

# Global and regional burden of first-ever ischaemic and haemorrhagic stroke during 1990–2010: findings from the Global Burden of Disease Study 2010

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## Summary

**Background** The burden of ischaemic and haemorrhagic stroke varies between regions and over time. With differences in prognosis, prevalence of risk factors, and treatment strategies, knowledge of stroke pathological type is important for targeted region-specific health-care planning for stroke and could inform priorities for type-specific prevention strategies. We used data from the Global Burden of Diseases, Injuries, and Risk Factors Study 2010 (GBD 2010) to estimate the global and regional burden of first-ever ischaemic and haemorrhagic stroke during 1990–2010.

**Methods** We searched Medline, Embase, LILACS, Scopus, PubMed, Science Direct, Global Health Database, the WHO library, and regional databases from 1990 to 2012 to identify relevant studies published between 1990 and 2010. We applied the GBD 2010 analytical technique (DisMod-MR) to calculate regional and country-specific estimates for ischaemic and haemorrhagic stroke incidence, mortality, mortality-to-incidence ratio, and disability-adjusted life-years (DALYs) lost, by age group (aged <75 years, ≥75 years, and in total) and country income level (high-income and low-income and middle-income) for 1990, 2005, and 2010.

**Findings** We included 119 studies (58 from high-income countries and 61 from low-income and middle-income countries). Worldwide, the burden of ischaemic and haemorrhagic stroke increased significantly between 1990 and 2010 in terms of the absolute number of people with incident ischaemic and haemorrhagic stroke (37% and 47% increase, respectively), number of deaths (21% and 20% increase), and DALYs lost (18% and 14% increase). In the past two decades in high-income countries, incidence of ischaemic stroke reduced significantly by 13% (95% CI 6–18), mortality by 37% (19–39), DALYs lost by 34% (16–36), and mortality-to-incidence ratios by 21% (10–27). For haemorrhagic stroke, incidence reduced significantly by 19% (1–15), mortality by 38% (32–43), DALYs lost by 39% (32–44), and mortality-to-incidence ratios by 27% (19–35). By contrast, in low-income and middle-income countries, we noted a significant increase of 22% (5–30) in incidence of haemorrhagic stroke and a 6% (–7 to 18) non-significant increase in the incidence of ischaemic stroke. Mortality rates for ischaemic stroke fell by 14% (9–19), DALYs lost by 17% (–11 to 21%), and mortality-to-incidence ratios by 16% (–12 to 22). For haemorrhagic stroke in low-income and middle-income countries, mortality rates reduced by 23% (–18 to 25%), DALYs lost by 25% (–21 to 28), and mortality-to-incidence ratios by 36% (–34 to 28).

**Interpretation** Although age-standardised mortality rates for ischaemic and haemorrhagic stroke have decreased in the past two decades, the absolute number of people who have these stroke types annually, and the number with related deaths and DALYs lost, is increasing, with most of the burden in low-income and middle-income countries. Further study is needed in these countries to identify which subgroups of the population are at greatest risk and who could be targeted for preventive efforts.

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## Introduction

Investigation of stroke burden by its major pathological types, and study of their secular trends in different regions of the world, is important for targeted region-specific health-care planning in stroke (eg, estimation of resources needed to care for patients with stroke, by type) and can inform priorities for type-specific prevention strategies. These data are also important for improving understanding of the health consequences and patterns of epidemiological transitions reported worldwide. Findings from systematic

reviews suggest that low-income and middle-income countries have a greater proportion of haemorrhagic stroke than do high-income countries,<sup>1</sup> that geographical variation is high in the incidence of major pathological types of stroke,<sup>1</sup> and that no substantial changes have taken place in the incidence of haemorrhagic stroke in the past three decades.<sup>2,3</sup> However, no detailed and systematic comprehensive estimates have been made of the global and regional incidence, case-fatality, disability-adjusted life-years (DALYs) lost, and secular trends of incidence of

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See Online for appendix

ischaemic or haemorrhagic stroke, especially for low-income and middle-income countries.<sup>4-6</sup> We report estimates from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD 2010) for incidence, mortality, mortality-to-incidence ratio, and DALYs lost in ischaemic or haemorrhagic stroke in all 21 regions of the world<sup>7</sup> in 1990, 2005, and 2010.

## Methods

### Systematic literature review

We did a systematic literature review to establish the review process. The search strategy and selection criteria have been described elsewhere.<sup>8,9</sup> We assessed pathological types of stroke for studies that used head CT or MRI within the first 2 weeks of stroke onset, or for those in which brain autopsy findings for confirmation of type were available for at least 70% of stroke cases. We categorised pathological stroke types into two groups—*ischaemic* and *haemorrhagic* (intracerebral haemorrhage and subarachnoid haemorrhage combined). We included all age groups in the analysis. We analysed only first-ever stroke events.

### Calculation of incidence, mortality, and DALYs lost

We have described our statistical analysis strategies elsewhere and in a companion report in *The Lancet*.<sup>8,9</sup> Briefly, we applied the GBD 2010 analytical technique (DisMod-MR) to calculate regional and country-specific estimates of incidence and mortality per 100 000 person-years for ischaemic and haemorrhagic stroke, and of DALYs lost per 100 000 people, by age group (<20 years, 20–64 years, 65–74 years, ≤75 years, total) and level of country income (high and low and middle) for 1990, 2005, and 2010.

### Disease modelling

For modelling of mortality for ischaemic and haemorrhagic stroke, we selected a set of relevant covariates (appendix) and assumed a plausible direction of effect on the basis of existing published work. The ensemble approach combined different model results developed with different combinations of covariates and statistical approaches.<sup>10</sup> In a separate process—the CODCorrect process<sup>11</sup>—the number of deaths from ischaemic or haemorrhagic stroke were rescaled to total the overall number of deaths (mortality envelope) for a country, sex, and age group. This process also ensured that the sum of cardiovascular disease deaths was equal to all deaths from cardiovascular disease (modelled independently). The appendix shows the estimates before and after correction for stroke deaths. We report age-standardised incidence and mortality rates per 100 000 person-years and estimates of DALYs lost per 100 000 people with the direct method of standardisation and WHO's standard population as a reference.<sup>12</sup> Additionally, we calculated mortality-to-incidence ratio for each region and country as an indicator of the success or failure of stroke management strategies in a particular region (ratio numbers were based on the total number of

incident cases and deaths). We estimated p values on the basis of 1000 draws of the posterior distribution of each statistic. Because some posterior distributions deviated significantly from normal, 2·5 and 97·5 percentiles of the draws were reported as the lower and upper bounds of the uncertainty interval for the statistic. We calculated 95% CIs for all rates.

### Role of the funding source

The sponsor of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The Writing and GBD Global Analysis Group had full access to all the data in the study and had final responsibility for the decision to submit for publication.

## Results

Characteristics of studies included in the analysis are described in the accompanying *Lancet* paper.<sup>9</sup> We included 119 studies (58 from high-income countries and 61 from low-income and middle-income countries) in this analysis.

Worldwide in 2010, an estimated 11 569 538 events of incident ischaemic stroke took place (63% in low-income and middle-income countries), and 5 324 997 events of incident haemorrhagic stroke (80% in low-income and middle-income countries); furthermore, 2 835 419 individuals died from ischaemic stroke (57% in low-income and middle-income countries) and 3 038 763 from haemorrhagic stroke (84% in low-income and middle-income countries; appendix). In 2010, 39 389 408 DALYs were lost because of ischaemic stroke (64% in low-income and middle-income countries) and 62 842 896 because of haemorrhagic stroke (86% in low-income and middle-income countries; appendix). In 2010, age-standardised incidence per 100 000 person-years of ischaemic stroke ranged from 51·88 in Qatar to 433·97 in Lithuania (table 1); incidence of haemorrhagic stroke ranged from 14·55 in Qatar to 159·81 in China; (table 2). Age-standardised mortality rates per 100 000 person-years for ischaemic stroke ranged from 9·17 in Qatar to 137·70 in Russia (table 1); the rate of haemorrhagic stroke ranged from 9·64 in the USA to 210·56 in Mongolia (table 2). DALYs lost per 100 000 people because of ischaemic stroke ranged from 163·89 in Israel to 2032·11 in Afghanistan (table 1); for haemorrhagic stroke the number of DALYs lost ranged from 178·20 in Switzerland to 4118·90 in Mongolia (table 2).

In the past two decades in high-income countries, incidence of ischaemic stroke significantly reduced by 13% (95% CI 6–18), mortality by 37% (19–39), DALYs by 34% (16–36), and mortality-to-incidence ratios by 21% (10–27; table 3). Reductions shown for haemorrhagic stroke were 19% (1–15%) for incidence, 38% (32–43%) for mortality, 39% (32–44%) for DALYs, and 27% (19–35%) for mortality-to-incidence ratio (table 3). Reductions in incidence in both stroke groups were significant for the younger age group (<75 years, from 110·80/100 000 [95% CI 103·05–118·54] to 100·47/100 000 [94·03–107·16],

|                              | 1990                   |                        |                           | 2010                   |                       |                           |
|------------------------------|------------------------|------------------------|---------------------------|------------------------|-----------------------|---------------------------|
|                              | Incidence              | Mortality              | DALYs                     | Incidence              | Mortality             | DALYs                     |
| Afghanistan                  | 123.46 (79.12-177.54)  | 114.82 (84.30-185.09)  | 2043.52 (1481.61-3088.72) | 146.75 (99.28-209.31)  | 117.32 (91.85-175.11) | 2032.11 (1576.60-2886.65) |
| Albania                      | 207.05 (136.39-297.44) | 24.79 (22.43-26.61)    | 403.25 (362.53-436.33)    | 206.14 (137.96-295.90) | 24.82 (19.48-28.49)   | 376.11 (301.21-428.25)    |
| Algeria                      | 114.43 (75.46-167.67)  | 68.03 (59.24-77.42)    | 1032.50 (915.68-1149.90)  | 132.16 (87.87-192.14)  | 52.51 (46.53-58.45)   | 743.03 (662.55-810.74)    |
| Andorra                      | 124.35 (82.26-180.14)  | 38.91 (30.65-46.02)    | 515.51 (425.67-598.11)    | 102.37 (68.71-147.29)  | 25.04 (19.77-30.88)   | 343.12 (279.97-411.83)    |
| Angola                       | 130.83 (87.64-185.57)  | 56.02 (42.36-85.34)    | 914.66 (685.08-1272.09)   | 159.78 (104.45-234.14) | 51.78 (37.27-73.88)   | 804.47 (578.70-1073.96)   |
| Antigua and Barbuda          | 138.03 (92.44-201.40)  | 33.85 (26.04-37.43)    | 566.51 (438.90-623.25)    | 135.86 (91.19-200.43)  | 17.38 (14.81-23.58)   | 304.44 (261.61-396.51)    |
| Argentina                    | 145.02 (92.92-214.96)  | 56.11 (42.83-60.54)    | 768.46 (603.26-820.37)    | 105.54 (70.12-152.50)  | 27.48 (23.16-41.50)   | 366.44 (323.59-515.43)    |
| Armenia                      | 198.51 (130.43-285.69) | 45.61 (39.76-51.77)    | 665.18 (581.27-745.76)    | 212.64 (141.77-308.13) | 41.17 (32.80-47.26)   | 609.06 (485.33-695.67)    |
| Australia                    | 98.11 (80.00-119.09)   | 39.05 (35.42-43.22)    | 432.98 (395.62-473.61)    | 76.27 (62.86-92.39)    | 20.51 (17.40-24.72)   | 222.28 (191.99-263.93)    |
| Austria                      | 127.84 (88.97-188.45)  | 46.92 (39.48-50.68)    | 556.56 (464.01-604.11)    | 101.51 (68.46-149.81)  | 17.77 (14.89-27.25)   | 229.79 (192.04-314.66)    |
| Azerbaijan                   | 199.90 (131.14-286.56) | 46.28 (40.57-52.12)    | 710.85 (624.67-792.38)    | 215.46 (139.56-314.49) | 40.04 (30.67-45.94)   | 622.35 (485.48-701.48)    |
| Bahrain                      | 52.48 (36.96-71.48)    | 36.58 (32.67-40.64)    | 588.81 (533.69-655.52)    | 57.20 (39.68-78.35)    | 18.19 (15.73-20.43)   | 301.05 (260.81-340.42)    |
| Bangladesh                   | 98.43 (64.40-139.90)   | 30.37 (23.18-40.55)    | 451.42 (352.40-599.58)    | 114.65 (73.51-165.19)  | 26.92 (18.39-37.92)   | 375.05 (275.86-522.38)    |
| Barbados                     | 176.96 (135.21-227.65) | 45.81 (37.62-49.51)    | 624.57 (519.75-679.14)    | 168.00 (130.76-216.70) | 24.29 (19.79-38.63)   | 331.29 (275.94-484.71)    |
| Belarus                      | 374.97 (310.93-447.27) | 97.28 (83.83-105.99)   | 1400.76 (1208.85-1505.36) | 424.19 (353.20-508.41) | 95.98 (69.90-107.44)  | 1471.88 (1119.52-1637.97) |
| Belgium                      | 128.33 (85.51-184.04)  | 51.82 (46.21-56.30)    | 610.28 (552.93-664.24)    | 103.23 (69.19-150.43)  | 24.97 (21.28-32.44)   | 308.30 (266.78-387.85)    |
| Belize                       | 143.25 (93.58-208.51)  | 41.85 (36.46-46.11)    | 589.04 (506.76-641.33)    | 138.68 (94.30-196.30)  | 31.61 (28.11-36.51)   | 455.49 (408.54-520.81)    |
| Benin                        | 123.88 (82.13-182.51)  | 42.57 (34.20-54.29)    | 680.40 (548.33-832.43)    | 140.88 (92.91-205.70)  | 43.30 (33.57-54.63)   | 682.47 (530.40-831.35)    |
| Bhutan                       | 102.58 (67.34-150.06)  | 28.40 (20.75-41.66)    | 425.27 (320.00-604.94)    | 118.28 (79.26-169.06)  | 28.94 (20.74-40.05)   | 417.28 (311.29-574.18)    |
| Bolivia                      | 89.35 (59.14-131.06)   | 39.10 (32.32-50.36)    | 649.83 (549.94-797.19)    | 85.24 (54.38-125.79)   | 27.80 (22.77-39.91)   | 445.56 (378.57-572.91)    |
| Bosnia and Herzegovina       | 219.50 (147.30-322.87) | 109.95 (101.14-116.78) | 1386.39 (1277.27-1469.83) | 211.50 (138.89-310.29) | 76.88 (62.43-88.99)   | 951.87 (772.34-1101.87)   |
| Botswana                     | 147.72 (97.34-219.56)  | 46.44 (35.31-63.10)    | 680.28 (533.73-900.18)    | 162.61 (105.89-236.68) | 27.56 (16.27-37.23)   | 429.80 (279.92-551.18)    |
| Brazil                       | 189.69 (146.96-242.19) | 61.26 (54.88-65.11)    | 909.78 (819.76-961.14)    | 178.73 (135.70-230.65) | 40.90 (37.40-48.07)   | 570.49 (527.46-664.13)    |
| Brunei                       | 180.76 (119.21-260.86) | 51.49 (33.37-62.02)    | 684.83 (468.34-809.48)    | 129.27 (84.07-188.85)  | 35.22 (24.83-43.17)   | 449.55 (342.72-535.42)    |
| Bulgaria                     | 234.42 (152.70-346.67) | 123.77 (114.18-129.74) | 1626.98 (1489.99-1703.95) | 222.16 (147.64-320.65) | 106.44 (90.94-114.27) | 1380.28 (1173.14-1472.21) |
| Burkina Faso                 | 117.01 (79.41-169.49)  | 23.71 (16.88-36.32)    | 417.76 (297.50-606.01)    | 143.78 (94.82-210.21)  | 46.24 (32.66-59.30)   | 747.73 (520.43-937.53)    |
| Burundi                      | 130.40 (87.07-194.12)  | 77.46 (40.12-127.01)   | 1207.49 (621.24-2071.37)  | 152.18 (101.34-220.44) | 68.26 (41.91-115.58)  | 1051.11 (631.89-1877.00)  |
| Cambodia                     | 136.77 (90.04-201.44)  | 46.30 (35.26-63.65)    | 766.77 (603.75-1037.40)   | 159.38 (104.29-232.28) | 50.27 (40.26-64.95)   | 800.41 (664.40-997.52)    |
| Cameroon                     | 127.52 (79.79-185.75)  | 44.72 (36.99-55.39)    | 722.89 (610.37-875.46)    | 147.32 (98.91-211.88)  | 41.05 (33.43-50.43)   | 653.51 (547.35-774.10)    |
| Canada                       | 133.05 (86.31-193.70)  | 32.98 (29.87-36.82)    | 404.86 (361.82-462.44)    | 108.17 (70.11-154.35)  | 18.91 (16.16-22.44)   | 287.30 (230.79-363.78)    |
| Cape Verde                   | 125.33 (81.77-185.50)  | 59.26 (49.66-69.54)    | 915.35 (779.53-1040.99)   | 141.31 (94.39-210.80)  | 48.23 (36.76-61.73)   | 706.46 (541.67-888.11)    |
| Central African Republic     | 139.23 (89.09-201.88)  | 63.25 (46.45-87.89)    | 1059.39 (765.24-1445.41)  | 169.80 (111.15-247.45) | 61.26 (43.01-88.81)   | 950.19 (664.29-1336.93)   |
| Chad                         | 124.95 (82.42-183.80)  | 38.25 (29.65-50.97)    | 644.51 (508.41-846.01)    | 143.13 (93.60-207.71)  | 38.36 (28.81-49.67)   | 638.96 (477.67-814.44)    |
| Chile                        | 109.41 (83.73-139.96)  | 51.25 (44.43-55.71)    | 657.01 (567.96-701.35)    | 77.75 (60.72-101.05)   | 23.34 (20.53-28.35)   | 301.59 (269.53-356.66)    |
| China                        | 226.45 (170.15-295.26) | 56.33 (40.82-83.26)    | 767.53 (547.02-1169.10)   | 240.58 (178.54-310.63) | 46.71 (36.74-61.60)   | 612.36 (478.07-835.78)    |
| Colombia                     | 97.43 (64.00-140.16)   | 37.70 (34.05-41.02)    | 532.03 (492.14-575.36)    | 97.39 (64.89-141.97)   | 28.59 (25.17-34.69)   | 364.58 (327.57-434.15)    |
| Comoros                      | 132.69 (89.63-191.24)  | 78.11 (60.70-95.77)    | 1209.70 (949.83-1484.21)  | 153.46 (99.95-223.69)  | 64.31 (51.10-79.74)   | 967.72 (770.27-1189.45)   |
| Congo                        | 137.39 (90.98-194.56)  | 70.00 (55.82-88.02)    | 1095.65 (880.79-1325.17)  | 169.89 (112.56-250.17) | 65.04 (53.05-79.84)   | 1000.83 (821.25-1203.96)  |
| Costa Rica                   | 93.79 (62.82-137.13)   | 17.36 (15.00-18.73)    | 262.73 (226.04-291.15)    | 92.28 (62.43-135.74)   | 11.60 (10.33-14.33)   | 170.66 (146.88-207.30)    |
| Côte d'Ivoire                | 129.60 (85.05-188.29)  | 47.55 (40.66-56.98)    | 781.17 (680.49-914.90)    | 150.37 (97.86-219.05)  | 50.99 (42.51-65.39)   | 847.53 (717.02-1052.67)   |
| Croatia                      | 223.75 (144.23-323.76) | 87.71 (82.15-93.93)    | 1127.75 (1059.04-1200.81) | 209.82 (136.39-306.18) | 56.71 (51.53-62.78)   | 694.70 (635.59-750.92)    |
| Cuba                         | 148.43 (100.02-215.34) | 48.99 (43.17-53.32)    | 683.65 (611.42-723.97)    | 144.44 (94.91-207.81)  | 43.31 (38.32-49.03)   | 540.19 (486.72-596.91)    |
| Cyprus                       | 127.46 (83.83-182.84)  | 37.19 (30.51-43.28)    | 505.08 (432.16-572.15)    | 103.41 (69.65-146.22)  | 21.89 (19.14-25.73)   | 311.11 (273.58-359.32)    |
| Czech Republic               | 234.26 (158.40-342.94) | 124.75 (115.89-133.89) | 1597.87 (1482.53-1719.91) | 215.06 (145.33-312.04) | 63.53 (58.08-74.57)   | 760.29 (703.10-885.82)    |
| Democratic Republic of Congo | 127.96 (84.82-186.24)  | 49.03 (39.19-67.43)    | 759.21 (629.24-1020.30)   | 163.54 (104.73-245.10) | 54.36 (42.41-78.56)   | 836.37 (650.05-1189.79)   |
| Denmark                      | 151.26 (130.58-174.11) | 33.96 (30.61-37.26)    | 442.27 (402.14-492.68)    | 121.39 (104.35-140.84) | 24.02 (20.77-27.46)   | 294.87 (259.02-332.85)    |
| Djibouti                     | 130.41 (85.37-186.49)  | 59.92 (41.60-82.13)    | 919.26 (652.52-1230.10)   | 149.03 (98.79-216.05)  | 48.12 (33.89-67.63)   | 720.40 (516.16-1005.00)   |
| Dominica                     | 139.87 (93.68-202.23)  | 38.05 (31.89-42.07)    | 581.40 (502.91-638.70)    | 131.44 (83.24-189.73)  | 24.97 (21.94-28.45)   | 402.76 (357.19-454.36)    |

(Continues on next page)

|                                | 1990                   |                        |                           | 2010                   |                       |                           |
|--------------------------------|------------------------|------------------------|---------------------------|------------------------|-----------------------|---------------------------|
|                                | Incidence              | Mortality              | DALYs                     | Incidence              | Mortality             | DALYs                     |
| (Continued from previous page) |                        |                        |                           |                        |                       |                           |
| Dominican Republic             | 144.34 (95.09-206.41)  | 37.98 (35.82-43.78)    | 628.79 (591.17-710.71)    | 146.01 (101.10-201.34) | 41.73 (31.43-46.04)   | 606.73 (482.11-667.83)    |
| Ecuador                        | 85.88 (55.40-123.43)   | 17.06 (15.95-18.76)    | 320.20 (297.16-346.87)    | 81.63 (53.79-120.97)   | 13.03 (11.60-14.21)   | 225.49 (201.81-248.00)    |
| Egypt                          | 116.40 (77.98-166.92)  | 59.43 (54.08-73.95)    | 1047.88 (961.54-1290.59)  | 135.78 (90.84-197.25)  | 51.70 (44.36-55.35)   | 887.97 (759.17-946.28)    |
| El Salvador                    | 95.65 (64.10-137.29)   | 28.25 (17.84-31.85)    | 411.06 (263.71-461.03)    | 94.21 (61.70-137.29)   | 11.86 (10.09-17.44)   | 174.26 (148.26-239.97)    |
| Equatorial Guinea              | 137.46 (90.44-200.69)  | 61.99 (46.58-97.20)    | 997.36 (743.04-1497.24)   | 165.16 (110.22-241.76) | 42.75 (22.16-66.14)   | 652.07 (354.69-957.68)    |
| Eritrea                        | 132.17 (88.23-189.05)  | 65.66 (43.95-89.62)    | 1004.47 (686.96-1357.41)  | 153.18 (98.83-220.46)  | 57.70 (44.83-75.89)   | 861.80 (677.76-1125.46)   |
| Estonia                        | 453.72 (382.56-533.59) | 123.71 (111.57-131.41) | 1732.03 (1527.49-1838.03) | 479.24 (403.87-556.40) | 61.32 (54.59-77.28)   | 863.10 (771.71-1050.82)   |
| Ethiopia                       | 124.30 (82.03-179.55)  | 38.98 (27.54-55.52)    | 647.28 (472.33-894.86)    | 142.44 (94.84-209.85)  | 36.18 (28.57-46.58)   | 563.51 (451.74-723.45)    |
| Federated States of Micronesia | 162.47 (108.25-239.44) | 83.11 (63.80-117.64)   | 1579.40 (1200.77-2093.35) | 134.78 (88.09-196.26)  | 74.29 (54.22-104.30)  | 1343.94 (975.11-1804.38)  |
| Fiji                           | 171.55 (112.01-255.29) | 138.55 (74.06-167.09)  | 2257.45 (1127.61-2712.22) | 140.38 (91.86-207.65)  | 45.33 (35.88-80.33)   | 694.11 (569.83-1189.50)   |
| Finland                        | 215.99 (187.63-249.96) | 50.33 (43.68-54.86)    | 646.94 (568.10-697.84)    | 173.86 (149.75-200.59) | 24.22 (21.54-28.86)   | 315.65 (280.18-370.38)    |
| France                         | 103.84 (86.98-121.60)  | 24.93 (21.82-27.38)    | 333.00 (298.32-374.73)    | 83.56 (69.61-98.86)    | 12.98 (11.38-16.46)   | 204.23 (171.58-251.21)    |
| Gabon                          | 135.32 (89.01-201.29)  | 59.68 (42.05-76.30)    | 930.71 (678.56-1152.98)   | 168.21 (110.03-241.96) | 55.00 (39.47-68.81)   | 827.07 (619.90-1016.05)   |
| Georgia                        | 135.30 (100.94-175.26) | 34.13 (25.91-38.80)    | 652.91 (498.72-742.27)    | 141.90 (105.32-187.30) | 24.80 (21.35-26.96)   | 503.14 (435.04-549.78)    |
| Germany                        | 176.31 (151.01-204.40) | 48.11 (38.99-51.89)    | 573.82 (485.52-610.07)    | 141.66 (119.49-164.84) | 21.11 (19.15-24.12)   | 281.30 (255.83-304.77)    |
| Ghana                          | 124.43 (84.02-179.86)  | 47.51 (38.77-58.96)    | 756.44 (646.32-908.03)    | 147.20 (97.92-215.04)  | 53.74 (45.06-63.86)   | 840.61 (731.78-968.97)    |
| Greece                         | 114.55 (93.64-139.06)  | 59.76 (54.00-63.89)    | 674.40 (609.85-722.78)    | 93.99 (77.18-113.77)   | 38.26 (34.57-45.32)   | 399.68 (363.64-471.30)    |
| Grenada                        | 144.38 (92.83-212.87)  | 71.64 (57.50-78.59)    | 1057.60 (838.63-1147.84)  | 141.40 (95.73-201.85)  | 49.41 (43.42-61.39)   | 705.15 (626.38-875.92)    |
| Guatemala                      | 92.95 (60.72-138.61)   | 25.70 (23.29-32.54)    | 374.61 (341.33-463.64)    | 94.50 (63.73-138.93)   | 19.27 (17.22-22.24)   | 307.77 (276.15-347.37)    |
| Guinea                         | 125.66 (81.75-184.21)  | 45.10 (36.22-59.27)    | 748.54 (612.65-951.02)    | 146.10 (96.62-211.84)  | 45.60 (36.08-59.82)   | 727.01 (589.53-918.22)    |
| Guinea-Bissau                  | 128.29 (83.85-182.22)  | 47.74 (36.36-64.36)    | 806.04 (622.04-1059.09)   | 146.79 (96.91-209.14)  | 49.03 (38.16-68.20)   | 802.14 (635.75-1098.98)   |
| Guyana                         | 149.64 (99.13-211.41)  | 97.05 (82.69-103.43)   | 1640.23 (1375.92-1745.31) | 146.17 (96.57-210.23)  | 75.54 (66.72-89.28)   | 1174.35 (1035.09-1454.73) |
| Haiti                          | 143.43 (91.57-204.66)  | 95.25 (85.72-105.96)   | 1608.38 (1456.51-1796.98) | 139.99 (90.96-209.14)  | 79.66 (70.96-91.06)   | 1327.33 (1189.57-1512.95) |
| Honduras                       | 99.98 (65.65-145.04)   | 47.08 (40.23-51.62)    | 686.84 (587.57-740.09)    | 103.76 (69.55-149.23)  | 45.15 (37.10-53.36)   | 613.21 (512.50-724.53)    |
| Hungary                        | 292.88 (242.05-350.84) | 110.04 (98.81-116.19)  | 1612.57 (1425.66-1696.89) | 271.23 (224.61-328.53) | 60.02 (54.76-73.86)   | 843.17 (774.06-1038.42)   |
| Iceland                        | 129.88 (87.04-191.98)  | 28.59 (25.13-31.34)    | 379.72 (332.33-424.45)    | 101.52 (67.12-148.47)  | 15.48 (13.59-17.63)   | 218.98 (186.12-268.41)    |
| India                          | 128.48 (99.48-165.68)  | 37.44 (29.91-49.08)    | 571.39 (450.84-750.65)    | 143.45 (108.84-184.56) | 38.83 (31.80-49.24)   | 556.56 (464.41-707.49)    |
| Indonesia                      | 129.71 (84.85-192.79)  | 71.91 (63.55-83.63)    | 1053.84 (938.47-1213.99)  | 149.53 (99.30-215.35)  | 77.39 (67.60-87.47)   | 1129.00 (1008.00-1271.85) |
| Iran                           | 489.50 (394.07-606.17) | 51.70 (43.69-61.62)    | 867.21 (741.41-1001.40)   | 570.82 (454.10-701.78) | 39.79 (33.45-47.08)   | 589.58 (506.39-681.66)    |
| Iraq                           | 116.68 (78.23-170.03)  | 68.25 (57.60-77.60)    | 1085.84 (928.03-1213.34)  | 135.41 (89.10-199.70)  | 64.61 (56.24-73.02)   | 991.66 (870.06-1104.45)   |
| Ireland                        | 132.03 (89.44-194.38)  | 43.66 (38.46-47.40)    | 517.51 (460.52-565.73)    | 103.14 (66.89-150.89)  | 20.65 (18.28-26.12)   | 246.40 (214.55-300.53)    |
| Israel                         | 126.46 (84.31-183.75)  | 18.04 (15.82-19.26)    | 293.81 (260.06-330.10)    | 97.32 (65.25-137.66)   | 8.93 (7.94-11.08)     | 163.89 (132.32-207.45)    |
| Italy                          | 88.97 (77.70-100.81)   | 56.73 (49.75-60.68)    | 641.76 (566.86-679.84)    | 71.17 (62.12-81.51)    | 28.40 (24.70-36.21)   | 303.40 (274.13-382.48)    |
| Jamaica                        | 138.70 (90.04-202.21)  | 65.75 (60.93-70.60)    | 1093.59 (1014.53-1176.40) | 138.14 (91.96-204.79)  | 52.53 (44.83-61.32)   | 807.27 (697.19-947.25)    |
| Japan                          | 176.15 (138.01-219.00) | 42.74 (38.55-46.44)    | 525.86 (478.51-573.58)    | 128.65 (102.08-158.56) | 24.63 (21.35-34.40)   | 311.20 (266.65-400.52)    |
| Jordan                         | 119.37 (78.88-174.83)  | 92.17 (82.20-103.57)   | 1371.33 (1234.35-1543.68) | 137.40 (91.10-202.27)  | 62.86 (55.51-69.74)   | 881.51 (788.74-966.51)    |
| Kazakhstan                     | 199.93 (131.73-298.62) | 85.20 (78.91-94.42)    | 1244.44 (1167.03-1373.69) | 220.44 (144.78-318.03) | 86.97 (73.13-97.59)   | 1339.38 (1102.21-1517.24) |
| Kenya                          | 128.70 (84.94-188.61)  | 43.88 (34.02-56.36)    | 634.55 (509.80-806.04)    | 142.70 (96.76-206.87)  | 35.04 (27.46-44.46)   | 500.06 (403.63-632.34)    |
| Kiribati                       | 167.18 (104.89-251.55) | 96.68 (84.04-106.88)   | 2001.91 (1788.88-2277.12) | 132.18 (84.70-201.41)  | 81.41 (68.70-99.00)   | 1762.55 (1449.04-2143.13) |
| Kuwait                         | 38.99 (27.99-53.84)    | 43.12 (39.31-51.44)    | 673.97 (623.75-774.00)    | 47.59 (33.03-66.96)    | 48.51 (34.44-54.83)   | 731.38 (523.39-815.60)    |
| Kyrgyzstan                     | 204.83 (129.55-305.74) | 122.34 (109.82-131.83) | 1759.28 (1575.60-1900.92) | 227.71 (150.80-320.96) | 103.98 (95.03-116.45) | 1641.24 (1503.74-1819.56) |
| Laos                           | 141.40 (92.87-204.98)  | 50.99 (38.12-70.32)    | 848.14 (647.68-1158.50)   | 164.38 (110.10-237.29) | 52.66 (41.11-66.56)   | 846.51 (668.98-1058.72)   |
| Latvia                         | 337.72 (225.62-492.44) | 144.03 (135.72-152.10) | 1930.56 (1818.95-2039.24) | 368.76 (245.77-535.20) | 101.51 (94.39-109.95) | 1361.22 (1254.15-1455.45) |
| Lebanon                        | 113.03 (77.69-163.31)  | 44.69 (38.02-53.16)    | 755.41 (638.47-869.84)    | 131.63 (87.60-187.30)  | 29.28 (22.42-35.33)   | 470.63 (377.11-558.91)    |
| Lesotho                        | 150.26 (98.60-216.01)  | 59.36 (47.90-79.20)    | 929.42 (762.75-1204.89)   | 164.12 (107.17-233.76) | 61.45 (46.77-80.83)   | 968.37 (743.00-1258.23)   |
| Liberia                        | 124.41 (81.18-182.37)  | 36.97 (31.35-46.15)    | 614.70 (535.12-734.60)    | 143.86 (95.30-210.85)  | 39.03 (31.69-55.15)   | 626.49 (527.11-843.73)    |
| Libya                          | 59.85 (45.91-78.39)    | 60.87 (51.19-71.94)    | 989.50 (852.64-1149.42)   | 70.05 (52.85-90.80)    | 56.45 (43.55-71.33)   | 847.68 (674.91-1060.66)   |
| Lithuania                      | 395.67 (336.83-465.73) | 77.54 (71.64-87.33)    | 1111.25 (1029.92-1214.01) | 433.97 (369.12-505.59) | 65.69 (52.76-71.93)   | 929.62 (773.04-1021.53)   |

(Continues on next page)



|                                  | 1990                   |                        |                           | 2010                   |                        |                           |
|----------------------------------|------------------------|------------------------|---------------------------|------------------------|------------------------|---------------------------|
|                                  | Incidence              | Mortality              | DALYs                     | Incidence              | Mortality              | DALYs                     |
| (Continued from previous page)   |                        |                        |                           |                        |                        |                           |
| Luxembourg                       | 122.27 (80.08–178.83)  | 34.85 (27.04–37.86)    | 466.85 (366.91–514.07)    | 97.37 (65.00–141.37)   | 12.19 (10.35–16.97)    | 185.50 (154.38–241.27)    |
| Macedonia                        | 227.71 (153.01–325.03) | 139.43 (129.88–150.84) | 1758.65 (1649.40–1889.33) | 216.08 (146.03–317.97) | 113.91 (100.93–123.90) | 1406.02 (1258.42–1514.30) |
| Madagascar                       | 139.89 (89.36–200.23)  | 95.49 (80.48–112.50)   | 1504.89 (1253.98–1797.84) | 157.77 (105.31–233.09) | 87.35 (67.96–107.84)   | 1338.27 (1034.18–1669.21) |
| Malawi                           | 134.90 (89.57–192.72)  | 74.66 (50.39–101.01)   | 1173.60 (807.07–1544.80)  | 155.67 (102.02–224.98) | 73.11 (50.44–97.22)    | 1128.13 (785.53–1499.41)  |
| Malaysia                         | 142.58 (93.63–205.06)  | 41.01 (36.88–46.39)    | 677.14 (617.90–752.95)    | 160.29 (103.87–228.78) | 32.97 (29.11–36.66)    | 539.21 (488.92–587.44)    |
| Maldives                         | 137.82 (86.14–209.82)  | 49.79 (40.11–75.61)    | 882.17 (727.14–1290.92)   | 155.63 (99.97–228.17)  | 30.76 (22.27–35.88)    | 514.21 (391.33–605.07)    |
| Mali                             | 126.79 (83.89–189.18)  | 47.35 (38.01–64.75)    | 794.68 (645.37–1067.58)   | 144.73 (94.62–206.39)  | 45.58 (36.56–58.62)    | 737.44 (609.16–930.12)    |
| Malta                            | 129.14 (84.65–185.22)  | 39.29 (35.48–42.40)    | 541.84 (489.60–588.38)    | 105.33 (67.81–156.75)  | 26.29 (22.86–29.36)    | 327.67 (293.11–370.69)    |
| Marshall Islands                 | 164.79 (104.55–240.28) | 75.21 (61.52–94.23)    | 1414.07 (1160.51–1757.14) | 134.71 (89.59–188.98)  | 62.81 (50.85–79.54)    | 1212.80 (989.35–1515.72)  |
| Mauritania                       | 125.24 (84.42–181.90)  | 43.59 (34.23–56.76)    | 731.49 (583.50–937.25)    | 143.69 (94.71–204.47)  | 40.51 (31.33–51.69)    | 666.70 (520.22–831.75)    |
| Mauritius                        | 148.20 (98.10–214.48)  | 90.65 (83.47–97.73)    | 1363.82 (1241.30–1454.40) | 163.84 (107.18–238.70) | 49.38 (43.22–67.42)    | 639.49 (562.49–865.81)    |
| Mexico                           | 93.30 (60.91–138.79)   | 27.83 (25.01–30.57)    | 381.05 (348.32–415.81)    | 96.53 (63.37–140.78)   | 21.17 (18.91–23.63)    | 303.79 (272.18–338.00)    |
| Moldova                          | 334.09 (226.47–480.15) | 99.00 (85.84–105.15)   | 1393.58 (1238.66–1480.19) | 372.76 (245.03–539.36) | 84.98 (75.44–90.81)    | 1309.11 (1143.44–1396.41) |
| Mongolia                         | 195.75 (130.62–291.84) | 10.58 (8.10–21.30)     | 260.70 (201.08–504.29)    | 215.68 (140.61–318.37) | 12.05 (8.75–23.74)     | 290.91 (214.06–551.35)    |
| Montenegro                       | 208.52 (142.10–298.30) | 25.02 (20.68–34.87)    | 399.34 (343.32–536.03)    | 202.23 (137.51–295.33) | 32.04 (27.60–36.50)    | 476.15 (408.08–530.06)    |
| Morocco                          | 112.40 (74.11–166.19)  | 65.74 (57.70–76.15)    | 1003.72 (891.46–1160.66)  | 129.40 (84.35–182.98)  | 51.88 (45.36–59.45)    | 772.66 (690.20–868.30)    |
| Mozambique                       | 118.32 (76.82–171.82)  | 36.48 (27.09–50.06)    | 557.01 (416.57–767.58)    | 137.14 (89.97–204.35)  | 40.44 (29.84–50.79)    | 628.08 (459.78–787.23)    |
| Myanmar                          | 133.45 (88.36–194.21)  | 62.17 (45.49–89.62)    | 972.84 (708.89–1399.10)   | 151.86 (100.65–229.09) | 60.42 (45.66–81.70)    | 926.06 (712.82–1268.84)   |
| Namibia                          | 155.54 (103.69–226.93) | 64.25 (52.81–77.97)    | 1011.77 (834.91–1201.91)  | 167.56 (112.68–242.49) | 59.46 (47.57–71.05)    | 923.70 (747.16–1085.04)   |
| Nepal                            | 102.97 (65.97–148.66)  | 29.56 (21.37–41.81)    | 450.08 (331.19–627.58)    | 114.24 (76.54–169.55)  | 32.42 (24.31–43.57)    | 469.04 (357.72–621.40)    |
| Netherlands                      | 105.14 (85.81–128.33)  | 26.36 (23.67–28.87)    | 357.03 (324.42–403.36)    | 83.51 (67.37–100.62)   | 14.70 (13.02–17.31)    | 221.16 (190.88–260.26)    |
| New Zealand                      | 101.69 (82.65–124.14)  | 33.69 (30.92–37.55)    | 401.55 (374.34–435.44)    | 79.45 (65.14–95.90)    | 18.03 (15.26–20.47)    | 211.54 (190.37–233.16)    |
| Nicaragua                        | 96.85 (64.71–138.64)   | 47.73 (35.89–52.11)    | 669.87 (507.03–728.71)    | 99.71 (65.79–142.11)   | 32.35 (28.42–39.91)    | 419.84 (375.98–521.79)    |
| Niger                            | 123.51 (82.89–179.36)  | 40.13 (30.96–54.16)    | 697.57 (536.42–894.12)    | 143.13 (92.13–206.42)  | 39.37 (24.47–57.14)    | 655.93 (414.11–938.39)    |
| Nigeria                          | 124.34 (84.76–178.73)  | 37.56 (31.63–47.09)    | 615.01 (525.20–724.97)    | 140.05 (93.96–209.06)  | 32.51 (24.16–41.84)    | 516.62 (394.63–636.64)    |
| North Korea                      | 163.69 (104.62–243.43) | 51.56 (39.94–73.01)    | 708.04 (560.24–1029.28)   | 170.70 (112.65–250.63) | 48.65 (35.67–80.09)    | 676.94 (492.18–1107.85)   |
| Norway                           | 135.58 (114.97–161.62) | 31.33 (27.93–34.05)    | 400.85 (361.27–437.93)    | 108.48 (89.94–129.51)  | 17.23 (15.35–20.74)    | 225.64 (197.05–265.65)    |
| Oman                             | 113.15 (74.57–164.52)  | 60.65 (54.05–70.48)    | 962.67 (862.72–1092.41)   | 140.90 (94.83–197.85)  | 40.50 (35.20–45.27)    | 614.91 (529.34–680.07)    |
| Pakistan                         | 106.41 (69.75–152.70)  | 35.24 (27.63–47.00)    | 518.10 (410.11–677.60)    | 124.15 (83.25–179.80)  | 38.43 (30.07–51.63)    | 548.42 (441.38–723.96)    |
| Palestine                        | 199.12 (155.50–253.32) | 47.94 (40.21–72.29)    | 807.65 (687.24–1143.78)   | 231.18 (180.64–289.83) | 62.27 (48.89–69.23)    | 980.30 (754.12–1081.73)   |
| Panama                           | 98.63 (64.08–144.70)   | 46.28 (41.22–50.41)    | 602.28 (529.08–646.08)    | 95.52 (63.95–138.38)   | 33.64 (29.76–39.13)    | 423.28 (381.18–486.07)    |
| Papua New Guinea                 | 139.67 (89.70–202.18)  | 21.12 (12.03–55.30)    | 473.69 (273.31–1196.48)   | 121.57 (81.76–180.50)  | 20.63 (10.64–54.01)    | 456.31 (246.57–1121.38)   |
| Paraguay                         | 151.25 (101.55–214.61) | 53.59 (44.76–57.86)    | 761.87 (643.01–815.00)    | 148.07 (98.49–216.43)  | 46.55 (41.35–56.96)    | 642.12 (578.57–780.23)    |
| Peru                             | 88.35 (56.04–133.26)   | 39.31 (28.61–42.95)    | 576.26 (452.63–620.74)    | 82.79 (55.45–118.27)   | 20.59 (17.74–28.80)    | 297.96 (267.06–374.22)    |
| Philippines                      | 136.85 (88.86–198.00)  | 34.32 (30.44–37.02)    | 584.44 (527.24–635.15)    | 162.29 (102.27–243.35) | 46.72 (37.42–51.96)    | 767.79 (599.08–845.12)    |
| Poland                           | 186.61 (154.28–222.44) | 78.40 (70.81–82.56)    | 1099.49 (985.17–1157.09)  | 173.18 (143.20–209.31) | 51.06 (43.56–56.00)    | 682.83 (592.15–736.13)    |
| Portugal                         | 140.80 (116.84–171.18) | 99.35 (84.28–104.63)   | 1150.99 (984.33–1210.02)  | 111.37 (92.24–133.22)  | 40.81 (34.32–61.48)    | 443.42 (379.75–637.78)    |
| Qatar                            | 46.52 (34.07–61.29)    | 31.27 (14.72–39.30)    | 481.27 (255.28–583.80)    | 51.88 (36.92–70.28)    | 9.17 (7.71–10.60)      | 178.34 (145.54–229.73)    |
| Romania                          | 224.83 (149.39–325.79) | 116.29 (106.29–122.22) | 1533.38 (1407.67–1607.59) | 215.44 (145.30–313.28) | 96.05 (86.82–102.67)   | 1253.57 (1114.25–1328.62) |
| Russia                           | 332.19 (283.79–387.29) | 155.05 (130.84–168.07) | 2075.00 (1726.12–2251.33) | 371.42 (316.04–430.26) | 137.70 (108.71–150.90) | 1909.12 (1509.93–2116.45) |
| Rwanda                           | 132.24 (87.29–191.80)  | 81.01 (59.15–103.35)   | 1279.95 (937.76–1634.12)  | 148.10 (97.28–218.84)  | 53.87 (38.08–70.30)    | 821.87 (598.32–1075.62)   |
| Saint Lucia                      | 143.23 (95.16–205.59)  | 67.77 (58.62–72.79)    | 962.57 (842.06–1027.79)   | 138.77 (92.50–201.12)  | 49.99 (43.00–63.34)    | 590.41 (522.70–711.90)    |
| Saint Vincent and the Grenadines | 143.43 (96.22–215.22)  | 54.55 (46.89–59.43)    | 799.28 (700.95–864.14)    | 142.78 (94.87–207.97)  | 37.23 (33.36–42.87)    | 532.50 (483.42–605.56)    |
| Samoa                            | 154.97 (102.10–226.51) | 72.00 (57.25–89.88)    | 1305.12 (1038.41–1580.51) | 121.73 (82.03–176.12)  | 36.08 (26.00–47.32)    | 633.65 (485.53–806.62)    |
| São Tomé and Príncipe            | 124.23 (79.90–185.26)  | 52.76 (45.57–61.11)    | 838.12 (749.29–948.56)    | 139.30 (92.94–202.58)  | 47.72 (34.67–58.61)    | 731.41 (534.64–880.55)    |
| Saudi Arabia                     | 75.98 (53.06–107.25)   | 58.82 (47.70–69.13)    | 893.63 (723.33–1028.57)   | 87.24 (60.18–118.66)   | 49.34 (39.57–56.03)    | 693.41 (550.38–775.91)    |
| Senegal                          | 120.62 (81.84–179.43)  | 27.07 (22.08–34.74)    | 502.52 (412.36–619.37)    | 136.78 (92.06–201.72)  | 23.10 (18.44–29.42)    | 406.29 (333.59–490.04)    |
| Serbia                           | 232.27 (189.36–279.75) | 126.13 (110.44–139.97) | 1673.92 (1468.73–1842.71) | 223.15 (182.64–267.29) | 100.02 (90.32–107.03)  | 1275.45 (1150.70–1356.54) |

(Continues on next page)

|                                | 1990                   |                        |                           | 2010                   |                      |                           |
|--------------------------------|------------------------|------------------------|---------------------------|------------------------|----------------------|---------------------------|
|                                | Incidence              | Mortality              | DALYs                     | Incidence              | Mortality            | DALYs                     |
| (Continued from previous page) |                        |                        |                           |                        |                      |                           |
| Seychelles                     | 143.07 (93.87-207.08)  | 51.98 (41.18-58.69)    | 1014.60 (802.63-1154.87)  | 165.61 (107.93-241.63) | 43.22 (29.29-51.85)  | 847.74 (604.91-1007.82)   |
| Sierra Leone                   | 130.10 (84.21-191.63)  | 48.72 (40.97-60.42)    | 861.85 (726.95-1036.72)   | 146.19 (96.30-216.95)  | 47.82 (36.64-62.68)  | 830.17 (628.20-1058.40)   |
| Singapore                      | 168.88 (112.44-243.12) | 38.79 (34.58-42.05)    | 618.61 (556.59-661.72)    | 125.06 (84.32-180.23)  | 25.03 (20.81-29.86)  | 380.49 (334.51-436.60)    |
| Slovakia                       | 231.40 (152.01-339.38) | 91.16 (84.54-100.41)   | 1264.42 (1181.78-1429.24) | 216.15 (144.39-317.41) | 62.38 (55.43-67.87)  | 846.43 (742.79-912.95)    |
| Slovenia                       | 227.00 (152.30-327.37) | 103.66 (88.77-110.13)  | 1342.99 (1132.03-1425.23) | 203.41 (135.47-291.41) | 43.61 (39.64-49.65)  | 535.32 (491.65-605.20)    |
| Solomon Islands                | 164.67 (107.42-247.03) | 87.27 (68.51-127.21)   | 1657.95 (1324.68-2230.28) | 137.24 (87.23-201.00)  | 83.64 (67.11-120.13) | 1569.27 (1277.69-2034.37) |
| Somalia                        | 131.44 (87.57-193.92)  | 63.89 (43.56-91.15)    | 998.64 (670.57-1469.73)   | 148.23 (100.02-212.47) | 54.18 (38.44-75.79)  | 833.63 (587.30-1193.85)   |
| South Africa                   | 156.24 (100.83-232.34) | 57.73 (46.82-63.82)    | 891.68 (727.57-980.54)    | 164.33 (108.79-239.90) | 37.94 (31.86-43.98)  | 578.27 (509.44-678.09)    |
| South Korea                    | 170.86 (113.60-247.69) | 135.92 (113.52-143.78) | 1829.59 (1559.02-1924.56) | 118.87 (77.06-172.16)  | 50.33 (43.84-68.38)  | 615.11 (546.79-806.32)    |
| Spain                          | 125.53 (82.75-178.37)  | 55.47 (45.96-59.68)    | 622.10 (534.40-659.20)    | 101.20 (68.00-145.08)  | 23.33 (19.80-34.49)  | 272.74 (241.86-368.36)    |
| Sri Lanka                      | 143.11 (93.26-211.56)  | 34.49 (30.34-37.30)    | 565.02 (502.87-615.42)    | 166.63 (105.68-242.79) | 35.21 (27.90-41.53)  | 504.86 (410.32-593.02)    |
| Sudan                          | 127.58 (84.00-182.50)  | 46.66 (32.97-62.20)    | 681.34 (505.72-906.83)    | 141.87 (95.29-207.95)  | 28.29 (20.74-37.80)  | 408.53 (304.52-548.46)    |
| Suriname                       | 146.22 (98.00-213.25)  | 60.75 (56.03-69.25)    | 881.80 (819.21-1007.19)   | 134.21 (90.04-192.98)  | 54.76 (41.98-61.25)  | 766.81 (601.71-853.73)    |
| Swaziland                      | 150.58 (99.78-219.83)  | 56.66 (47.10-69.34)    | 885.79 (755.43-1058.65)   | 169.40 (111.58-251.25) | 63.13 (51.63-75.70)  | 1016.68 (844.68-1185.45)  |
| Sweden                         | 152.49 (131.01-175.04) | 38.13 (34.81-42.64)    | 465.41 (423.86-521.73)    | 123.05 (107.23-141.35) | 24.07 (21.26-27.79)  | 277.38 (243.93-323.24)    |
| Switzerland                    | 125.86 (82.82-180.68)  | 34.72 (29.55-38.86)    | 415.95 (360.17-467.24)    | 102.40 (68.93-146.83)  | 18.22 (15.35-21.80)  | 221.75 (185.41-267.06)    |
| Syria                          | 116.40 (78.01-170.01)  | 33.97 (29.23-45.06)    | 597.94 (519.90-774.28)    | 133.55 (87.73-194.30)  | 25.92 (21.45-34.23)  | 438.68 (372.56-576.67)    |
| Taiwan                         | 175.30 (114.44-254.00) | 46.11 (38.63-54.77)    | 631.55 (541.57-742.02)    | 171.33 (111.65-251.30) | 25.50 (21.11-29.89)  | 365.87 (322.44-408.88)    |
| Tajikistan                     | 202.25 (132.22-301.74) | 66.57 (58.54-74.87)    | 987.61 (872.24-1100.64)   | 222.52 (141.48-323.06) | 70.44 (58.76-81.06)  | 1049.02 (889.42-1186.86)  |
| Tanzania                       | 145.35 (110.40-192.14) | 32.94 (26.04-42.76)    | 492.57 (396.45-635.12)    | 164.72 (125.04-212.77) | 27.31 (21.72-34.77)  | 401.02 (326.29-503.60)    |
| Thailand                       | 132.59 (86.81-192.40)  | 11.54 (10.23-16.66)    | 245.43 (219.41-313.90)    | 148.42 (94.76-214.80)  | 21.85 (12.88-25.45)  | 362.44 (247.55-408.31)    |
| The Bahamas                    | 141.24 (95.73-205.82)  | 48.54 (41.06-53.34)    | 705.01 (594.63-767.40)    | 123.26 (82.38-176.04)  | 17.31 (13.68-21.33)  | 298.03 (246.87-366.94)    |
| The Gambia                     | 129.99 (84.38-188.55)  | 54.55 (40.42-73.07)    | 939.71 (688.58-1238.98)   | 144.93 (96.57-211.43)  | 46.57 (34.56-60.37)  | 774.71 (569.25-992.07)    |
| Timor-Leste                    | 140.94 (94.35-207.72)  | 42.22 (35.70-52.93)    | 700.65 (596.06-861.25)    | 159.90 (105.03-230.49) | 42.31 (35.50-53.99)  | 683.79 (581.08-835.97)    |
| Togo                           | 125.75 (80.72-186.47)  | 47.89 (40.34-58.83)    | 772.10 (667.60-921.22)    | 146.90 (96.07-214.15)  | 44.09 (36.44-57.15)  | 697.46 (586.36-859.85)    |
| Tonga                          | 154.47 (102.84-226.70) | 43.79 (36.51-55.34)    | 736.97 (620.01-880.04)    | 125.87 (80.14-185.93)  | 29.00 (22.16-37.14)  | 496.39 (403.83-595.92)    |
| Trinidad and Tobago            | 147.48 (97.88-211.86)  | 58.93 (52.82-63.31)    | 902.12 (818.24-961.59)    | 140.59 (93.82-204.10)  | 49.12 (43.56-56.99)  | 694.70 (621.57-796.41)    |
| Tunisia                        | 114.35 (75.12-166.26)  | 52.71 (44.03-68.66)    | 857.27 (727.22-1085.52)   | 131.74 (87.89-196.63)  | 42.22 (34.70-53.76)  | 643.58 (544.73-793.48)    |
| Turkey                         | 118.76 (77.04-172.36)  | 85.85 (74.86-98.55)    | 1584.20 (1381.62-1798.93) | 134.52 (89.34-194.56)  | 52.58 (45.23-60.66)  | 876.02 (755.98-1015.71)   |
| Turkmenistan                   | 204.63 (134.72-293.46) | 39.84 (33.18-53.11)    | 651.03 (552.85-875.89)    | 224.97 (147.90-331.72) | 36.88 (30.56-48.08)  | 597.69 (504.09-783.60)    |
| Uganda                         | 126.96 (84.55-187.20)  | 48.78 (32.22-69.83)    | 729.36 (513.73-1039.60)   | 149.77 (99.00-216.38)  | 48.75 (33.16-65.56)  | 729.75 (510.40-979.97)    |
| Ukraine                        | 489.09 (397.46-593.28) | 129.68 (106.36-139.89) | 1754.54 (1467.52-1894.03) | 533.40 (435.20-649.73) | 98.48 (82.02-109.55) | 1416.57 (1193.93-1564.73) |
| United Arab Emirates           | 117.83 (77.64-168.75)  | 64.65 (54.43-75.38)    | 909.18 (749.83-1046.47)   | 137.48 (88.73-208.76)  | 44.52 (34.11-54.82)  | 597.00 (453.16-720.42)    |
| UK                             | 107.73 (92.42-123.44)  | 45.64 (39.88-49.66)    | 533.70 (476.53-579.14)    | 85.22 (72.87-98.49)    | 24.15 (21.24-28.37)  | 276.52 (243.86-325.32)    |
| USA                            | 173.61 (135.82-216.70) | 31.19 (28.23-34.75)    | 406.58 (378.82-446.68)    | 143.11 (112.54-177.75) | 19.06 (16.84-22.43)  | 295.76 (270.88-325.55)    |
| Uruguay                        | 143.59 (93.67-205.84)  | 54.49 (50.14-60.54)    | 651.16 (608.20-714.45)    | 107.02 (69.94-157.65)  | 40.32 (35.13-46.66)  | 469.94 (419.19-521.25)    |
| Uzbekistan                     | 209.11 (136.77-303.30) | 88.91 (79.87-99.84)    | 1471.01 (1326.31-1626.00) | 232.09 (153.46-341.62) | 90.59 (72.26-103.99) | 1416.15 (1126.03-1591.91) |
| Vanuatu                        | 165.23 (108.98-251.57) | 91.57 (66.01-133.65)   | 1761.23 (1257.30-2505.95) | 140.83 (95.71-207.38)  | 90.83 (63.54-136.11) | 1668.40 (1173.50-2381.14) |
| Venezuela                      | 96.97 (63.20-135.96)   | 34.71 (31.96-37.67)    | 514.70 (468.10-551.44)    | 98.91 (65.47-145.88)   | 24.89 (22.38-28.02)  | 348.51 (319.84-391.20)    |
| Vietnam                        | 117.64 (75.82-175.82)  | 11.56 (8.83-20.46)     | 226.49 (185.51-346.03)    | 135.07 (88.39-196.21)  | 9.72 (7.75-15.16)    | 191.27 (166.51-253.89)    |
| Yemen                          | 119.42 (80.21-176.17)  | 61.01 (45.34-93.61)    | 1100.37 (819.21-1575.56)  | 139.90 (94.80-198.95)  | 54.53 (42.72-76.11)  | 918.91 (741.67-1239.23)   |
| Zambia                         | 131.70 (86.55-194.13)  | 61.17 (45.98-84.84)    | 907.95 (700.54-1203.86)   | 153.96 (100.60-221.64) | 64.91 (48.27-86.31)  | 968.73 (745.39-1235.93)   |
| Zimbabwe                       | 146.19 (110.75-187.21) | 38.73 (32.14-47.24)    | 576.93 (495.19-688.81)    | 163.63 (125.69-206.52) | 51.30 (38.04-72.22)  | 787.20 (598.89-1088.91)   |

Data are point estimates (95% CIs). DALYs=disability-adjusted life-years.

Table 1: Age-standardised incidence and mortality per 100 000 person-years and DALYs lost per 100 000 people for ischaemic stroke by country in 1990 and 2010

|                              | 1990                  |                        |                           | 2010                   |                        |                           |
|------------------------------|-----------------------|------------------------|---------------------------|------------------------|------------------------|---------------------------|
|                              | Incidence             | Mortality              | DALYs                     | Incidence              | Mortality              | DALYs                     |
| Afghanistan                  | 32.38 (20.07-48.38)   | 140.36 (80.70-225.62)  | 3145.91 (1752.03-4983.92) | 48.34 (30.99-75.08)    | 146.55 (87.89-218.10)  | 3194.66 (1866.82-4725.39) |
| Albania                      | 87.83 (56.27-130.05)  | 119.31 (111.21-135.34) | 1926.62 (1795.45-2146.28) | 76.21 (47.24-114.70)   | 121.80 (104.38-137.36) | 1777.90 (1532.66-2008.27) |
| Algeria                      | 33.96 (21.18-51.61)   | 66.29 (57.34-74.64)    | 1384.16 (1173.98-1574.49) | 48.14 (29.98-71.87)    | 47.04 (39.71-52.77)    | 884.13 (747.68-985.38)    |
| Andorra                      | 43.01 (27.89-64.51)   | 22.53 (18.62-27.44)    | 400.71 (335.67-488.56)    | 36.42 (23.09-52.77)    | 15.84 (12.80-19.57)    | 263.04 (215.98-319.57)    |
| Angola                       | 52.37 (33.71-79.46)   | 68.66 (47.87-100.54)   | 1626.45 (1087.86-2480.45) | 67.91 (41.86-100.60)   | 55.22 (41.47-74.49)    | 1233.90 (897.03-1633.72)  |
| Antigua and Barbuda          | 68.25 (42.91-100.86)  | 85.96 (63.49-98.99)    | 1572.05 (1146.98-1816.90) | 63.79 (41.55-98.74)    | 43.76 (34.11-63.65)    | 743.96 (589.34-1067.01)   |
| Argentina                    | 66.74 (43.02-103.75)  | 39.89 (33.49-43.23)    | 1061.64 (880.40-1147.44)  | 50.72 (32.15-74.38)    | 24.73 (21.59-31.01)    | 592.24 (514.76-760.28)    |
| Armenia                      | 106.73 (68.91-158.01) | 63.23 (55.65-70.11)    | 1110.03 (987.90-1227.58)  | 116.08 (74.97-169.26)  | 51.06 (42.88-60.15)    | 919.11 (765.09-1076.45)   |
| Australia                    | 31.50 (24.69-39.32)   | 18.01 (16.51-20.56)    | 364.87 (333.19-414.50)    | 25.09 (19.66-31.51)    | 9.34 (7.79-10.76)      | 175.94 (153.16-196.55)    |
| Austria                      | 42.80 (28.38-64.41)   | 31.76 (27.52-34.53)    | 571.64 (497.75-621.74)    | 35.70 (23.17-54.13)    | 15.63 (13.27-19.56)    | 262.27 (227.53-326.34)    |
| Azerbaijan                   | 107.86 (69.51-156.75) | 81.51 (70.97-91.31)    | 1535.58 (1348.24-1737.51) | 122.24 (77.40-184.87)  | 66.17 (50.86-77.54)    | 1207.62 (954.16-1397.14)  |
| Bahrain                      | 11.75 (7.86-16.76)    | 39.57 (34.96-45.30)    | 826.30 (719.36-943.44)    | 18.35 (12.19-26.93)    | 18.48 (15.95-20.99)    | 343.90 (297.80-385.64)    |
| Bangladesh                   | 56.95 (37.13-84.17)   | 37.84 (23.95-48.52)    | 731.58 (466.99-930.16)    | 53.60 (32.80-80.28)    | 27.87 (17.67-40.21)    | 506.02 (318.99-726.78)    |
| Barbados                     | 76.97 (56.33-102.55)  | 51.25 (42.36-56.44)    | 901.62 (729.89-998.39)    | 78.64 (57.95-102.74)   | 31.26 (24.97-43.17)    | 510.59 (423.39-664.13)    |
| Belarus                      | 50.91 (38.84-65.95)   | 38.64 (35.03-44.37)    | 943.22 (850.40-1038.97)   | 70.93 (54.42-90.44)    | 33.12 (29.41-37.44)    | 842.63 (735.32-942.29)    |
| Belgium                      | 40.92 (26.04-60.23)   | 17.01 (15.12-18.71)    | 399.86 (352.96-438.00)    | 35.73 (23.29-53.65)    | 11.72 (8.76-14.02)     | 248.32 (202.82-281.02)    |
| Belize                       | 57.25 (36.41-86.71)   | 48.19 (40.84-53.68)    | 944.01 (775.51-1048.84)   | 59.16 (39.05-88.18)    | 36.27 (31.90-42.01)    | 659.90 (587.09-770.98)    |
| Benin                        | 62.88 (41.19-92.74)   | 56.22 (46.46-69.16)    | 1339.64 (1035.03-1687.79) | 71.66 (46.03-105.27)   | 52.37 (42.56-65.75)    | 1159.14 (929.98-1442.15)  |
| Bhutan                       | 46.60 (29.61-70.74)   | 34.27 (22.43-48.14)    | 692.47 (445.01-1001.88)   | 50.36 (31.64-73.49)    | 29.41 (21.02-42.05)    | 573.47 (403.05-827.87)    |
| Bolivia                      | 43.23 (28.46-64.37)   | 62.17 (51.81-75.36)    | 1416.23 (1153.63-1705.81) | 37.97 (23.78-57.92)    | 40.29 (33.06-53.32)    | 864.46 (704.43-1110.46)   |
| Bosnia and Herzegovina       | 78.98 (51.41-121.84)  | 95.10 (84.93-102.68)   | 1644.97 (1467.06-1790.23) | 67.49 (43.57-99.37)    | 56.74 (45.85-70.11)    | 949.16 (746.78-1158.57)   |
| Botswana                     | 69.73 (45.81-106.21)  | 54.04 (41.37-71.73)    | 1078.87 (826.02-1425.30)  | 86.31 (55.25-125.77)   | 30.73 (20.14-45.15)    | 702.49 (501.15-1021.92)   |
| Brazil                       | 73.82 (55.22-98.40)   | 59.11 (51.33-63.82)    | 1387.87 (1196.75-1497.00) | 65.23 (48.15-87.12)    | 38.01 (34.45-43.50)    | 795.16 (727.96-922.21)    |
| Brunei                       | 66.02 (42.63-97.83)   | 47.11 (36.47-66.29)    | 977.16 (775.16-1316.98)   | 47.98 (29.66-73.74)    | 33.41 (26.16-43.75)    | 653.60 (526.32-838.39)    |
| Bulgaria                     | 76.40 (48.40-117.11)  | 88.61 (78.12-95.27)    | 1769.53 (1545.61-1894.97) | 64.62 (40.63-92.73)    | 56.87 (47.85-74.54)    | 1155.49 (986.22-1486.86)  |
| Burkina Faso                 | 62.49 (41.68-90.68)   | 35.24 (25.83-52.57)    | 836.07 (612.03-1206.25)   | 73.77 (47.36-108.31)   | 59.15 (46.22-76.79)    | 1254.96 (977.13-1624.95)  |
| Burundi                      | 58.88 (36.80-89.45)   | 119.29 (49.79-238.90)  | 2640.01 (1110.21-5335.50) | 85.78 (56.17-128.12)   | 97.13 (48.09-190.72)   | 2102.41 (1026.78-4246.36) |
| Cambodia                     | 67.56 (42.78-100.94)  | 103.89 (66.39-133.23)  | 2205.84 (1407.92-2862.63) | 90.87 (58.35-134.37)   | 87.50 (67.13-108.70)   | 1827.47 (1413.63-2257.56) |
| Cameroon                     | 62.35 (38.77-94.39)   | 56.08 (46.25-67.29)    | 1332.60 (1092.78-1607.11) | 73.19 (48.57-109.56)   | 50.31 (41.05-63.46)    | 1140.87 (927.59-1420.10)  |
| Canada                       | 36.11 (22.99-53.87)   | 12.36 (11.34-14.43)    | 297.98 (271.22-338.55)    | 30.34 (19.17-45.92)    | 7.07 (5.87-8.08)       | 172.03 (146.93-198.39)    |
| Cape Verde                   | 65.98 (42.13-97.94)   | 69.12 (58.38-84.95)    | 1535.00 (1245.29-1877.36) | 78.16 (50.83-118.24)   | 50.03 (40.25-67.58)    | 1046.83 (833.51-1377.99)  |
| Central African Republic     | 53.29 (33.35-79.41)   | 84.79 (49.20-118.85)   | 2137.54 (1234.35-3007.33) | 71.70 (46.54-105.33)   | 72.06 (39.58-109.11)   | 1582.98 (863.23-2429.22)  |
| Chad                         | 64.01 (41.02-95.31)   | 54.12 (41.65-71.21)    | 1306.41 (941.93-1732.94)  | 73.82 (47.80-109.23)   | 48.55 (35.68-63.94)    | 1118.45 (793.66-1496.38)  |
| Chile                        | 58.26 (42.38-76.24)   | 43.21 (38.58-48.77)    | 884.19 (787.41-996.20)    | 46.93 (35.24-61.38)    | 22.36 (19.41-26.57)    | 443.90 (385.72-519.42)    |
| China                        | 121.33 (88.26-158.31) | 110.70 (79.06-139.48)  | 2127.05 (1557.05-2669.67) | 159.81 (117.90-211.92) | 80.20 (63.78-97.92)    | 1489.11 (1192.70-1781.08) |
| Colombia                     | 39.27 (25.42-59.58)   | 36.04 (32.66-39.99)    | 869.43 (784.64-970.85)    | 37.56 (24.16-55.05)    | 23.76 (21.33-28.17)    | 481.91 (434.18-574.34)    |
| Comoros                      | 59.91 (37.61-91.16)   | 110.41 (75.89-155.66)  | 2427.98 (1651.64-3415.09) | 88.40 (54.90-133.28)   | 86.33 (59.88-134.03)   | 1810.09 (1248.99-2818.61) |
| Congo                        | 53.00 (33.09-77.79)   | 79.04 (63.51-98.57)    | 1797.82 (1439.61-2207.65) | 71.26 (47.06-106.80)   | 74.12 (59.62-90.92)    | 1670.18 (1335.20-2080.75) |
| Costa Rica                   | 39.17 (25.18-58.37)   | 32.66 (27.13-35.94)    | 533.69 (444.77-576.23)    | 37.47 (24.62-56.47)    | 20.72 (18.15-25.75)    | 315.30 (282.86-377.05)    |
| Côte d'Ivoire                | 65.08 (42.17-96.41)   | 62.95 (53.09-76.31)    | 1527.57 (1284.24-1837.16) | 77.17 (49.64-116.24)   | 66.99 (52.03-89.17)    | 1570.58 (1193.09-2057.32) |
| Croatia                      | 73.09 (46.69-109.64)  | 66.78 (60.49-75.06)    | 1347.08 (1213.87-1513.46) | 61.80 (39.21-92.64)    | 36.85 (32.41-41.55)    | 676.27 (603.83-766.63)    |
| Cuba                         | 49.32 (32.28-73.14)   | 23.57 (21.31-26.30)    | 670.95 (590.64-735.04)    | 52.72 (32.62-79.01)    | 19.37 (16.80-21.37)    | 447.54 (398.33-526.01)    |
| Cyprus                       | 46.23 (29.97-69.32)   | 35.77 (29.99-41.83)    | 691.65 (554.70-815.41)    | 37.48 (23.90-54.48)    | 20.58 (17.90-23.61)    | 348.31 (303.80-396.36)    |
| Czech Republic               | 65.56 (42.93-97.95)   | 42.87 (35.49-46.86)    | 861.81 (702.82-944.06)    | 54.36 (34.75-80.88)    | 18.27 (16.05-21.98)    | 346.51 (306.25-421.05)    |
| Democratic Republic of Congo | 53.34 (34.56-79.41)   | 66.79 (43.64-91.65)    | 1519.59 (958.73-2090.78)  | 74.31 (46.83-113.89)   | 76.71 (45.17-108.68)   | 1705.80 (1010.86-2446.15) |
| Denmark                      | 49.74 (39.46-60.83)   | 31.87 (28.50-36.29)    | 571.92 (518.13-645.86)    | 45.93 (36.67-56.85)    | 21.39 (18.17-24.64)    | 342.82 (292.11-384.48)    |
| Djibouti                     | 55.95 (34.91-83.62)   | 73.86 (52.58-104.04)   | 1616.92 (1139.98-2313.28) | 79.63 (51.95-117.27)   | 58.54 (39.22-84.33)    | 1213.71 (810.59-1730.60)  |

(Continues on next page)

|                                | 1990                  |                        |                           | 2010                  |                        |                           |
|--------------------------------|-----------------------|------------------------|---------------------------|-----------------------|------------------------|---------------------------|
|                                | Incidence             | Mortality              | DALYs                     | Incidence             | Mortality              | DALYs                     |
| (Continued from previous page) |                       |                        |                           |                       |                        |                           |
| Dominica                       | 62.59 (40.62-95.64)   | 51.95 (45.28-57.38)    | 928.89 (805.98-1020.71)   | 65.79 (41.60-96.32)   | 36.72 (31.10-41.52)    | 638.53 (543.74-713.44)    |
| Dominican Republic             | 61.04 (39.86-90.45)   | 66.64 (57.17-72.38)    | 1303.47 (1105.08-1409.70) | 60.98 (40.42-88.28)   | 50.06 (43.99-55.91)    | 872.75 (771.52-996.06)    |
| Ecuador                        | 43.24 (27.43-65.11)   | 49.31 (40.25-53.71)    | 960.03 (807.88-1031.91)   | 37.62 (23.99-55.16)   | 29.12 (26.09-34.15)    | 546.17 (490.13-617.37)    |
| Egypt                          | 32.51 (21.44-48.85)   | 82.18 (68.53-111.24)   | 1750.39 (1399.34-2471.82) | 44.51 (28.95-66.85)   | 75.63 (62.68-83.93)    | 1740.15 (1349.96-1996.75) |
| El Salvador                    | 41.78 (26.94-59.72)   | 40.54 (29.52-46.45)    | 871.35 (608.72-1010.87)   | 35.66 (22.18-53.66)   | 22.58 (19.38-29.78)    | 415.02 (363.05-539.86)    |
| Equatorial Guinea              | 54.30 (34.75-81.58)   | 83.36 (52.45-132.67)   | 1956.43 (1169.59-3383.61) | 67.67 (44.23-101.98)  | 39.87 (24.61-61.43)    | 912.56 (574.09-1410.99)   |
| Eritrea                        | 57.31 (36.98-86.90)   | 99.37 (58.65-134.84)   | 2158.52 (1247.56-2934.37) | 82.60 (53.01-121.45)  | 74.53 (52.09-96.67)    | 1553.71 (1091.58-2042.22) |
| Estonia                        | 56.38 (44.51-70.87)   | 32.57 (27.37-36.29)    | 757.38 (647.31-839.42)    | 77.51 (59.75-96.98)   | 15.32 (13.64-18.89)    | 362.36 (320.27-431.90)    |
| Ethiopia                       | 58.71 (37.05-88.48)   | 63.81 (39.97-86.13)    | 1452.71 (905.66-1957.68)  | 83.14 (54.83-124.22)  | 50.22 (34.01-66.05)    | 1058.38 (719.14-1382.45)  |
| Federated States of Micronesia | 54.09 (34.29-84.81)   | 85.56 (61.12-125.35)   | 1827.12 (1242.79-2833.48) | 42.47 (25.60-63.41)   | 73.33 (51.89-104.97)   | 1495.77 (998.90-2240.12)  |
| Fiji                           | 52.15 (31.91-79.48)   | 116.44 (73.27-154.01)  | 2498.42 (1495.41-3358.43) | 35.78 (21.47-54.19)   | 70.70 (56.57-92.74)    | 1352.59 (1073.57-1785.89) |
| Finland                        | 76.79 (62.23-92.47)   | 25.55 (22.56-27.96)    | 564.36 (494.81-620.66)    | 65.58 (53.51-80.84)   | 12.85 (11.37-14.65)    | 275.97 (246.55-317.77)    |
| France                         | 39.22 (30.52-48.70)   | 25.96 (22.76-28.86)    | 469.01 (414.78-522.83)    | 33.04 (26.22-40.57)   | 14.29 (12.30-17.67)    | 249.02 (220.56-293.35)    |
| Gabon                          | 51.60 (33.10-79.78)   | 59.28 (42.22-87.19)    | 1373.64 (971.49-1993.70)  | 68.11 (43.10-100.52)  | 54.04 (41.73-70.86)    | 1178.20 (900.06-1542.79)  |
| Georgia                        | 114.11 (84.08-150.57) | 134.54 (122.00-155.11) | 2329.98 (2098.73-2678.33) | 127.67 (94.78-167.06) | 120.91 (100.66-131.77) | 2158.84 (1773.80-2372.75) |
| Germany                        | 57.76 (47.17-69.60)   | 20.65 (18.07-22.45)    | 409.94 (345.09-442.33)    | 49.55 (40.43-60.33)   | 11.53 (8.94-13.03)     | 206.28 (162.16-228.29)    |
| Ghana                          | 63.24 (41.72-96.66)   | 62.51 (51.23-74.02)    | 1435.02 (1142.08-1726.77) | 76.00 (48.23-111.67)  | 66.26 (53.05-79.84)    | 1455.56 (1160.67-1758.99) |
| Greece                         | 42.18 (32.40-53.79)   | 60.39 (54.23-65.86)    | 885.15 (789.71-971.71)    | 34.45 (26.57-43.01)   | 39.66 (34.96-46.30)    | 539.20 (486.25-619.74)    |
| Grenada                        | 63.85 (40.80-95.87)   | 76.30 (59.18-85.52)    | 1598.01 (1218.03-1805.26) | 64.22 (41.96-94.85)   | 51.99 (44.69-66.42)    | 1021.89 (891.92-1313.61)  |
| Guatemala                      | 40.70 (27.03-61.26)   | 29.10 (25.22-39.47)    | 625.22 (543.29-850.26)    | 39.26 (25.69-57.94)   | 22.93 (19.69-26.14)    | 509.09 (434.28-571.93)    |
| Guinea                         | 63.43 (40.73-93.23)   | 63.69 (49.97-76.72)    | 1564.02 (1147.28-1916.25) | 74.43 (48.10-110.60)  | 58.43 (45.91-71.57)    | 1316.32 (1005.35-1606.85) |
| Guinea-Bissau                  | 64.76 (40.99-95.12)   | 64.36 (44.47-88.92)    | 1589.56 (1033.82-2214.40) | 75.10 (48.01-108.41)  | 65.20 (47.78-93.60)    | 1508.11 (1063.77-2226.72) |
| Guyana                         | 69.55 (44.09-101.81)  | 140.42 (117.46-152.61) | 3049.34 (2488.00-3335.79) | 66.69 (41.71-99.39)   | 100.27 (86.62-126.77)  | 1992.14 (1689.83-2592.39) |
| Haiti                          | 77.62 (50.32-114.72)  | 176.83 (156.03-220.78) | 3734.29 (3288.33-4675.20) | 81.30 (52.69-120.80)  | 151.08 (122.82-170.69) | 3025.42 (2489.78-3428.36) |
| Honduras                       | 41.49 (26.31-60.77)   | 51.16 (44.58-56.45)    | 1282.80 (1099.89-1453.30) | 41.03 (27.08-59.70)   | 44.64 (37.74-52.01)    | 953.58 (802.70-1127.74)   |
| Hungary                        | 87.70 (67.03-113.73)  | 54.04 (47.86-58.88)    | 1119.71 (979.37-1234.18)  | 69.65 (53.41-89.30)   | 27.98 (24.33-35.43)    | 551.64 (487.44-696.04)    |
| Iceland                        | 41.03 (26.58-62.48)   | 25.08 (21.81-28.18)    | 387.31 (337.11-428.17)    | 35.12 (21.80-53.30)   | 12.64 (10.87-14.73)    | 175.52 (153.47-199.26)    |
| India                          | 49.92 (36.57-66.34)   | 47.41 (35.42-60.28)    | 1005.95 (757.57-1276.15)  | 55.10 (40.29-72.61)   | 43.55 (33.92-53.83)    | 863.78 (667.23-1071.38)   |
| Indonesia                      | 83.22 (53.66-126.22)  | 116.48 (100.25-137.03) | 2264.89 (1938.33-2687.76) | 110.12 (72.96-161.63) | 115.94 (102.34-132.33) | 2253.24 (1993.79-2588.68) |
| Iran                           | 85.45 (62.40-111.58)  | 49.32 (39.80-62.22)    | 1094.55 (899.59-1362.04)  | 118.49 (87.54-156.12) | 33.28 (27.21-42.52)    | 597.35 (497.01-751.15)    |
| Iraq                           | 29.81 (19.56-44.65)   | 58.03 (50.07-68.52)    | 1215.04 (1035.01-1462.66) | 42.51 (27.73-63.66)   | 56.59 (47.64-65.30)    | 1118.20 (946.45-1310.65)  |
| Ireland                        | 40.09 (25.43-59.71)   | 26.11 (23.44-29.82)    | 524.58 (471.14-595.45)    | 34.23 (21.71-51.87)   | 13.91 (11.83-15.68)    | 262.00 (227.21-292.88)    |
| Israel                         | 44.15 (28.22-65.07)   | 40.49 (35.11-44.35)    | 641.33 (561.85-703.92)    | 38.17 (24.55-57.02)   | 19.75 (16.90-25.20)    | 284.96 (250.71-352.41)    |
| Italy                          | 29.68 (25.04-34.80)   | 20.40 (18.40-22.93)    | 456.32 (406.40-505.63)    | 25.11 (21.06-29.75)   | 11.97 (9.82-13.44)     | 233.26 (207.96-258.69)    |
| Jamaica                        | 69.01 (44.06-103.96)  | 65.79 (60.14-73.08)    | 1129.81 (1029.47-1244.08) | 71.37 (44.77-107.35)  | 48.74 (41.11-57.98)    | 788.02 (668.48-933.15)    |
| Japan                          | 86.32 (66.43-111.61)  | 27.94 (25.55-31.98)    | 590.92 (539.81-672.58)    | 63.82 (49.73-80.86)   | 18.78 (16.84-21.58)    | 395.45 (353.24-448.71)    |
| Jordan                         | 28.59 (18.03-43.47)   | 45.27 (39.32-54.05)    | 923.63 (796.41-1122.27)   | 39.63 (24.78-60.53)   | 26.70 (23.52-30.11)    | 505.74 (445.91-573.74)    |
| Kazakhstan                     | 115.73 (72.91-177.52) | 91.80 (84.11-103.07)   | 1739.40 (1604.38-1988.89) | 121.82 (79.00-181.33) | 86.24 (72.10-99.73)    | 1745.57 (1458.58-1982.28) |
| Kenya                          | 57.57 (37.53-84.98)   | 57.92 (40.75-78.85)    | 1193.23 (826.37-1646.54)  | 79.14 (51.07-118.20)  | 41.41 (29.30-58.35)    | 825.39 (570.11-1181.62)   |
| Kiribati                       | 58.98 (35.66-93.15)   | 99.64 (83.95-113.92)   | 2172.20 (1835.42-2531.39) | 46.87 (28.84-68.67)   | 86.71 (68.73-112.06)   | 1912.64 (1455.89-2480.24) |
| Kuwait                         | 8.52 (5.54-12.18)     | 19.09 (16.05-21.66)    | 384.58 (332.06-427.59)    | 12.04 (7.53-17.68)    | 13.82 (11.77-15.92)    | 306.23 (246.04-344.25)    |
| Kyrgyzstan                     | 115.75 (71.97-172.05) | 77.01 (69.46-88.20)    | 1701.78 (1554.85-1949.66) | 125.66 (81.91-186.14) | 79.79 (69.68-87.94)    | 1887.93 (1633.11-2082.01) |
| Laos                           | 68.88 (43.99-102.67)  | 102.71 (64.91-143.62)  | 2231.75 (1370.35-3148.88) | 94.10 (61.25-137.73)  | 88.64 (63.03-119.79)   | 1871.37 (1297.34-2553.71) |
| Latvia                         | 46.50 (29.37-68.34)   | 36.85 (32.10-41.72)    | 824.35 (721.80-928.11)    | 63.89 (40.81-96.28)   | 19.84 (17.93-24.03)    | 459.94 (416.96-547.94)    |
| Lebanon                        | 25.44 (16.38-37.96)   | 39.51 (31.07-54.27)    | 908.04 (711.60-1189.35)   | 34.80 (22.56-52.19)   | 23.68 (16.20-32.01)    | 483.61 (334.29-641.00)    |
| Lesotho                        | 75.52 (48.73-110.15)  | 84.43 (60.12-106.01)   | 1763.94 (1260.06-2235.85) | 95.47 (62.88-139.65)  | 82.78 (60.03-109.84)   | 1852.42 (1335.01-2529.38) |
| Liberia                        | 63.57 (40.60-97.61)   | 49.17 (41.99-58.27)    | 1251.85 (1025.57-1525.77) | 76.11 (48.66-114.08)  | 52.87 (38.88-69.45)    | 1191.25 (860.92-1541.76)  |
| Libya                          | 14.68 (10.50-20.06)   | 50.32 (40.30-73.04)    | 1080.74 (870.33-1549.52)  | 21.36 (15.06-28.74)   | 44.99 (37.35-60.29)    | 866.78 (733.84-1123.70)   |

(Continues on next page)



|                                  | 1990                  |                        |                           | 2010                  |                        |                           |
|----------------------------------|-----------------------|------------------------|---------------------------|-----------------------|------------------------|---------------------------|
|                                  | Incidence             | Mortality              | DALYs                     | Incidence             | Mortality              | DALYs                     |
| (Continued from previous page)   |                       |                        |                           |                       |                        |                           |
| Lithuania                        | 47.95 (37.23–60.91)   | 22.09 (19.34–25.22)    | 566.61 (496.15–647.61)    | 69.91 (53.46–89.25)   | 14.42 (12.60–16.05)    | 378.74 (329.23–419.35)    |
| Luxembourg                       | 50.13 (32.09–75.27)   | 57.61 (48.48–62.95)    | 840.59 (721.56–917.38)    | 40.78 (26.10–59.83)   | 27.78 (24.42–33.83)    | 387.27 (345.03–445.48)    |
| Macedonia                        | 85.45 (55.59–125.94)  | 115.15 (104.24–133.48) | 1949.23 (1785.49–2234.89) | 74.62 (48.29–115.23)  | 89.37 (74.94–100.19)   | 1482.28 (1244.62–1640.77) |
| Madagascar                       | 62.46 (39.65–91.91)   | 132.15 (109.49–153.91) | 3027.30 (2514.12–3503.92) | 85.81 (55.40–127.22)  | 108.73 (80.30–138.18)  | 2405.47 (1750.41–3096.58) |
| Malawi                           | 59.06 (38.27–86.58)   | 109.88 (68.22–146.25)  | 2471.91 (1474.05–3320.76) | 83.55 (55.38–124.27)  | 93.23 (55.79–126.92)   | 2004.28 (1180.99–2751.18) |
| Malaysia                         | 64.52 (40.59–95.27)   | 69.90 (60.64–78.98)    | 1395.26 (1205.09–1565.67) | 81.39 (50.97–120.14)  | 51.30 (45.21–57.61)    | 941.20 (830.42–1058.26)   |
| Maldives                         | 69.88 (43.00–106.10)  | 34.56 (20.52–54.54)    | 801.63 (495.42–1262.54)   | 83.62 (51.73–125.20)  | 19.69 (12.84–26.85)    | 383.11 (259.12–501.57)    |
| Mali                             | 64.01 (40.87–96.31)   | 70.90 (47.27–89.21)    | 1692.08 (1083.04–2161.41) | 72.92 (46.78–106.44)  | 62.21 (47.66–76.67)    | 1419.09 (1040.14–1756.29) |
| Malta                            | 41.44 (26.35–61.87)   | 27.86 (21.00–31.94)    | 476.19 (367.78–535.97)    | 35.46 (22.96–53.25)   | 16.85 (13.83–19.27)    | 254.55 (216.03–287.85)    |
| Marshall Islands                 | 53.31 (32.66–81.29)   | 72.49 (54.47–100.55)   | 1514.81 (1134.73–2144.79) | 40.74 (24.98–60.98)   | 62.23 (46.73–81.93)    | 1351.12 (1018.72–1820.99) |
| Mauritania                       | 62.75 (40.90–94.30)   | 60.86 (46.04–74.13)    | 1419.40 (1017.07–1731.73) | 73.88 (48.22–108.35)  | 53.73 (45.12–66.51)    | 1206.70 (1002.47–1474.45) |
| Mauritius                        | 62.63 (40.18–95.35)   | 88.22 (78.25–98.62)    | 1831.98 (1619.89–2043.45) | 81.52 (52.11–122.45)  | 46.31 (39.81–62.10)    | 873.44 (756.25–1173.03)   |
| Mexico                           | 38.63 (24.60–57.71)   | 22.71 (20.41–26.07)    | 519.69 (469.00–597.43)    | 37.57 (24.23–56.12)   | 18.76 (15.61–20.84)    | 403.42 (344.61–447.65)    |
| Moldova                          | 48.61 (30.56–73.62)   | 61.54 (54.99–70.90)    | 1414.42 (1265.07–1636.56) | 69.30 (44.05–102.24)  | 50.87 (46.55–58.52)    | 1168.68 (1065.34–1347.79) |
| Mongolia                         | 134.27 (86.73–198.39) | 195.71 (172.64–214.86) | 3835.64 (3387.14–4220.57) | 147.61 (92.17–222.58) | 210.56 (178.44–234.44) | 4118.90 (3456.44–4590.27) |
| Montenegro                       | 86.29 (54.51–126.07)  | 121.73 (100.50–142.71) | 2150.08 (1704.93–2594.54) | 73.86 (45.81–109.54)  | 92.18 (81.68–108.28)   | 1405.71 (1270.00–1623.20) |
| Morocco                          | 33.45 (21.20–50.82)   | 55.20 (47.11–66.88)    | 1284.88 (1032.83–1568.27) | 47.00 (29.22–70.38)   | 40.20 (35.26–47.63)    | 879.61 (751.12–1038.37)   |
| Mozambique                       | 58.59 (37.54–87.82)   | 47.08 (32.03–63.07)    | 957.46 (647.43–1293.10)   | 82.45 (52.96–123.34)  | 46.72 (34.91–61.16)    | 973.83 (728.18–1284.54)   |
| Myanmar                          | 82.44 (53.76–119.91)  | 129.23 (66.65–186.29)  | 2550.91 (1298.36–3780.29) | 107.06 (67.85–165.67) | 104.96 (60.01–152.44)  | 2045.19 (1134.39–3011.95) |
| Namibia                          | 74.59 (47.92–111.16)  | 85.34 (69.45–103.16)   | 1810.14 (1461.74–2220.19) | 91.30 (59.55–134.68)  | 70.51 (57.08–84.22)    | 1474.78 (1196.76–1758.93) |
| Nepal                            | 49.25 (31.52–72.96)   | 41.47 (27.35–55.33)    | 852.99 (565.75–1132.83)   | 53.38 (34.43–81.17)   | 41.07 (28.64–54.84)    | 814.93 (560.17–1093.69)   |
| Netherlands                      | 35.89 (27.90–46.36)   | 31.31 (27.78–35.18)    | 506.34 (452.67–567.91)    | 32.29 (25.28–41.34)   | 17.83 (15.72–20.89)    | 274.08 (246.08–312.01)    |
| New Zealand                      | 32.98 (25.97–42.02)   | 27.94 (25.26–31.36)    | 512.85 (460.64–567.45)    | 26.09 (20.42–33.48)   | 13.64 (11.19–15.73)    | 228.84 (194.28–254.75)    |
| Nicaragua                        | 43.66 (27.60–64.14)   | 46.50 (38.84–50.51)    | 958.43 (778.30–1050.75)   | 40.88 (26.32–62.23)   | 37.15 (32.83–43.33)    | 680.60 (613.19–802.70)    |
| Niger                            | 63.44 (41.03–92.75)   | 61.54 (48.22–82.19)    | 1557.09 (1193.48–2057.92) | 75.99 (48.09–112.22)  | 53.71 (39.11–75.71)    | 1234.63 (882.84–1755.42)  |
| Nigeria                          | 63.00 (40.33–91.61)   | 46.93 (39.63–57.50)    | 1139.24 (930.01–1370.28)  | 71.80 (47.75–105.59)  | 34.96 (27.73–46.07)    | 787.10 (622.03–1023.60)   |
| North Korea                      | 76.81 (47.70–115.69)  | 96.58 (66.93–129.46)   | 1932.22 (1347.69–2545.62) | 113.35 (73.34–164.98) | 100.95 (67.84–134.55)  | 2021.85 (1357.81–2681.88) |
| Norway                           | 45.24 (35.85–56.11)   | 35.25 (30.67–38.94)    | 544.24 (481.33–603.55)    | 39.93 (31.85–49.21)   | 18.82 (16.36–22.56)    | 264.92 (237.92–307.38)    |
| Oman                             | 29.95 (19.21–45.29)   | 53.52 (42.19–78.19)    | 1127.60 (880.88–1689.35)  | 43.96 (28.37–65.65)   | 34.57 (28.68–46.47)    | 647.26 (543.84–851.95)    |
| Pakistan                         | 46.86 (30.33–69.30)   | 43.26 (31.10–54.16)    | 902.07 (637.46–1122.29)   | 53.05 (34.20–78.66)   | 44.83 (34.71–56.44)    | 918.76 (700.39–1159.68)   |
| Palestine                        | 70.68 (50.87–93.93)   | 160.10 (123.96–183.56) | 2695.26 (2085.44–3170.88) | 98.75 (73.64–129.98)  | 111.36 (90.76–122.93)  | 1812.97 (1476.46–2008.30) |
| Panama                           | 42.60 (27.53–61.27)   | 41.80 (36.00–46.52)    | 794.43 (666.77–875.29)    | 42.10 (26.46–62.06)   | 31.80 (27.50–37.60)    | 556.56 (485.79–674.16)    |
| Papua New Guinea                 | 44.73 (28.18–66.88)   | 38.90 (17.55–89.55)    | 987.56 (404.90–2349.07)   | 37.30 (23.35–56.13)   | 35.41 (14.24–82.81)    | 896.80 (338.67–2186.15)   |
| Paraguay                         | 66.87 (43.92–99.72)   | 67.84 (58.75–73.41)    | 1283.31 (1111.28–1382.38) | 60.31 (38.27–88.81)   | 59.88 (52.84–71.19)    | 1141.72 (1006.28–1348.51) |
| Peru                             | 38.95 (24.73–58.02)   | 25.05 (21.54–27.76)    | 652.50 (565.88–722.09)    | 34.14 (21.90–51.03)   | 18.10 (15.00–20.73)    | 397.11 (317.25–457.52)    |
| Philippines                      | 63.46 (40.04–96.81)   | 55.37 (48.57–60.31)    | 1298.15 (1158.07–1410.20) | 86.11 (54.44–128.07)  | 62.84 (52.23–69.71)    | 1404.09 (1154.76–1552.66) |
| Poland                           | 67.17 (51.85–85.23)   | 103.91 (84.95–112.96)  | 1656.19 (1397.37–1781.00) | 53.23 (40.57–67.33)   | 42.40 (34.70–62.24)    | 730.66 (636.92–965.39)    |
| Portugal                         | 63.73 (49.93–79.93)   | 70.99 (58.64–76.93)    | 1272.09 (1062.84–1372.14) | 51.08 (39.53–63.76)   | 31.95 (25.96–43.16)    | 531.49 (446.27–690.67)    |
| Qatar                            | 11.07 (7.60–15.52)    | 35.30 (23.01–44.89)    | 642.27 (426.01–816.95)    | 14.55 (9.61–21.38)    | 13.21 (11.39–15.94)    | 228.07 (193.91–266.29)    |
| Romania                          | 76.44 (48.67–115.87)  | 84.47 (76.68–92.70)    | 1630.50 (1467.94–1776.19) | 66.03 (43.68–98.07)   | 62.91 (57.04–72.90)    | 1158.05 (1057.38–1352.39) |
| Russia                           | 44.22 (34.99–55.22)   | 48.85 (42.45–60.64)    | 1077.46 (947.62–1257.88)  | 61.98 (49.22–77.13)   | 42.07 (36.16–51.95)    | 984.31 (846.51–1153.35)   |
| Rwanda                           | 58.77 (37.85–87.88)   | 115.98 (72.06–174.63)  | 2619.76 (1625.12–3977.20) | 82.94 (54.59–121.29)  | 65.93 (45.18–97.79)    | 1390.55 (940.59–2073.23)  |
| Saint Lucia                      | 66.78 (42.99–99.23)   | 75.86 (62.81–82.76)    | 1493.03 (1224.06–1631.94) | 69.61 (45.11–105.35)  | 49.12 (42.26–61.48)    | 828.14 (719.22–1076.13)   |
| Saint Vincent and the Grenadines | 64.80 (41.78–98.88)   | 74.81 (61.63–82.82)    | 1350.31 (1117.30–1485.12) | 63.69 (40.81–94.22)   | 48.30 (42.39–58.33)    | 828.83 (733.04–994.07)    |
| Samoa                            | 54.89 (34.50–81.20)   | 78.91 (54.29–138.00)   | 1634.85 (1098.33–2976.81) | 42.89 (26.49–64.79)   | 38.24 (25.43–64.37)    | 750.84 (501.42–1279.31)   |
| São Tomé and Príncipe            | 66.63 (42.02–99.60)   | 64.44 (56.95–74.16)    | 1603.26 (1374.12–1878.56) | 77.79 (51.22–112.51)  | 51.19 (41.54–64.36)    | 1149.64 (931.41–1426.71)  |
| Saudi Arabia                     | 19.77 (13.07–28.92)   | 48.14 (40.75–57.05)    | 914.11 (765.69–1102.68)   | 28.54 (19.24–40.97)   | 39.60 (32.78–45.14)    | 693.54 (579.12–783.90)    |
| Senegal                          | 62.37 (40.43–94.15)   | 38.84 (27.67–48.73)    | 995.45 (677.52–1237.63)   | 71.28 (46.17–109.08)  | 29.28 (20.07–39.23)    | 697.77 (459.22–909.72)    |

(Continues on next page)

|                                | 1990                  |                        |                           | 2010                  |                       |                           |
|--------------------------------|-----------------------|------------------------|---------------------------|-----------------------|-----------------------|---------------------------|
|                                | Incidence             | Mortality              | DALYs                     | Incidence             | Mortality             | DALYs                     |
| (Continued from previous page) |                       |                        |                           |                       |                       |                           |
| Serbia                         | 74.94 (58.88–95.55)   | 46.07 (39.14–54.10)    | 1043.61 (881.72–1233.81)  | 63.36 (48.55–81.04)   | 29.91 (27.17–35.02)   | 630.58 (570.13–751.23)    |
| Seychelles                     | 69.12 (43.95–103.50)  | 97.49 (85.62–116.66)   | 1960.06 (1715.79–2341.14) | 84.11 (54.87–124.58)  | 64.67 (54.06–79.60)   | 1291.34 (1096.74–1556.40) |
| Sierra Leone                   | 66.35 (42.88–98.22)   | 68.60 (56.14–86.92)    | 1764.68 (1441.59–2160.31) | 77.18 (48.52–116.51)  | 63.25 (49.64–83.02)   | 1493.49 (1176.24–1928.42) |
| Singapore                      | 60.17 (37.41–88.38)   | 43.60 (38.30–47.60)    | 888.80 (777.61–963.48)    | 44.19 (27.09–66.03)   | 22.88 (19.50–26.48)   | 423.67 (369.99–484.55)    |
| Slovakia                       | 60.26 (37.80–90.12)   | 37.59 (31.23–42.14)    | 815.83 (680.19–916.90)    | 48.61 (30.16–72.59)   | 18.45 (16.57–21.32)   | 394.83 (349.14–452.98)    |
| Slovenia                       | 62.70 (41.20–94.44)   | 20.08 (18.26–23.80)    | 529.13 (478.98–609.60)    | 54.37 (34.38–81.95)   | 10.64 (8.18–12.05)    | 239.31 (200.77–267.03)    |
| Solomon Islands                | 56.89 (34.87–90.41)   | 103.78 (72.78–166.92)  | 2203.88 (1467.18–3745.73) | 45.66 (28.35–69.58)   | 103.92 (72.78–183.19) | 2212.52 (1474.80–4107.02) |
| Somalia                        | 58.84 (37.68–89.02)   | 91.07 (54.06–138.65)   | 2001.11 (1185.95–3169.81) | 83.58 (56.36–125.63)  | 73.62 (44.00–109.01)  | 1556.55 (897.72–2384.59)  |
| South Africa                   | 68.11 (43.62–103.37)  | 74.30 (56.10–84.77)    | 1599.62 (1168.81–1835.14) | 87.41 (56.38–129.75)  | 46.01 (39.32–58.26)   | 992.31 (855.75–1314.38)   |
| South Korea                    | 76.67 (48.49–113.79)  | 82.17 (69.41–88.35)    | 1771.30 (1480.71–1903.95) | 56.40 (35.64–82.98)   | 27.08 (23.03–34.40)   | 502.64 (438.80–636.30)    |
| Spain                          | 44.62 (28.97–64.48)   | 19.37 (17.48–22.07)    | 461.74 (406.85–518.50)    | 37.89 (24.83–56.11)   | 11.48 (9.49–13.04)    | 232.61 (205.26–261.44)    |
| Sri Lanka                      | 58.71 (35.56–88.55)   | 37.75 (33.27–42.48)    | 862.44 (756.44–957.19)    | 76.41 (46.98–115.86)  | 30.14 (24.71–35.76)   | 568.76 (471.43–668.07)    |
| Sudan                          | 55.18 (36.07–81.15)   | 59.15 (41.39–77.83)    | 1211.16 (816.91–1604.45)  | 78.15 (50.87–117.40)  | 31.56 (24.40–40.89)   | 606.22 (463.24–792.24)    |
| Suriname                       | 60.97 (38.78–90.52)   | 72.48 (66.11–84.60)    | 1402.32 (1282.78–1609.71) | 68.64 (46.03–102.07)  | 59.50 (42.19–69.79)   | 1087.32 (782.07–1264.49)  |
| Swaziland                      | 70.63 (45.06–107.53)  | 71.67 (55.92–86.85)    | 1496.79 (1164.47–1828.40) | 90.04 (57.42–134.81)  | 76.70 (60.46–91.43)   | 1711.61 (1363.69–2046.68) |
| Sweden                         | 45.61 (36.43–55.96)   | 19.13 (17.40–22.20)    | 373.19 (340.46–429.95)    | 40.28 (32.21–49.20)   | 11.60 (10.19–13.09)   | 206.75 (182.66–234.94)    |
| Switzerland                    | 42.36 (26.93–62.95)   | 21.06 (18.19–24.25)    | 364.76 (321.14–409.43)    | 35.13 (22.78–52.29)   | 11.60 (9.69–13.88)    | 178.20 (151.74–207.62)    |
| Syria                          | 28.12 (18.21–42.19)   | 81.09 (69.28–101.75)   | 1783.33 (1531.60–2212.06) | 39.90 (25.60–59.26)   | 57.14 (43.48–73.27)   | 1178.71 (913.17–1477.89)  |
| Taiwan                         | 75.67 (48.17–113.82)  | 61.87 (52.12–75.17)    | 1241.32 (1059.43–1501.85) | 103.26 (64.43–154.74) | 31.31 (27.17–36.14)   | 626.24 (539.08–715.26)    |
| Tajikistan                     | 118.08 (74.67–173.75) | 100.58 (82.63–111.90)  | 1854.19 (1544.07–2037.64) | 130.74 (83.13–197.37) | 99.98 (75.54–115.10)  | 1834.22 (1400.71–2135.69) |
| Tanzania                       | 63.46 (46.11–85.90)   | 42.12 (30.42–54.08)    | 842.81 (613.47–1072.85)   | 88.65 (66.29–118.53)  | 30.47 (22.09–40.39)   | 602.19 (434.65–799.86)    |
| Thailand                       | 60.82 (38.30–90.11)   | 50.98 (46.36–59.20)    | 1042.42 (934.30–1190.47)  | 86.71 (54.53–131.91)  | 40.98 (34.58–47.62)   | 745.67 (617.30–842.08)    |
| The Bahamas                    | 60.08 (39.21–88.72)   | 54.75 (48.04–60.85)    | 1092.09 (950.91–1202.25)  | 57.83 (36.99–86.04)   | 20.24 (16.41–24.65)   | 386.72 (329.53–461.38)    |
| The Gambia                     | 66.12 (41.96–98.24)   | 72.87 (48.77–103.28)   | 1784.42 (1140.76–2556.43) | 74.74 (48.13–112.12)  | 56.22 (38.19–77.12)   | 1272.12 (842.34–1754.94)  |
| Timor-Leste                    | 68.09 (43.25–102.83)  | 80.84 (63.55–101.98)   | 1714.79 (1345.79–2161.32) | 90.77 (58.53–135.33)  | 74.97 (61.43–95.66)   | 1552.52 (1280.45–1961.11) |
| Togo                           | 63.59 (39.36–94.99)   | 64.43 (54.37–76.22)    | 1507.89 (1268.35–1781.72) | 76.09 (48.89–112.89)  | 56.93 (45.74–71.50)   | 1269.49 (1023.12–1585.01) |
| Tonga                          | 43.96 (26.64–67.27)   | 40.17 (31.34–53.68)    | 736.58 (559.75–1023.03)   | 34.73 (21.23–54.04)   | 25.35 (19.32–34.02)   | 472.33 (359.43–645.30)    |
| Trinidad and Tobago            | 58.57 (37.52–85.29)   | 66.29 (58.06–72.33)    | 1381.74 (1201.77–1500.52) | 58.30 (37.22–88.57)   | 47.42 (40.70–60.26)   | 885.18 (764.82–1115.63)   |
| Tunisia                        | 29.26 (18.80–44.52)   | 49.24 (35.97–66.71)    | 1037.10 (749.67–1394.29)  | 41.23 (26.52–61.62)   | 36.46 (27.21–49.91)   | 684.66 (510.75–918.06)    |
| Turkey                         | 31.88 (19.98–48.12)   | 86.59 (72.16–105.73)   | 2232.46 (1883.47–2676.85) | 43.11 (27.71–64.35)   | 48.84 (41.02–57.91)   | 1115.81 (909.72–1325.63)  |
| Turkmenistan                   | 113.39 (72.18–165.80) | 118.90 (104.96–127.56) | 2501.36 (2218.82–2663.97) | 122.50 (78.73–184.04) | 101.60 (84.50–117.40) | 2081.03 (1717.38–2419.32) |
| Uganda                         | 57.23 (36.50–85.86)   | 59.23 (33.75–87.68)    | 1291.39 (729.16–1902.39)  | 81.25 (52.94–120.81)  | 49.36 (31.29–71.54)   | 1022.84 (636.60–1484.18)  |
| Ukraine                        | 68.19 (51.08–88.54)   | 42.44 (38.74–48.70)    | 960.88 (871.95–1065.18)   | 88.61 (68.21–114.21)  | 31.92 (28.20–37.06)   | 752.98 (656.08–842.01)    |
| United Arab Emirates           | 27.41 (17.57–40.84)   | 47.38 (35.97–71.18)    | 880.78 (658.87–1320.96)   | 39.90 (23.69–62.76)   | 33.00 (24.29–46.22)   | 556.49 (398.72–777.45)    |
| UK                             | 34.24 (28.26–41.50)   | 25.56 (23.15–28.59)    | 519.62 (468.66–579.08)    | 30.18 (24.70–36.60)   | 14.07 (11.81–15.71)   | 265.46 (233.03–298.43)    |
| USA                            | 47.05 (35.19–61.19)   | 14.17 (13.05–16.49)    | 363.74 (333.94–418.12)    | 41.50 (31.27–54.01)   | 9.64 (8.02–10.88)     | 244.64 (211.74–270.17)    |
| Uruguay                        | 69.68 (44.89–104.75)  | 49.18 (44.39–54.29)    | 1091.88 (981.97–1203.16)  | 56.67 (36.13–83.98)   | 32.70 (29.01–37.56)   | 700.65 (621.56–794.78)    |
| Uzbekistan                     | 107.56 (69.37–162.76) | 71.39 (64.55–82.60)    | 1477.76 (1346.84–1691.67) | 118.68 (76.53–177.70) | 67.45 (58.42–78.94)   | 1315.77 (1142.14–1557.77) |
| Vanuatu                        | 55.52 (35.41–86.38)   | 95.15 (66.56–144.08)   | 2036.96 (1356.54–3292.51) | 45.07 (28.63–67.23)   | 92.76 (64.18–138.74)  | 1927.40 (1285.56–3048.34) |
| Venezuela                      | 39.72 (25.44–56.81)   | 43.00 (37.78–47.38)    | 868.61 (761.27–956.67)    | 38.64 (24.51–56.73)   | 29.72 (26.23–34.31)   | 576.03 (518.11–671.29)    |
| Vietnam                        | 95.94 (62.08–142.34)  | 159.56 (121.07–182.13) | 2572.06 (1935.45–2942.07) | 119.71 (78.89–177.22) | 114.77 (89.56–131.54) | 1763.67 (1386.67–2029.02) |
| Yemen                          | 31.73 (20.28–47.90)   | 72.28 (44.87–115.97)   | 1736.69 (1089.34–2663.97) | 46.31 (30.01–68.16)   | 62.70 (43.53–93.46)   | 1361.41 (949.48–1966.49)  |
| Zambia                         | 56.44 (35.51–85.74)   | 71.19 (52.05–91.20)    | 1440.84 (1038.28–1851.49) | 81.86 (51.66–118.80)  | 69.38 (53.14–90.51)   | 1391.56 (1038.13–1831.28) |
| Zimbabwe                       | 67.30 (48.84–88.82)   | 45.15 (37.93–53.82)    | 946.51 (800.48–1135.37)   | 89.14 (66.26–115.40)  | 64.52 (47.90–87.33)   | 1434.77 (1051.30–1978.22) |

Data are point estimates (95% CIs). DALYs=disability-adjusted life-years.

Table 2: Age-standardised incidence and mortality per 100 000 person-years, and DALYs lost per 100 000 people, for haemorrhagic stroke, by country in 1990 and 2010

|                              | 1990       |                                 | 2005       |                               | 2010       |                              | p value* |
|------------------------------|------------|---------------------------------|------------|-------------------------------|------------|------------------------------|----------|
|                              | n          | Point estimate (95% CI)         | n          | Point estimate (95% CI)       | n          | Point estimate (95% CI)      |          |
| <b>High-income countries</b> |            |                                 |            |                               |            |                              |          |
| <b>Aged &lt;20 years</b>     |            |                                 |            |                               |            |                              |          |
| <b>Ischaemic</b>             |            |                                 |            |                               |            |                              |          |
| Incidence                    | 8268       | 2.46 (2.25-2.67)                | 6680       | 2.21 (2.00-2.43)              | 6110       | 2.11 (1.91-2.33)             | 0.013    |
| MIR                          | ..         | 0.035 (0.031-0.041)             | ..         | 0.031 (0.022-0.037)           | ..         | 0.025 (0.017-0.031)          | 0.006    |
| DALYs                        | 35 027     | 10.42 (9.49-11.77)              | 28 444     | 9.42 (6.92-10.83)             | 22 912     | 7.89 (5.68-9.66)             | 0.008    |
| Mortality                    | 384        | 0.11 (0.10-0.13)                | 291        | 0.10 (0.06-0.11)              | 223        | 0.08 (0.05-0.10)             | 0.003    |
| <b>Haemorrhagic</b>          |            |                                 |            |                               |            |                              |          |
| Incidence                    | 5107       | 1.52 (1.40-1.65)                | 3735       | 1.24 (1.13-1.36)              | 3393       | 1.17 (1.07-1.28)             | <0.001   |
| MIR                          | ..         | 0.289 (0.238-0.335)             | ..         | 0.196 (0.160-0.232)           | ..         | 0.163 (0.127-0.198)          | <0.001   |
| DALYs                        | 154 507    | 45.98 (37.73-51.49)             | 71 713     | 23.76 (20.49-26.98)           | 55 326     | 19.06 (15.66-22.17)          | <0.001   |
| Mortality                    | 1974       | 0.59 (0.48-0.66)                | 907        | 0.30 (0.26-0.34)              | 691        | 0.24 (0.19-0.28)             | <0.001   |
| <b>Aged ≥20-64 years</b>     |            |                                 |            |                               |            |                              |          |
| <b>Ischaemic</b>             |            |                                 |            |                               |            |                              |          |
| Incidence                    | 619 121    | 87.16 (81.02-93.66)             | 663 271    | 85.60 (79.89-91.93)           | 743 213    | 93.82 (87.23-100.81)         | 0.060    |
| MIR                          | ..         | 0.142 (0.122-0.157)             | ..         | 0.114 (0.098-0.128)           | ..         | 0.092 (0.077-0.104)          | <0.001   |
| DALYs                        | 2 818 833  | 396.84 (353.88-423.46)          | 2 650 292  | 342.02 (302.66-371.93)        | 2 451 018  | 309.40 (272.20-340.16)       | <0.001   |
| Mortality                    | 87 833     | 12.37 (10.74-13.29)             | 75 345     | 9.72 (8.37-10.66)             | 68 140     | 8.60 (7.31-9.59)             | <0.001   |
| <b>Haemorrhagic</b>          |            |                                 |            |                               |            |                              |          |
| Incidence                    | 343 294    | 48.33 (44.87-52.17)             | 379 159    | 48.93 (45.35-52.75)           | 409 193    | 51.65 (47.80-55.32)          | 0.105    |
| MIR                          | ..         | 0.465 (0.407-0.519)             | ..         | 0.368 (0.320-0.413)           | ..         | 0.294 (0.255-0.335)          | <0.001   |
| DALYs                        | 5 369 589  | 755.94 (673.55-821.03)          | 4 878 882  | 629.62 (560.28-688.56)        | 4 148 598  | 523.70 (463.91-581.56)       | <0.001   |
| Mortality                    | 159 383    | 22.44 (19.89-24.48)             | 139 460    | 18.00 (15.97-19.81)           | 119 958    | 15.14 (13.30-16.94)          | <0.001   |
| <b>Aged 65-74 years</b>      |            |                                 |            |                               |            |                              |          |
| <b>Ischaemic</b>             |            |                                 |            |                               |            |                              |          |
| Incidence                    | 1 013 498  | 1212.57 (1122.02-1302.50)       | 1 207 812  | 1136.70 (1059.80-1220.27)     | 1 206 882  | 1104.11 (1027.09-1183.37)    | 0.031    |
| MIR                          | ..         | 0.188 (0.159-0.206)             | ..         | 0.177 (0.154-0.196)           | ..         | 0.143 (0.126-0.158)          | <0.001   |
| DALYs                        | 3 781 762  | 4524.60 (3941.34-4749.17)       | 4 348 756  | 4092.73 (3599.19-4348.87)     | 3 546 196  | 3244.21 (2906.40-3457.03)    | <0.001   |
| Mortality                    | 189 921    | 227.23 (196.05-239.23)          | 213 996    | 201.40 (176.80-214.06)        | 172 850    | 158.13 (141.31-169.43)       | <0.001   |
| <b>Haemorrhagic</b>          |            |                                 |            |                               |            |                              |          |
| Incidence                    | 237 332    | 283.95 (261.35-306.24)          | 268 304    | 252.51 (233.33-273.71)        | 273 711    | 250.40 (232.66-270.48)       | 0.009    |
| MIR                          | ..         | 0.574 (0.509-0.652)             | ..         | 0.492 (0.432-0.575)           | ..         | 0.391 (0.346-0.460)          | <0.001   |
| DALYs                        | 2 616 799  | 3130.80 (2838.73-3459.35)       | 2 547 071  | 2397.11 (2191.68-2767.00)     | 2 056 267  | 1881.16 (1720.23-2175.44)    | <0.001   |
| Mortality                    | 136 046    | 162.77 (146.94-179.98)          | 131 703    | 123.95 (113.39-143.70)        | 106 836    | 97.74 (89.22-113.97)         | <0.001   |
| <b>Aged ≥75 years</b>        |            |                                 |            |                               |            |                              |          |
| <b>Ischaemic</b>             |            |                                 |            |                               |            |                              |          |
| Incidence                    | 1 751 254  | 2824.36 (2627.56-3018.41)       | 2 031 829  | 2365.13 (2201.91-2540.09)     | 2 297 052  | 2344.00 (2197.01-2503.82)    | <0.001   |
| MIR                          | ..         | 0.537 (0.475-0.584)             | ..         | 0.466 (0.428-0.513)           | ..         | 0.422 (0.388-0.466)          | 0.003    |
| DALYs                        | 8 279 171  | 13 354.53 (11 987.70-13 857.29) | 8 273 750  | 9 660.42 (9 191.97-10 223.96) | 8 231 616  | 8 434.88 (8 041.62-9 048.47) | <0.001   |
| Mortality                    | 939 894    | 1 511.37 (1 353.61-1 565.14)    | 946 346    | 1 082.75 (1 031.81-1 161.73)  | 968 866    | 950.10 (905.53-1 030.62)     | <0.001   |
| <b>Haemorrhagic</b>          |            |                                 |            |                               |            |                              |          |
| Incidence                    | 258 372    | 417.51 (385.93-450.79)          | 323 137    | 378.54 (349.89-409.60)        | 364 687    | 380.14 (351.37-409.58)       | 0.035    |
| MIR                          | ..         | 0.979 (0.882-1.118)             | ..         | 0.820 (0.731-0.954)           | ..         | 0.748 (0.664-0.870)          | <0.001   |
| DALYs                        | 2 359 112  | 3 817.36 (3 571.28-4 300.03)    | 2 342 929  | 2 776.87 (2 589.80-3 203.22)  | 2 309 063  | 2 457.70 (2 273.57-2 848.71) | <0.001   |
| Mortality                    | 252 454    | 407.10 (380.48-462.06)          | 264 630    | 306.54 (285.54-353.63)        | 272 324    | 275.06 (253.75-320.33)       | <0.001   |
| <b>All ages</b>              |            |                                 |            |                               |            |                              |          |
| <b>Ischaemic</b>             |            |                                 |            |                               |            |                              |          |
| Incidence                    | 3 392 142  | 193.02 (179.74-205.88)          | 3 909 592  | 172.07 (161.23-183.52)        | 4 253 257  | 168.45 (158.25-179.52)       | 0.001    |
| MIR                          | ..         | 0.359 (0.316-0.390)             | ..         | 0.316 (0.290-0.343)           | ..         | 0.285 (0.263-0.311)          | <0.001   |
| DALYs                        | 14 914 794 | 842.32 (749.15-875.30)          | 15 301 242 | 671.23 (618.65-703.07)        | 14 251 741 | 556.98 (517.25-588.11)       | <0.001   |

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|                                | 1990     |                            | 2005     |                            | 2010     |                            | p value* |
|--------------------------------|----------|----------------------------|----------|----------------------------|----------|----------------------------|----------|
|                                | n        | Point estimate (95% CI)    | n        | Point estimate (95% CI)    | n        | Point estimate (95% CI)    |          |
| (Continued from previous page) |          |                            |          |                            |          |                            |          |
| Mortality                      | 1218033  | 63.80 (56.45–66.00)        | 1235978  | 47.77 (45.04–50.41)        | 1210080  | 40.29 (38.23–43.12)        | <0.001   |
| Haemorrhagic                   |          |                            |          |                            |          |                            |          |
| Incidence                      | 844105   | 53.30 (49.44–57.25)        | 974336   | 49.12 (45.75–52.84)        | 1050985  | 48.81 (45.44–52.13)        | 0.032    |
| MIR                            | ..       | 0.652 (0.589–0.729)        | ..       | 0.551 (0.492–0.628)        | ..       | 0.476 (0.430–0.546)        | <0.001   |
| DALYs                          | 10500007 | 695.26 (629.69–753.52)     | 9840594  | 529.78 (484.51–582.25)     | 8569255  | 425.13 (385.67–470.63)     | <0.001   |
| Mortality                      | 549858   | 32.65 (29.95–35.68)        | 536700   | 24.55 (22.67–27.37)        | 499809   | 20.25 (18.57–22.91)        | <0.001   |
| <b>Low-income countries</b>    |          |                            |          |                            |          |                            |          |
| Aged <20 years                 |          |                            |          |                            |          |                            |          |
| Ischaemic                      |          |                            |          |                            |          |                            |          |
| Incidence                      | 37604    | 1.96 (1.74–2.21)           | 42644    | 1.98 (1.78–2.23)           | 42607    | 1.97 (1.76–2.19)           | 0.467    |
| MIR                            | ..       | 0.158 (0.128–0.196)        | ..       | 0.108 (0.085–0.132)        | ..       | 0.099 (0.078–0.120)        | <0.001   |
| DALYs                          | 725569   | 37.81 (31.77–44.84)        | 564074   | 26.20 (20.44–31.46)        | 516534   | 23.85 (17.78–28.53)        | <0.001   |
| Mortality                      | 8737     | 0.46 (0.38–0.54)           | 6788     | 0.32 (0.25–0.38)           | 6212     | 0.29 (0.21–0.34)           | <0.001   |
| Haemorrhagic                   |          |                            |          |                            |          |                            |          |
| Incidence                      | 24132    | 1.26 (1.12–1.42)           | 31290    | 1.45 (1.31–1.63)           | 31333    | 1.45 (1.30–1.60)           | 0.036    |
| MIR                            | ..       | 1.153 (0.858–1.439)        | ..       | 0.695 (0.484–0.895)        | ..       | 0.638 (0.433–0.832)        | <0.001   |
| DALYs                          | 3842839  | 200.23 (148.70–247.29)     | 2909492  | 135.12 (94.33–166.46)      | 2658426  | 122.75 (84.26–154.03)      | <0.001   |
| Mortality                      | 47489    | 2.47 (1.84–3.05)           | 36251    | 1.68 (1.18–2.08)           | 33152    | 1.53 (1.05–1.91)           | <0.001   |
| Aged ≥20–64 years              |          |                            |          |                            |          |                            |          |
| Ischaemic                      |          |                            |          |                            |          |                            |          |
| Incidence                      | 1048665  | 52.22 (46.05–59.19)        | 1605620  | 57.20 (50.38–65.30)        | 1958154  | 62.80 (55.35–71.12)        | 0.023    |
| MIR                            | ..       | 0.162 (0.125–0.229)        | ..       | 0.131 (0.105–0.176)        | ..       | 0.116 (0.096–0.152)        | 0.001    |
| DALYs                          | 5724385  | 285.06 (235.39–382.78)     | 7242596  | 258.01 (221.90–331.52)     | 7822374  | 250.88 (222.65–313.29)     | 0.013    |
| Mortality                      | 169222   | 8.43 (6.79–11.60)          | 209449   | 7.46 (6.28–9.87)           | 226360   | 7.26 (6.36–9.35)           | 0.006    |
| Haemorrhagic                   |          |                            |          |                            |          |                            |          |
| Incidence                      | 932934   | 46.46 (40.34–53.15)        | 1699290  | 60.54 (52.05–71.01)        | 2048034  | 65.68 (56.36–76.71)        | 0.001    |
| MIR                            | ..       | 0.736 (0.569–0.918)        | ..       | 0.494 (0.397–0.602)        | ..       | 0.422 (0.333–0.515)        | <0.001   |
| DALYs                          | 23320724 | 1161.33 (946.76–1394.12)   | 28837888 | 1027.33 (877.98–1183.65)   | 29450146 | 944.51 (802.88–1095.88)    | <0.001   |
| Mortality                      | 682773   | 34.00 (27.64–41.04)        | 833453   | 29.69 (25.27–34.26)        | 858841   | 27.54 (23.33–32.06)        | <0.001   |
| Aged 65–74 years               |          |                            |          |                            |          |                            |          |
| Ischaemic                      |          |                            |          |                            |          |                            |          |
| Incidence                      | 1448192  | 1152.07 (993.10–1330.23)   | 2242233  | 1178.40 (1023.70–1368.17)  | 2503522  | 1197.93 (1046.63–1376.61)  | 0.363    |
| MIR                            | ..       | 0.188 (0.143–0.261)        | ..       | 0.167 (0.132–0.222)        | ..       | 0.152 (0.125–0.200)        | 0.039    |
| DALYs                          | 5256373  | 4181.55 (3367.95–5547.71)  | 7286998  | 3829.67 (3233.25–4924.07)  | 7455071  | 3567.24 (3120.81–4518.74)  | 0.005    |
| Mortality                      | 270306   | 215.03 (171.34–289.19)     | 372174   | 195.60 (163.42–253.47)     | 379837   | 181.75 (157.63–232.97)     | 0.006    |
| Haemorrhagic                   |          |                            |          |                            |          |                            |          |
| Incidence                      | 635720   | 505.73 (426.21–595.26)     | 1138008  | 598.08 (507.06–706.31)     | 1243472  | 595.00 (507.58–703.97)     | 0.085    |
| MIR                            | ..       | 0.868 (0.648–1.106)        | ..       | 0.632 (0.498–0.791)        | ..       | 0.563 (0.434–0.700)        | <0.001   |
| DALYs                          | 10345455 | 8230.02 (6557.97–10024.44) | 13489314 | 7089.29 (5966.41–8334.24)  | 13110681 | 6273.45 (5331.21–7356.20)  | <0.001   |
| Mortality                      | 547366   | 435.44 (345.66–530.97)     | 714434   | 375.47 (315.28–442.45)     | 695399   | 332.75 (282.67–390.97)     | <0.001   |
| Aged ≥75 years                 |          |                            |          |                            |          |                            |          |
| Ischaemic                      |          |                            |          |                            |          |                            |          |
| Incidence                      | 1312155  | 2367.54 (2026.74–2735.51)  | 2297208  | 2537.52 (2202.95–2941.36)  | 2811999  | 2575.40 (2240.67–2950.24)  | 0.222    |
| MIR                            | ..       | 0.440 (0.355–0.562)        | ..       | 0.384 (0.312–0.480)        | ..       | 0.362 (0.298–0.443)        | 0.046    |
| DALYs                          | 5507099  | 9938.45 (8486.20–12399.96) | 8176998  | 9013.12 (7860.57–10865.64) | 9343686  | 8553.44 (7572.78–10099.22) | 0.001    |
| Mortality                      | 574779   | 1075.73 (915.74–1336.49)   | 877484   | 997.48 (870.23–1204.49)    | 1012930  | 949.88 (838.56–1128.36)    | 0.01     |
| Haemorrhagic                   |          |                            |          |                            |          |                            |          |
| Incidence                      | 403286   | 713.83 (603.31–847.38)     | 793903   | 861.85 (735.11–1020.98)    | 951173   | 859.36 (729.17–1012.58)    | 0.065    |
| MIR                            | ..       | 1.479 (1.090–1.900)        | ..       | 1.094 (0.855–1.356)        | ..       | 1.008 (0.784–1.250)        | 0.002    |

(Continues on next page)

|                                | 1990       |                               | 2005       |                              | 2010       |                              | p value* |
|--------------------------------|------------|-------------------------------|------------|------------------------------|------------|------------------------------|----------|
|                                | n          | Point estimate (95% CI)       | n          | Point estimate (95% CI)      | n          | Point estimate (95% CI)      |          |
| (Continued from previous page) |            |                               |            |                              |            |                              |          |
| DALYs                          | 5 873 138  | 10 249.10 (7846.57–12 615.18) | 8 302 502  | 8 907.91 (7406.47–10 533.99) | 9 054 390  | 8 113.74 (6818.88–9 519.69)  | 0.002    |
| Mortality                      | 5 918 886  | 10 72.90 (819.30–13 294.49)   | 8 622 58   | 9 55.71 (789.22–11 38.04)    | 9 515 62   | 8 74.84 (736.84–10 26.62)    | 0.007    |
| All ages                       |            |                               |            |                              |            |                              |          |
| Ischaemic                      |            |                               |            |                              |            |                              |          |
| Incidence                      | 3 846 616  | 170.53 (148.24–195.28)        | 6 187 705  | 178.68 (156.28–205.59)       | 7 316 281  | 181.70 (159.10–206.78)       | 0.267    |
| MIR                            | ..         | 0.266 (0.213–0.354)           | ..         | 0.238 (0.193–0.303)          | ..         | 0.223 (0.186–0.276)          | 0.051    |
| DALYs                          | 17 213 426 | 734.86 (619.49–948.36)        | 23 270 664 | 658.32 (571.81–818.09)       | 25 137 666 | 613.93 (550.41–748.03)       | <0.001   |
| Mortality                      | 10 230 444 | 50.13 (42.02–64.07)           | 14 658 95  | 45.77 (39.69–56.27)          | 16 253 339 | 43.05 (38.25–51.96)          | <0.001   |
| Haemorrhagic                   |            |                               |            |                              |            |                              |          |
| Incidence                      | 1 996 072  | 81.40 (69.54–94.31)           | 3 662 492  | 98.80 (84.77–115.66)         | 4 274 013  | 99.43 (85.37–116.28)         | 0.040    |
| MIR                            | ..         | 0.932 (0.708–1.177)           | ..         | 0.668 (0.534–0.822)          | ..         | 0.595 (0.470–0.729)          | <0.001   |
| DALYs                          | 43 382 156 | 1 614.23 (1 292.98–1 946.36)  | 53 539 196 | 1 363.83 (1 154.83–1 580.73) | 54 273 644 | 1 207.21 (1 024.82–1 408.04) | <0.001   |
| Mortality                      | 18 695 514 | 80.37 (63.72–96.98)           | 24 463 97  | 69.29 (58.11–81.26)          | 25 389 54  | 61.93 (52.53–72.34)          | <0.001   |
| Globally                       |            |                               |            |                              |            |                              |          |
| Aged <20 years                 |            |                               |            |                              |            |                              |          |
| Ischaemic                      |            |                               |            |                              |            |                              |          |
| Incidence                      | 45 872     | 2.03 (1.85–2.25)              | 49 324     | 2.01 (1.83–2.23)             | 48 716     | 1.98 (1.80–2.18)             | 0.371    |
| MIR                            | ..         | 0.136 (0.112–0.165)           | ..         | 0.098 (0.077–0.118)          | ..         | 0.090 (0.070–0.108)          | <0.001   |
| DALYs                          | 760 596    | 33.73 (28.57–39.77)           | 592 518    | 24.13 (18.80–28.77)          | 539 446    | 21.96 (16.39–26.10)          | <0.001   |
| Mortality                      | 9 121      | 0.40 (0.34–0.48)              | 7 079      | 0.29 (0.22–0.34)             | 6 435      | 0.26 (0.20–0.31)             | <0.001   |
| Haemorrhagic                   |            |                               |            |                              |            |                              |          |
| Incidence                      | 29 240     | 1.30 (1.17–1.43)              | 35 025     | 1.43 (1.29–1.58)             | 34 727     | 1.41 (1.29–1.56)             | 0.120    |
| MIR                            | ..         | 1.001 (0.765–1.237)           | ..         | 0.642 (0.452–0.819)          | ..         | 0.592 (0.404–0.762)          | <0.001   |
| DALYs                          | 3 997 346  | 177.24 (132.48–217.62)        | 2 981 205  | 121.43 (85.31–149.09)        | 2 713 752  | 110.50 (76.32–138.09)        | <0.001   |
| Mortality                      | 49 464     | 2.19 (1.64–2.68)              | 37 159     | 1.51 (1.07–1.86)             | 33 843     | 1.38 (0.95–1.72)             | <0.001   |
| Aged ≥20–64 years              |            |                               |            |                              |            |                              |          |
| Ischaemic                      |            |                               |            |                              |            |                              |          |
| Incidence                      | 1 667 786  | 61.35 (56.39–66.65)           | 2 268 891  | 63.34 (57.92–69.84)          | 2 701 367  | 69.09 (63.00–76.01)          | 0.035    |
| MIR                            | ..         | 0.154 (0.133–0.194)           | ..         | 0.126 (0.108–0.159)          | ..         | 0.109 (0.095–0.134)          | <0.001   |
| DALYs                          | 8 543 219  | 314.27 (278.37–384.70)        | 9 892 888  | 276.19 (249.70–334.81)       | 10 273 392 | 262.73 (241.48–312.86)       | <0.001   |
| Mortality                      | 2 570 56   | 9.46 (8.30–11.77)             | 2 847 93   | 7.95 (7.09–9.86)             | 2 945 00   | 7.53 (6.85–9.24)             | <0.001   |
| Haemorrhagic                   |            |                               |            |                              |            |                              |          |
| Incidence                      | 1 276 228  | 46.95 (42.30–51.87)           | 2 078 450  | 58.03 (51.33–66.39)          | 2 457 227  | 62.84 (55.30–71.67)          | 0.001    |
| MIR                            | ..         | 0.662 (0.544–0.787)           | ..         | 0.470 (0.389–0.557)          | ..         | 0.400 (0.325–0.478)          | <0.001   |
| DALYs                          | 28 690 314 | 1 055.41 (895.45–1 232.70)    | 33 716 770 | 941.29 (818.42–1 072.58)     | 33 598 744 | 859.26 (741.90–985.04)       | <0.001   |
| Mortality                      | 8 421 56   | 30.98 (26.27–36.36)           | 9 729 13   | 27.16 (23.57–31.04)          | 9 787 99   | 25.03 (21.57–28.77)          | <0.001   |
| Aged 65–74 years               |            |                               |            |                              |            |                              |          |
| Ischaemic                      |            |                               |            |                              |            |                              |          |
| Incidence                      | 2 461 690  | 117.62 (107.38–129.17)        | 3 450 045  | 116.34 (105.37–128.73)       | 3 710 404  | 116.57 (105.96–128.45)       | 0.426    |
| MIR                            | ..         | 0.187 (0.161–0.229)           | ..         | 0.170 (0.147–0.205)          | ..         | 0.149 (0.130–0.180)          | 0.001    |
| DALYs                          | 9 038 136  | 431.85 (386.43–506.83)        | 11 635 754 | 392.93 (359.88–460.94)       | 11 001 267 | 345.31 (318.54–408.80)       | <0.001   |
| Mortality                      | 4 602 26   | 219.90 (195.49–261.22)        | 5 861 70   | 197.67 (178.67–234.07)       | 5 526 87   | 173.64 (158.88–207.65)       | <0.001   |
| Haemorrhagic                   |            |                               |            |                              |            |                              |          |
| Incidence                      | 873 052    | 417.16 (369.14–471.98)        | 1 406 313  | 474.25 (414.57–545.31)       | 1 517 183  | 476.66 (418.82–549.38)       | 0.078    |
| MIR                            | ..         | 0.786 (0.627–0.967)           | ..         | 0.605 (0.491–0.730)          | ..         | 0.531 (0.426–0.640)          | <0.001   |
| DALYs                          | 12 962 254 | 6 193.55 (5 168.67–7 330.20)  | 16 036 385 | 5 407.96 (4 672.18–6 260.19) | 15 166 948 | 4 765.06 (4 129.38–5 527.14) | <0.001   |
| Mortality                      | 6 834 12   | 326.54 (272.05–386.99)        | 8 461 38   | 285.34 (245.88–331.99)       | 8 022 34   | 252.04 (218.06–292.88)       | <0.001   |
| Aged ≥75 years                 |            |                               |            |                              |            |                              |          |
| Ischaemic                      |            |                               |            |                              |            |                              |          |
| Incidence                      | 3 063 410  | 2 614.89 (2 426.49–2 809.55)  | 4 329 037  | 2 452.72 (2 245.04–2 674.44) | 5 109 051  | 2 472.93 (2 279.15–2 687.39) | 0.176    |

(Continues on next page)



|                                | 1990     |                              | 2005     |                            | 2010     |                           | p value* |
|--------------------------------|----------|------------------------------|----------|----------------------------|----------|---------------------------|----------|
|                                | n        | Point estimate (95% CI)      | n        | Point estimate (95% CI)    | n        | Point estimate (95% CI)   |          |
| (Continued from previous page) |          |                              |          |                            |          |                           |          |
| MIR                            | ..       | 0.495 (0.450-0.547)          |          | 0.422 (0.379-0.483)        |          | 0.389 (0.348-0.450)       | <0.001   |
| DALYs                          | 13786270 | 11766.13 (11034.98-12688.85) | 16450747 | 9314.39 (8699.15-10498.56) | 17575302 | 8509.08 (7979.52-9562.85) | <0.001   |
| Mortality                      | 1514673  | 1313.55 (1225.05-1407.29)    | 1823831  | 1040.14 (972.42-1184.36)   | 1981797  | 952.73 (893.26-1082.61)   | <0.001   |
| <b>Haemorrhagic</b>            |          |                              |          |                            |          |                           |          |
| Incidence                      | 661658   | 558.61 (503.36-624.07)       | 1117040  | 630.25 (558.49-712.17)     | 1315860  | 640.06 (569.10-724.72)    | 0.046    |
| MIR                            | ..       | 1.280 (1.041-1.542)          |          | 1.012 (0.841-1.208)        |          | 0.934 (0.767-1.107)       | 0.001    |
| DALYs                          | 8232250  | 6899.22 (5819.05-8101.89)    | 10645431 | 5985.97 (5185.38-6900.83)  | 11363453 | 5544.55 (4848.87-6377.47) | <0.001   |
| Mortality                      | 844340   | 719.66 (605.91-844.83)       | 1126888  | 638.52 (554.36-736.04)     | 1223886  | 592.56 (517.87-681.36)    | <0.001   |
| <b>All ages</b>                |          |                              |          |                            |          |                           |          |
| <b>Ischaemic</b>               |          |                              |          |                            |          |                           |          |
| Incidence                      | 7238758  | 181.19 (167.30-196.23)       | 10097297 | 175.46 (160.08-192.26)     | 11569538 | 176.44 (161.46-192.21)    | 0.324    |
| MIR                            | ..       | 0.310 (0.278-0.352)          |          | 0.268 (0.237-0.310)        |          | 0.245 (0.219-0.285)       | <0.001   |
| DALYs                          | 32128220 | 795.80 (733.54-906.40)       | 38571908 | 667.77 (617.11-774.20)     | 39389408 | 597.80 (559.75-691.68)    | <0.001   |
| Mortality                      | 2241077  | 57.59 (53.69-63.97)          | 2701873  | 46.92 (43.58-53.67)        | 2835419  | 42.27 (39.60-48.71)       | <0.001   |
| <b>Haemorrhagic</b>            |          |                              |          |                            |          |                           |          |
| Incidence                      | 2840177  | 69.36 (62.46-77.18)          | 4636828  | 80.33 (71.40-91.69)        | 5324997  | 81.52 (72.27-92.82)       | 0.033    |
| MIR                            | ..       | 0.847 (0.692-1.009)          |          | 0.643 (0.536-0.766)        |          | 0.571 (0.471-0.676)       | <0.001   |
| DALYs                          | 53882164 | 1266.94 (1068.41-1484.26)    | 63379792 | 1081.81 (935.41-1234.23)   | 62842896 | 956.22 (827.57-1104.44)   | <0.001   |
| Mortality                      | 2419372  | 59.66 (50.61-69.71)          | 2983097  | 51.61 (44.68-59.07)        | 3038763  | 46.14 (40.13-53.15)       | <0.001   |

Data are point estimates (95% CIs), unless otherwise indicated. DALYs=disability-adjusted life-years. \*p-values are for the trend in rates between 1990 and 2010 only.

**Table 3: Age-adjusted annual incidence and mortality rates (per 100 000 person-years), mortality-to-incidence ratio (MIR), and DALYs lost for ischaemic and haemorrhagic stroke, by age group in high-income, low-income, and middle-income countries, and globally in 1990, 2005, and 2010**

p=0.021, for incidence of ischaemic stroke, and from 41.92/100 000 [38.89-45.15] to 38.46/100 000 [35.68-41.16], p=0.038, for incidence of haemorrhagic stroke). Worldwide, in the younger age group, the incidence of ischaemic stroke did not change, but we noted a significant increase in the incidence of haemorrhagic stroke, from 54.07 (48.56-60.22) to 64.07 (56.45-73.33; p=0.028). In the older age group (≥75 years) we noted no significant change in the incidence of ischaemic stroke (from 2614.89/100 000 [2426.49-2809.55] to 2472.93/100 000 [2279.15-2687.39], p=0.176), whereas a significant reduction was shown in the incidence of haemorrhagic stroke (from 558.61/100 000 [503.36-624.07] to 640.06/100 000 [569.10-724.72], p=0.046).

We noted a significant increase of 22% (95% CI 5-30) in the incidence of haemorrhagic stroke in low-income and middle-income countries in the past two decades, with a 19% (5-30) significant increase in people younger than 75 years. A non-significant increase of 6% (18%, -7 to 32) was shown in the incidence of ischaemic stroke; additionally, mortality rates were reduced by 14% (-2% to 32), DALYs lost by 16% (1-35%), and mortality-to-incidence ratio by 16% (-5% to 37); however, these differences were not significant. Similarly for haemorrhagic stroke, mortality rates were reduced by 23% (-3% to 36%), DALYs lost by 25% (7-38%), and mortality-to-incidence ratio by 36% (16-49%), likewise not significantly. In the past two decades, the incidence of both ischaemic and haemorrhagic stroke in low-

|                     | High-income |             |             |          | Low-income and middle-income |             |             |          | Globally    |             |             |          |
|---------------------|-------------|-------------|-------------|----------|------------------------------|-------------|-------------|----------|-------------|-------------|-------------|----------|
|                     | 1990        | 2005        | 2010        | p value* | 1990                         | 2005        | 2010        | p value* | 1990        | 2005        | 2010        | p value* |
| <b>Ischaemic</b>    |             |             |             |          |                              |             |             |          |             |             |             |          |
| Incidence           | 75.4 (0.13) | 75.9 (0.13) | 76.2 (0.13) | <0.001   | 69.6 (0.12)                  | 70.6 (0.11) | 70.8 (0.12) | <0.001   | 72.9 (0.11) | 73.0 (0.10) | 73.1 (0.10) | 0.079    |
| Mortality           | 80.7 (0.12) | 81.3 (0.22) | 82.7 (0.21) | <0.001   | 75.1 (0.32)                  | 76.4 (0.27) | 77.1 (0.26) | <0.001   | 78.1 (0.27) | 78.6 (0.20) | 79.4 (0.19) | <0.001   |
| <b>Haemorrhagic</b> |             |             |             |          |                              |             |             |          |             |             |             |          |
| Incidence           | 67.6 (0.13) | 68.7 (0.14) | 69.1 (0.15) | <0.001   | 62.8 (0.15)                  | 63.7 (0.13) | 63.8 (0.13) | <0.001   | 64.7 (0.11) | 65.0 (0.10) | 65.1 (0.11) | 0.001    |
| Mortality           | 71.6 (0.29) | 73.0 (0.30) | 74.8 (0.32) | <0.001   | 66.8 (0.29)                  | 68.2 (0.28) | 68.9 (0.31) | <0.001   | 68.0 (0.23) | 69.1 (0.25) | 69.9 (0.30) | <0.001   |

Data are mean (SD). \*p-values are for the trend in mean age between 1990 and 2010 only.

**Table 4: Mean age of incident and fatal strokes in 1990, 2005, and 2010, by stroke type and country income level**

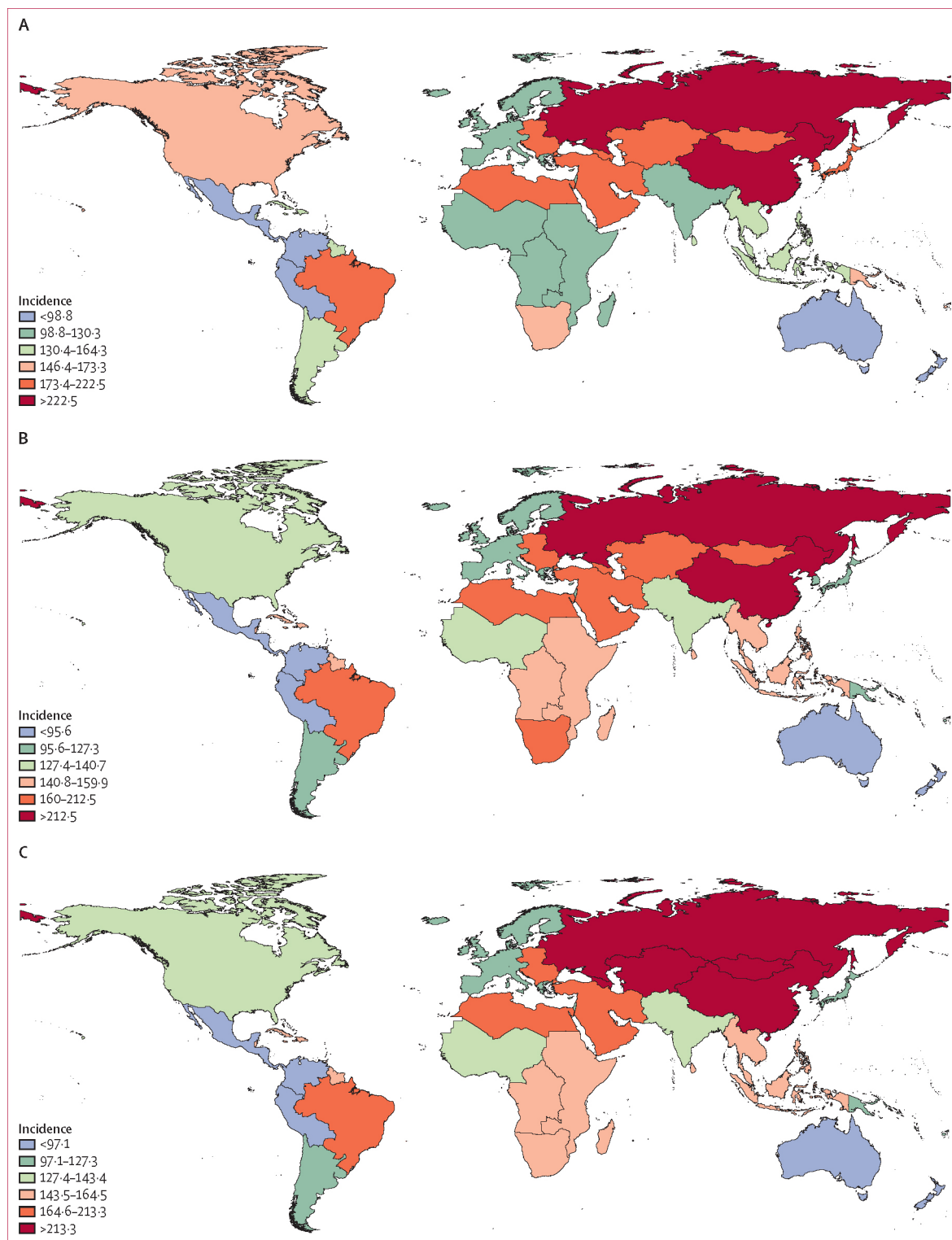


Figure 1: Age-standardised incidence of ischaemic stroke per 100 000 person-years for 1990 (A), 2005 (B), and 2010 (C)

income and middle-income countries increased significantly in people aged 20–64 years (table 3). Worldwide, the mean age of people with incident and fatal stroke has

increased in the past two decades, with the largest increase noted in high-income countries (table 4). In 2010, the mean age of patients with incident and fatal

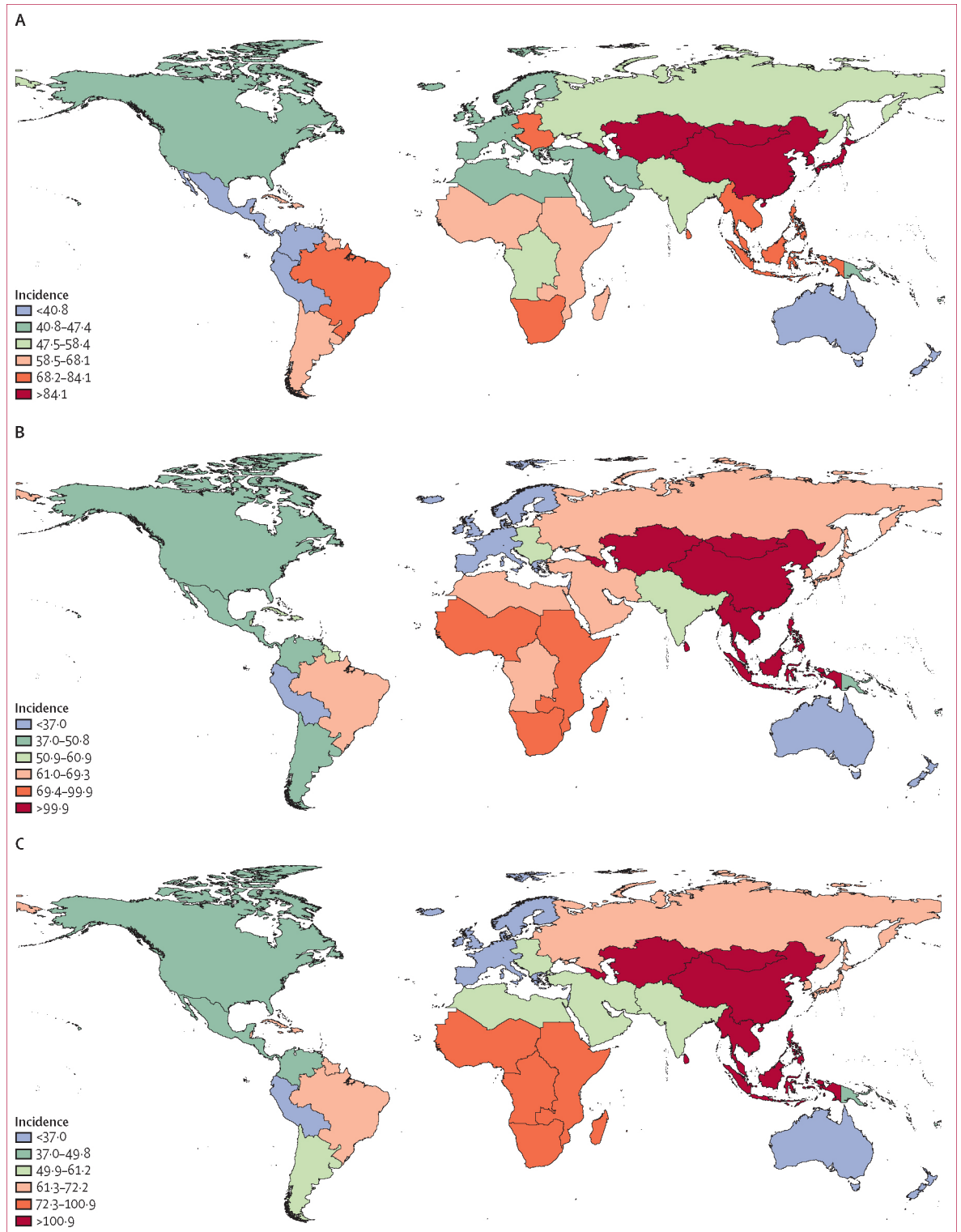


Figure 2: Age-standardised incidence of haemorrhagic stroke per 100 000 person-years for 1990 (A), 2005 (B), and 2010 (C)

ischaemic and haemorrhagic stroke was 3–5 years greater in high-income than in low-income to middle-income countries (table 4).

By GBD region, in the past two decades, the largest increases in incidence of ischaemic stroke were in eastern Europe, central and east Asia, north and sub-

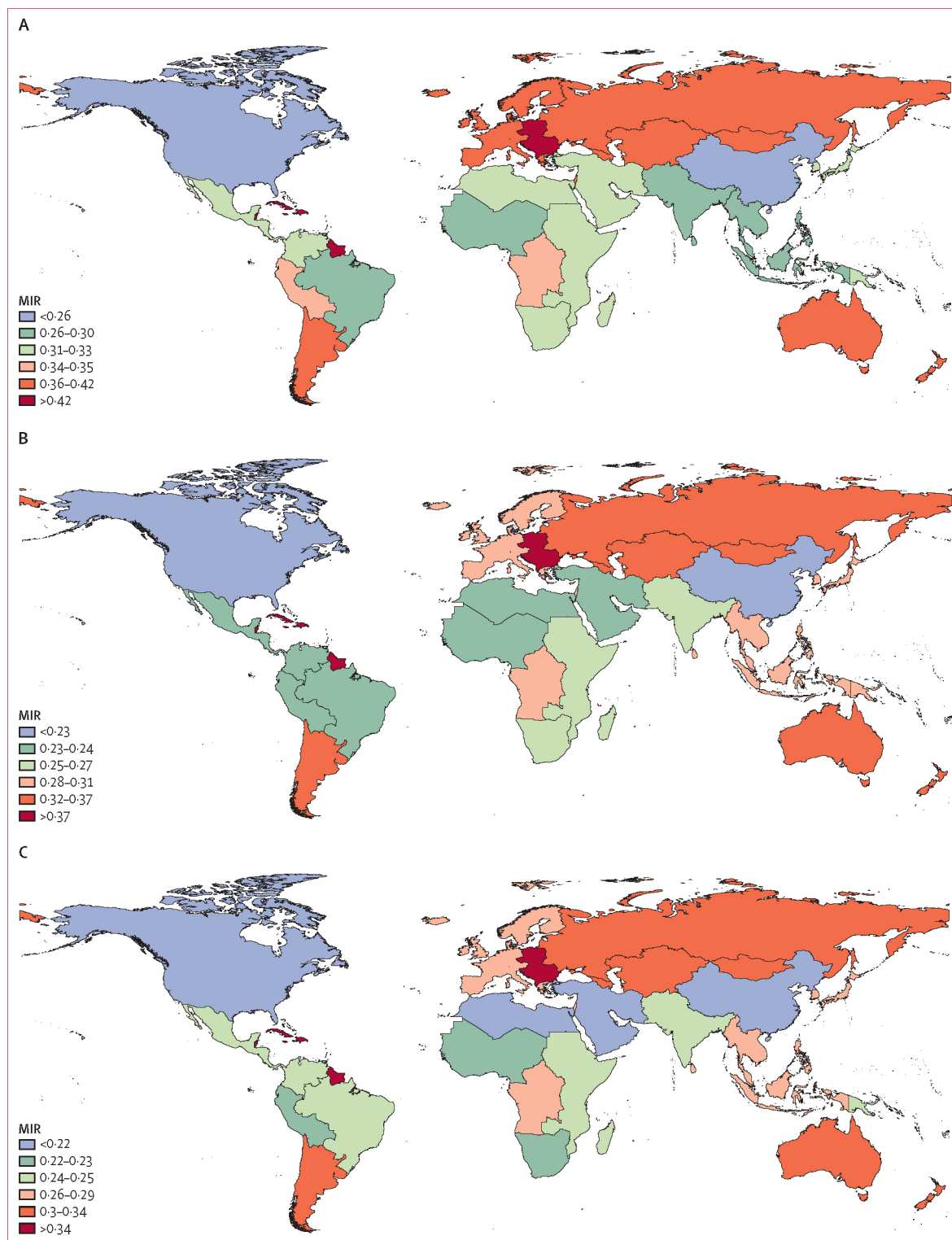


Figure 3: Mortality-to-incidence ratio (MIR) for ischaemic stroke for 1990 (A), 2005 (B), and 2010 (C)

Saharan Africa, and the Middle East (figure 1), with the largest increase (22%) noted in the Democratic Republic of Congo. Notably, some of the largest decreases in

incidence of ischaemic stroke between 1990 and 2010 were also in these regions (South Korea 44%, Chile 41%, Brunei 41%; figure 1). Up to 2010, the highest rates of

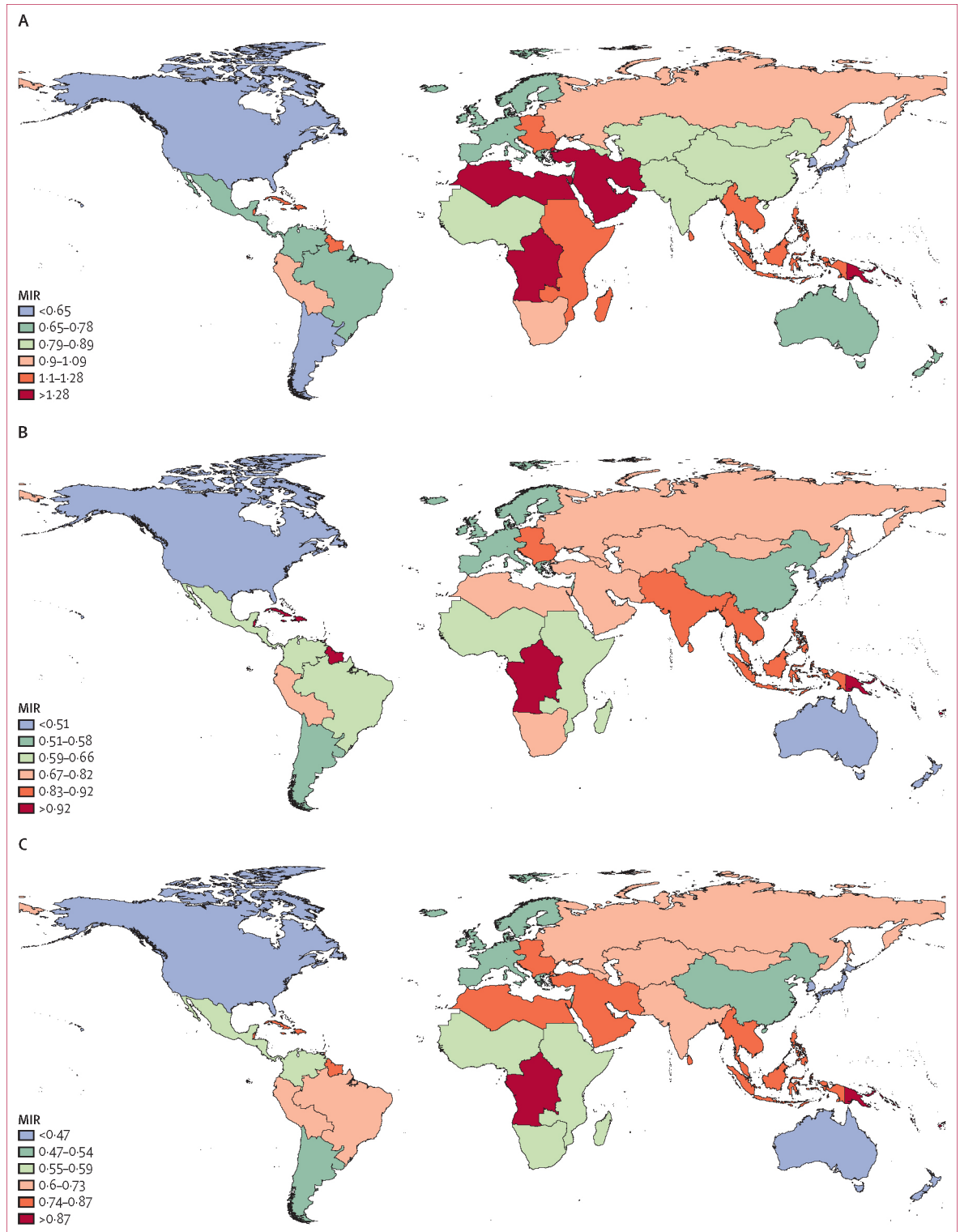


Figure 4: Mortality-to-incidence ratio (MIR) for haemorrhagic stroke for 1990 (A), 2005 (B), and 2010 (C)

ischaemic stroke were in eastern Europe (particularly Russia: 238–416/100 000) and central and east Asia, North Africa, and the Middle East (178–238/100 000). The

largest increases in incidence of haemorrhagic stroke by GBD region were in eastern and central Europe, North and sub-Saharan Africa, and the Middle East, whereas in



high-income regions of North America, western Europe, and tropical and southern Latin America incidence of haemorrhagic stroke decreased significantly (figure 2). In 2010, the highest incidences of haemorrhagic stroke were in central and east Asia (101–158/100 000) and east and southern sub-Saharan Africa (73–101/100 000), whereas the lowest rates were in high-income North America, central and Andean Latin America, western Europe, and Oceania (Australasia; 25–40/100 000). Between 1990 and 2010, mortality-to-incidence ratios for ischaemic stroke noticeably reduced in western Europe, Australasia, and central and Andean Latin America, but increased in North Africa, the Middle East, and southeast Asia (figure 3). For haemorrhagic stroke, we noted decreases in mortality-to-incidence ratios in northern Africa; the Middle East; central, east, and southern sub-Saharan Africa; and east and southeast Asia, whereas moderate increases were evident in central Latin America and high-income Asia-Pacific regions (figure 4).

In 2010, the lowest mortality-to-incidence ratios for ischaemic stroke were in high-income North America and east Asia (0·17–0·19) and for haemorrhagic stroke in high-income North America (0·25). The highest mortality-to-incidence ratios for ischaemic stroke were in central Europe and the Caribbean (0·34–0·38), and for haemorrhagic stroke in Oceania (0·94–1·27). In 2010, the age-specific incidences of ischaemic and haemorrhagic stroke increased significantly with age in all GBD regions (figures 5, 6). Although we noted no differences in the age-specific incidence of ischaemic stroke between high-income and low-income countries (figure 5), age-specific rates of haemorrhagic stroke increased in low-income to middle-income countries (figure 6). Age-specific rates were significantly greater in people older than 45 years in low-income to middle-income countries than in high-income countries. Age-specific mortality rates, mortality-to-incidence ratios, and DALYs for both stroke types were greater overall in low-income to middle-income countries than in high-income countries, but significant differences between higher-income and lower-income countries were only apparent for haemorrhagic stroke incidence, mortality, DALYs in people older than 40 years, and for mortality-to-incidence ratios across all age groups (figures 5, 6).

## Discussion

This study is the first to report the global burden of ischaemic and haemorrhagic stroke in terms of incidence, mortality, DALYs lost, and mortality-to-incidence ratio across GBD regions and countries in 1990, 2005, and 2010, and across all age groups of the population. Several important findings were shown (panel). First, the burden of both stroke types has increased significantly between 1990 and 2010 in terms of an increased absolute number of people with incident stroke, number of deaths, and number of DALYs lost. Although the absolute number of incident ischaemic stroke was twice that of haemorrhagic

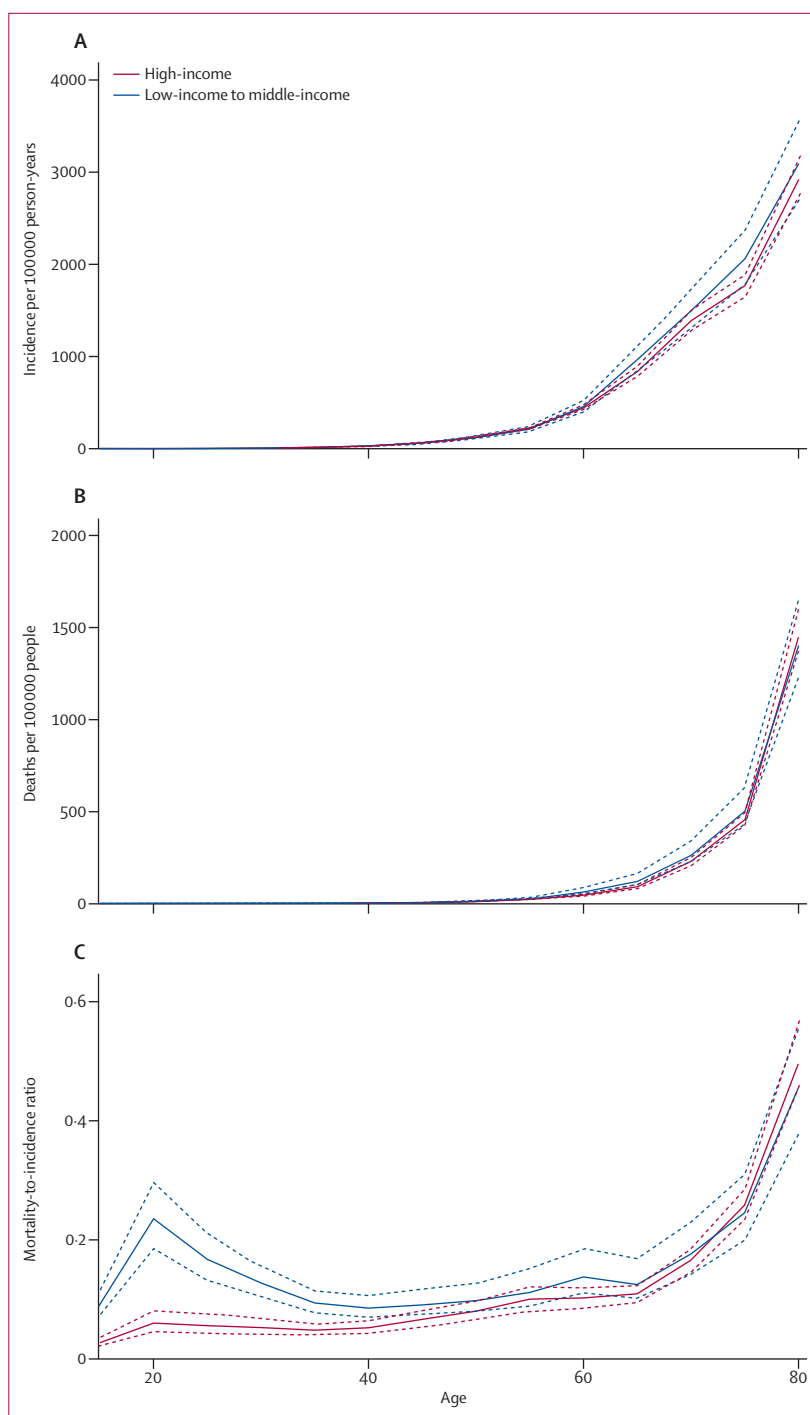
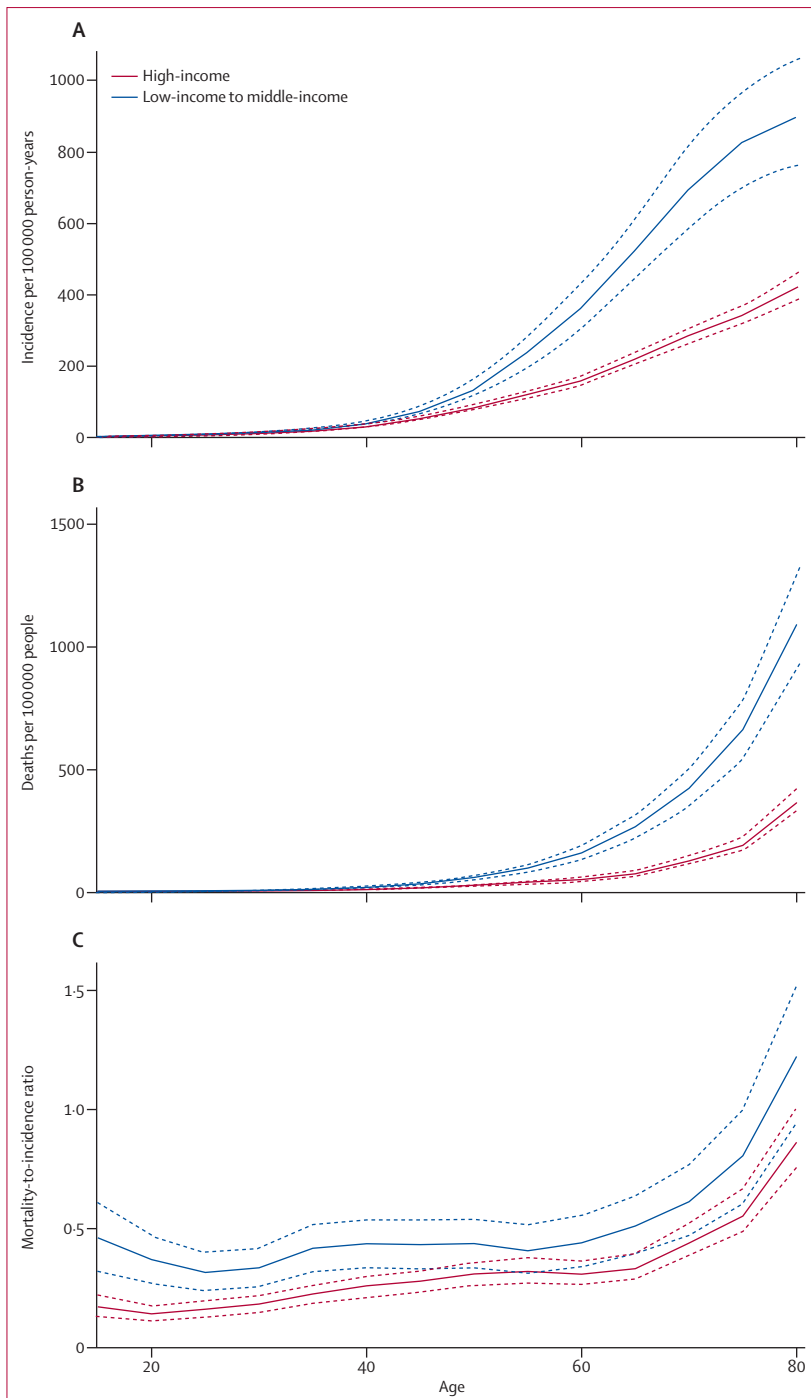


Figure 5: Incidence (A), mortality (B), and mortality-to-incidence ratio (C) for ischaemic stroke, by age and country income level, for 2010

stroke, the overall global burden of haemorrhagic stroke (deaths and DALYs) was higher. Whereas the main stroke pathological type in high-income countries was ischaemic stroke, most stroke burden worldwide was due to haemorrhagic stroke.



**Figure 6:** Incidence (A), mortality (B), and mortality-to-incidence ratio (C) for haemorrhagic stroke, by age and country income level, for 2010

Second, the bulk of stroke burden in terms of incident events, deaths, and DALYs lost is borne by low-income to middle-income countries. These countries were particularly disproportionately affected by burden of haemorrhagic stroke compared with high-income countries. By contrast with high-income countries, where

the overall incidence, mortality, DALYs, and mortality-to-incidence ratio of both ischaemic and haemorrhagic stroke have declined in the past two decades in both younger (<75 years) and older ( $\geq 75$  years) age groups, in low-income to middle-income countries incidence of both stroke types increased significantly (especially in people aged 20–65 years). The average age at which people had ischaemic and haemorrhagic strokes was 3–5 years younger in low-income to middle-income countries than in high-income countries. Roughly a quarter of all events of ischaemic stroke and about half of all those of haemorrhagic stroke are happening in people younger than 65 years, with 73% and 83% of them, respectively, residing in low-income and middle-income countries. In 1990–2010, the incidence of both stroke types increased significantly in adults aged 20–64 years in low-income and middle-income countries. Our findings of a greater proportion of haemorrhagic stroke in low-income and middle-income countries compared with high-income countries, noticeable geographical variation in the incidence of major pathological types of stroke, and diverging trends in stroke incidence between low-income countries (increase in rates) and high-income countries (decrease in rates) are in line with the results of a systematic review of population-based studies of stroke incidence.<sup>1</sup> However, unlike findings from that review,<sup>1</sup> we also noted significant changes in incidence of haemorrhagic stroke in the past two decades.

Encouragingly, although we noted a trend towards an increase in the incidence of ischaemic stroke, a trend towards reduction in mortality rates for both ischaemic and haemorrhagic stroke, DALYs, and mortality-to-incidence ratios took place in low-income to middle-income countries. This finding might show advances in diagnosis of stroke type, and more targeted health care in some developing regions in low-income to middle-income countries in the past 2 decades, particularly because low-income to middle-income countries might be more heterogeneous than high-income countries.

The discrepancies between countries of different income levels are probably driven by the occurrence of the epidemiological transition.<sup>13</sup> In the past few decades worldwide, life expectancy has increased, childhood mortality has reduced, and health status has improved overall in many regions.<sup>11</sup> Globally, ageing populations are driving increases in the incidence of both ischaemic and haemorrhagic stroke. In low-income and middle-income countries, diseases related to infection and undernutrition have been replaced with more chronic diseases such as stroke and heart disease as the leading cause of disease burden, but unlike many low-income to middle-income countries, most high-income countries have implemented improved prevention strategies and better health care for these chronic disorders.<sup>14</sup> Moreover, industrialisation and urbanisation have led to changes in the nutritional quality of foods, with high-fibre carbohydrates and fresh produce being replaced with

more processed carbohydrates and high-fat diets.<sup>15</sup> The resultant increase in the prevalence of diabetes, together with increases in smoking rates and increasingly sedentary lifestyles, have contributed to increased atherosclerotic disease.<sup>14</sup> During different phases of epidemiological transition, increased incidence of haemorrhagic stroke is expected, particularly in low-income and middle-income countries, because hypertension is the dominant risk factor for this stroke type.

We noted substantial differences between countries in incidence, mortality, DALYs, and mortality-to-incidence ratio for both stroke types. The alarmingly high stroke burden in China, particularly for haemorrhagic stroke,<sup>16</sup> might be attributable to the increased prevalence of risk factors for this stroke type—namely high blood pressure and smoking—and an ageing population.<sup>17</sup> A review suggested that haemorrhagic stroke contributed to more stroke burden in China than it did in high-income countries, but wide regional differences were reported in the incidence and type of stroke.<sup>18</sup> Hypertension, diabetes, dyslipidaemia, and smoking are modifiable risk factors that have increased in China. In India, smoking has been attributed as the cause of many deaths, particularly in men, with vascular causes being among the main contributors to death.<sup>19</sup>

Eastern European countries have undergone many socioeconomic changes in the past two decades. In particular, in Russia, alcohol was strongly associated with adult mortality.<sup>20</sup> More than half of deaths in Russian men are attributable to cardiovascular disease, with hypertension, hypercholesterolaemia, tobacco use, inadequate diet, obesity, insufficient physical activity, and alcohol being among the prevalent risk factors for death.<sup>21</sup>

The decline in incidence, mortality, DALYs, and mortality-to-incidence ratios in high-income countries is likely to be because of improved prevention, and acute and chronic treatment of stroke. High-income regions such as western Europe, North America, Australia, and New Zealand have increased efforts to prevent and diagnose stroke, which might be shown by the delay of stroke incidence to older age groups.<sup>14</sup> Mortality-to-incidence ratios for ischaemic stroke in people younger than 40 years were significantly higher in low-income to middle-income countries than in high-income countries. This finding might show an increased prevalence of risk factors such as alcohol use; tobacco smoking, including second-hand exposure; and high blood pressure in this age group, or it might be due to chance.<sup>22</sup> By contrast, the increased overall global burden of stroke in low-income and middle-income countries could be attributable to reduced levels of awareness of risk factors, low levels of primary and follow-up health care, and a scarcity of basic drugs and equipment for the prevention and treatment of stroke.<sup>23</sup>

To progress our understanding of the burden of ischaemic and haemorrhagic stroke, and to better inform large initiatives in health funding, further study is

### Panel: Research in context

#### Systematic review

We searched Medline, Embase, LILACS, Scopus, PubMed, Science Direct, Global Health Database, the WHO library, and WHO regional databases between 1990 and 2010 to identify studies published between 1990 and 2010. We searched the databases with various key or title words: “stroke”, “isch(a)emic stroke”, “intracerebral”, “intraparenchymal”, “subarachnoid”, “h(a)emorrhage” AND title or key-words “population-based”, “community-based”, “community”, “epidemiology”, “epidemiological”, “incidence”, “attack rates”, “survey”, “surveillance”, “mortality”, “morbidity”, “fatality”, “case-fatality”, or “trends”. We assessed pathological types of stroke only for studies that had findings for head CT, MRI, or brain autopsy findings available for at least 70% of stroke cases. We classified cases of stroke with no neuroimaging or autopsy verification of pathological type of the stroke as a stroke of undetermined pathological type. We categorised pathological types of stroke into two groups: ischaemic strokes and haemorrhagic strokes (intracerebral haemorrhage and subarachnoid haemorrhage combined). We assessed only first-ever stroke events.

#### Interpretation

This study is the first to report the global burden of ischaemic and haemorrhagic stroke in terms of incidence, mortality, DALYs lost, and mortality-to-incidence ratio across GBD regions and countries in 1990, 2005, and 2010, and across all age groups of the population. Our results show that age-standardised mortality rates for ischaemic and haemorrhagic stroke have decreased in the past two decades; however, the absolute number of people who have these stroke types every year, and the number with related deaths and DALYs lost, is increasing, with most of the burden in low-income and middle-income countries. Our findings could be used as a vital source of information for future planning of preventive strategies for stroke, but further study is needed to identify which subgroups of the population are at greatest risk and who will benefit most from targeted preventive efforts.

needed that is specific to low-income to middle-income countries in terms of improved identification of what subgroups of the population are at greatest risk (eg, by age, sex, and ethnic origin) and could be targeted for preventive efforts. High-quality community-based epidemiological studies in low-income and middle-income countries with early neuroimaging investigations to identify stroke types are needed across WHO regions because heterogeneity is likely to exist across large regions such as central Asia and sub-Saharan Africa. A systematic review recommended the establishment of sustainable systems to obtain stroke data shared by other non-communicable diseases, and a wide application of feasible and practical surveillance techniques (eg, WHO STEPS) particularly in low-income countries.<sup>24</sup> Population-wide preventive strategies should be given priority because even modest changes in prevalence of risk factors (eg, reduction of blood pressure, smoking cessation, and reduction of salt intake) could contribute substantially to the cumulative population risk reduction.<sup>6,25</sup> Interventions to reduce the burden of chronic disease in low-income to middle-income countries should be cost effective and financially feasible.<sup>26</sup> Because of the overlap of risk factors related to ischaemic stroke and ischaemic heart disease, preventive efforts focused on these factors (eg, raised blood pressure, cholesterol, diabetes, smoking) would be a cost-effective way to target prevention in a wide population. Raised

blood pressure is the strongest risk factor for both ischaemic and haemorrhagic stroke, and on the basis of the high burden of both types, prevention programmes should focus on control of blood pressure, including both individual screening and treatment but also population-wide lowering of blood pressure.

Tobacco control (via increased taxes, reduced advertising, and banning of smoking in public places), strategies for salt reduction, and evidence-based multidrug strategies to treat those at high risk of cardiovascular disease, would be relevant for prevention of both haemorrhagic and ischaemic stroke. Several successful and cost-effective campaigns have already been identified and need to be adapted on a wider scale worldwide.<sup>26</sup> Government initiatives to encourage and support healthy diets and increased physical activity are imperative in countries of all income types. Similarly, engaging of food manufacturers to achieve these goals by reduction of salt levels and fat content in processed foods would need to be implemented at government level.<sup>27,28</sup>

Haemorrhagic stroke was once a major cause of death in high-income nations, but its importance has receded in those regions over the 20th century.<sup>29</sup> Our results suggest that, in the first decade of the 21st century, haemorrhagic stroke remains an important cause of death and disability worldwide. With the possible exception of raised blood pressure, other risk factors for haemorrhagic stroke have not been as well researched as have those for ischaemic stroke. Hence, studies to elucidate risk factors for haemorrhagic stroke are a high priority for future epidemiological research.

Our study had several limitations. Although we made every attempt to include as much data as possible from low-income and middle-income countries, such data is scarce, particularly from ideal population-based studies. Therefore, some studies from these countries were not of high methodological quality. Because we applied standard methodological criteria for selection of studies across the 20 year study period (1990–2010), we believe that the quality of data was consistent for studies selected for the analysis. Stroke diagnosis is unlikely to have changed between 1990 and 2010. Most diagnoses have been based on clinical (WHO) criteria and where imaging was available for verification of pathological types on CT images. However, changes might have taken place in the quality of routinely collected data over time, including diagnostic accuracy of stroke occurrence and its pathological classification, especially in low-income and middle-income countries. To assess potential effects of incomplete and less than optimum methodological quality data even in settings where no data are available for a country, cross-validation and out-of-sample predictive validity tests and simulation studies (sensitivity analyses) have been done. These tests have shown that the modelling strategies used in the study were robust.

Low-income and middle-income countries might have had lower rates of neuroimaging investigations

than did high-income countries, thus reducing the ability to distinguish between types; as such, stroke incidence by type might be under-reported, particularly in rural areas of low-income and middle-income countries. For example, in the Trivandrum stroke registry study in India, brain imaging was unavailable for 44% of rural patients.<sup>29</sup> Additionally, different modes of clinical presentation of ischaemic and haemorrhagic stroke could have affected the chances of investigators undertaking neuroimaging studies in low-income and middle-income countries towards higher rates in neuroimaging studies in most patients with severe disease, thus introducing a diagnostic bias. However, the effect of such bias is unlikely to be substantial because most estimates of the burden of ischaemic and haemorrhagic stroke were approximated from studies reporting neuroimaging verification of pathological types of stroke in roughly 70% of the patients. Although we cannot exclude the possibility of errors in calculations of stroke disability weights, the high correlations of weights across settings suggest that there is a broadly shared set of common values for health losses due to stroke, thus increasing our confidence in the reliability of calculations of disability weights. Our study's greatest strengths are in the systematic attainment of a large and globally representative dataset and in the use of an innovative methodology that takes into account present evidence about stroke. Therefore, despite the limitations denoted above, our findings provide a unique global perspective on stroke burden by type, and could be used as a vital source of information for future planning of preventive strategies for stroke worldwide.

#### Contributors

VLF, AM, GM, and ME developed the study concept and oversaw the research. VLF, RK, EW, DAB, LA, and MC undertook reviews of studies. VLF, RK, and EM extracted data from retrieved articles and, together with MHF and MN, managed databases. MHF and MN undertook statistical analysis of the data and produced graphs. RK and VF wrote the first draft of the report. MHF, MN, and CM developed the statistical model and wrote a section on statistical analysis and DALYs' estimates. All authors contributed to critical revision of the manuscript for important intellectual content.

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#### Conflicts of interest

We declare that we have no conflicts of interest.

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