiting more than three months in G20+ countries for which data are available, 2020 (or nearest year)

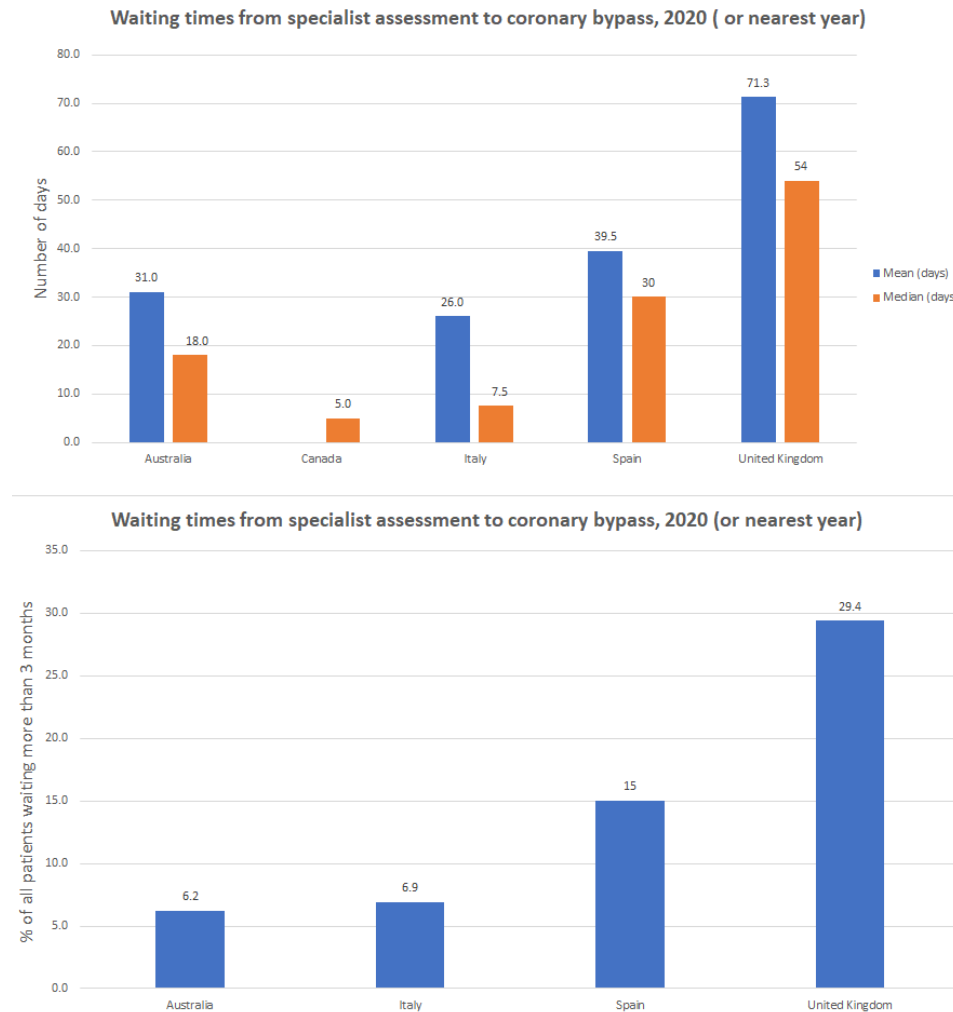


Source: OECD Health Statistics 2020.

A coronary artery bypass graft (CABG) is a surgical procedure used to treat coronary heart disease to create a new path for improving blood flow to the heart.<sup>55</sup> Occasionally, the operation is an emergency, but most of the time, it is an elective procedure. Comparable data on waiting times were available in five G20+ countries, where the median waiting times from specialist assessment to CABG ranged from 5 days in Canada to 7.5 days in Italy, 18 days in Canada, 30 days in Australia and 54 days in the United Kingdom (Figure 2.35).

In the G20+ countries, the proportion of patients requiring CABG who waited longer than three months to undergo CABG ranged from 6.2% in Australia to 6.9% in Italy, 15% in Spain and 29.4% in the United Kingdom, while the lowest proportions occurred in Denmark (1.3%) (Figure 2.35).

Figure 2.35 Waiting Times from Specialist Assessment to Coronary Bypass reported in number of days and in percentage of all patients waiting more than three months in G20+ countries for which data are available, 2020 (or nearest year)



Source: OECD Health Statistics 2020.

### 3.0 Discussion

Cardiovascular Disease (CVD) is the number 1 cause of death globally. In 2019 it led to 18.6 million deaths worldwide. From 2009 to 2019, worldwide, the number of people with CVD increased from 271 million to 523 million people. Similarly, in G20+ countries, CVD is the number 1 cause of mortality and morbidity in 40% of the countries, and the number 2 cause in 55% of countries. After a period of decline in 1990-2010, CVD mortality levels have increased in most G20+ countries.

As with the major adverse impact on the health and wellbeing of the population, CVD is also a major cost to health systems and economies. The direct costs for CVD on G20+ health systems are very substantial and account for a large proportion of the total healthcare expenditures in G20+ countries, ranging from 11% in Australia to 15% in the United States. The direct cost of CVD amounts to more than \$600 billion to G20+ health systems each year.

Yet, despite the vast health and economic burden of CVD to the G20+, most of the essential data needed to examine and compare health system performance are woefully absent. This shows a major failure of leadership, policy and implementation in health systems for a condition that accounts for the largest number of deaths in G20+.

The paucity of CVD related data is unacceptable and inexcusable. Analysis of the few available data suggests the response of health systems has been poor in terms of effectiveness, efficiency, equity and responsiveness of CVD prevention and care provided. For example, in G20+ countries, on average, only 48% of patients at risk of CVD are prescribed primary preventive medications, and in some G20+ countries, this figure is just 26.5%. There are major differences in the performance levels achieved among G20+ countries, while major inequities exist in the prevention of CVD risk, access to CVD care, diagnostics and medications, and CVD-

related health outcomes. As a result, there are large numbers of unnecessary deaths and huge economic cost to G20+ from CVD, for example, amounting to USD400 billion in the US and USD\$109 billion in Japan.

To effectively address CVD, G20+ countries need decisive and concerted action. These include, among others:

- (i) robust digital data systems to regularly collect essential data to measure the incidence, prevalence, morbidity and mortality of CVD in G20+ countries
- (ii) a major G20+ initiative with the capacity for new data collection G20+ wide analysis to examine health systems performance (using established approaches such as that developed by the OECD) in addressing the CVD burden in G20+ countries to ascertain areas of weakness and to inform policy and practice
- (iii) G20+ wide studies to quantify the health, economic and societal burden of CVD
- (iv) creation of a cross-country G20+ collaboration to learn from examples of successful initiatives in G20+ countries in addressing CVD burden
- (v) identification of innovations and interventions that can be scaled-up at the population level to equitably address the CVD burden in G20+ countries, and to quantify the cost and benefits of investing in innovations to improve effectiveness, efficiency, equity and responsiveness of CVD management, and
- (vi) the establishment of novel strategic public-private partnerships that can be used to harness different capabilities to scale-up innovations and existing cost-effective interventions to decisively address the CVD burden and better prepare for the future challenges posed by CVD.

There is an imperative for urgent action to address the silent pandemic of CVD in G20+ and beyond. Appropriate and timely investments in innovations to decisively address CVD will help prevent millions of avoidable deaths each year, alleviate unnecessary suffering, and bring much health, economic, and societal benefits to individuals, communities, and countries.

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