Supplementary Table 1. Population size and age structure by urbanity: data from the 2015 Population Census of Korea

|  |  |  |  |
| --- | --- | --- | --- |
| 　 | Metropolitan | Urban | Rural |
| Total population | 41,677,695  | 4,616,802  | 4,774,878  |
| Age group |  |  |  |
|  Under 15 (%) | 14.0 | 15.3 | 9.0 |
|  15–64 (%) | 74.8 | 70.4 | 64.3 |
|  65+ (%) | 11.2 | 14.4 | 26.7 |
|  Mean (yr) | 39.4  | 40.4  | 48.4  |
|  Median (yr) | 40.1  | 41.1  | 51.2  |

*Notes.* Metropolitan corresponds to *dong*, urban to *eup*, and rural to *myeon*.

Supplementary Table 2. Distribution of numbers of population and deaths among 3,377 small-areas in Korea: findings from the National Health Information Database of Korea, 2013–2017.

|  |  |  |
| --- | --- | --- |
|  | No. of population | No. of deaths |
| Median (IQR) | Minimum | Maximum | Median (IQR) | Minimum | Maximum |
| Total | 111,077(181,207) | 10,244 | 1,476,696 | 677(547) | 50 | 4,956 |
| Metropolitan | 184,637(157,904) | 11,991 | 1,476,696 | 827(516) | 50 | 4,956 |
| Urban | 156,131(172,083) | 12,165 | 915,262 | 1,212(742) | 181 | 4,479 |
| Rural | 32,307(25,027) | 10,244 | 460,205 | 443(266) | 94 | 2,341 |

*Notes.* IQR = Interquartile range.

Metropolitan corresponds to *dong*, urban to *eup*, and rural to *myeon*.



Supplementary Figure 1. Age distribution and age-specific mortality ratios by urbanity with the standard population: findings from the National Health Information Database of Korea, 2013–2017.

Supplementary Table 3. Distribution of SMRs according to urbanity when the age-specific mortality rate was hypothesized to be the same in all small-areas: findings from the National Health Information Database of Korea, 2013–2017.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 　 | Median | IQR | Min | Max |
| Metropolitan | 98.5 | 0.6 | 97.5 | 104.6 |
| Urban | 98.5 | 0.3 | 97.6 | 102.0 |
| Rural | 98.3 | 0.3 | 97.7 | 101.2 |

*Notes.* IQR = Interquartile range; Max = Maximum; Min = Minimum.

SMF was rescaled by multiplying by 100.

Metropolitan corresponds to *dong*, urban to *eup*, and rural to *myeon*.

Supplementary Table 4. Comparison of the top 30 small-areas with high mortality as measured by CMF with their results for SMR and LE: findings from the National Health Information Database of Korea, 2013–2017

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Type | CMF(95% CI) | SMR(95% CI) | LE(95% CI) | CMF rank(highest to lowest) (1) | SMR rank(highest to lowest)(2) | LE rank(lowest to highest)(3) | (1) - (2) | (1) - (3) |
| 862 | *Rural* | 189.0(172.6,207.0) | 181.8(166.1,198.9) | 74.8(73.6,76.1) | 1 | 1 | 3 | 0 | -2 |
| 112 | *Rural* | 164.3(151.1,178.8) | 153.8(141.7,166.9) | 76.1(74.1,78.1) | 2 | 4 | 13 | -2 | -11 |
| 778 | *Metropolitan* | 164.3(144.6,186.7) | 157.6(139.4,178.2) | 77.2(76.1,78.3) | 3 | 2 | 7 | 1 | -4 |
| 1573 | *Rural* | 159.5(133.9,189.9) | 121.8(108.1,137.2) | 76.5(75.3,77.6) | 4 | 227 | 26 | -223 | -22 |
| 2685 | *Rural* | 158.3(126.2,198.7) | 127.9(106.5,153.5) | 78.4(77.3,79.3) | 5 | 102 | 4 | -97 | 1 |
| 2952 | *Metropolitan* | 156.5(145.8,168.0) | 153.9(143.7,164.8) | 79.0(77.6,80.4) | 6 | 3 | 32 | 3 | -26 |
| 2326 | *Rural* | 156.5(128.2,191.0) | 122.8(106.4,141.7) | 78.4(77.4,79.3) | 7 | 194 | 28 | -187 | -21 |
| 1757 | *Rural* | 156.2(137.5,177.4) | 133.6(119.3,149.6) | 76.4(71.9,80.0) | 8 | 36 | 19 | -28 | -11 |
| 260 | *Rural* | 155.1(128.5,187.2) | 133.1(114.6,154.6) | 79.1(78.1,80.2) | 9 | 40 | 25 | -31 | -16 |
| 1593 | *Rural* | 154.5(128.0,186.5) | 134.3(116.8,154.5) | 79.4(78.3,80.5) | 10 | 30 | 5 | -20 | 5 |
| 562 | *Metropolitan* | 154.1(133.0,178.6) | 131.6(115.0,150.6) | 79.2(78.3,80.1) | 11 | 54 | 27 | -43 | -16 |
| 2221 | *Rural* | 153.5(125.9,187.3) | 121.2(104.9,140.1) | 78.1(76.7,79.5) | 12 | 249 | 8 | -237 | 4 |
| 3266 | *Rural* | 153.1(124.0,189.0) | 143.8(117.7,175.6) | 79.0(77.6,80.3) | 13 | 8 | 10 | 5 | 3 |
| 1739 | *Metropolitan* | 152.1(130.3,177.6) | 132.8(117.5,150.1) | 78.7(77.7,79.7) | 14 | 43 | 14 | -29 | 0 |
| 1033 | *Rural* | 149.5(124.4,179.7) | 118.5(103.8,135.3) | 79.0(78.1,80.0) | 15 | 353 | 12 | -338 | 3 |
| 3143 | *Rural* | 149.3(119.7,186.4) | 117.4(99.7,138.2) | 77.7(74.0,81.1) | 16 | 401 | 23 | -385 | -7 |
| 2302 | *Metropolitan* | 148.4(134.9,163.3) | 151.0(137.7,165.6) | 79.0(78.3,79.8) | 17 | 5 | 78 | 12 | -61 |
| 1813 | *Rural* | 147.1(120.5,179.4) | 137.8(115.3,164.7) | 78.1(76.6,79.5) | 18 | 16 | 41 | 2 | -23 |
| 2812 | *Rural* | 146.2(122.5,174.4) | 124.8(108.6,143.4) | 78.6(75.6,80.9) | 19 | 149 | 31 | -130 | -12 |
| 1670 | *Rural* | 146.1(126.6,168.7) | 130.4(115.9,146.7) | 79.2(78.1,80.3) | 20 | 67 | 36 | -47 | -16 |
| 680 | *Rural* | 146.0(128.4,166.1) | 133.6(119.7,149.1) | 79.6(78.6,80.6) | 21 | 37 | 52 | -16 | -31 |
| 1398 | *Rural* | 145.9(119.0,178.8) | 127.8(110.3,148.0) | 78.4(76.8,79.8) | 22 | 105 | 2 | -83 | 20 |
| 2820 | *Rural* | 145.6(127.4,166.4) | 128.5(114.2,144.6) | 79.0(77.8,80.2) | 23 | 94 | 48 | -71 | -25 |
| 2934 | *Metropolitan* | 145.5(134.7,157.2) | 144.7(134.2,156.0) | 79.3(78.4,80.1) | 24 | 7 | 76 | 17 | -52 |
| 2433 | *Rural* | 145.5(120.7,175.3) | 119.1(103.8,136.7) | 79.7(78.1,81.3) | 25 | 330 | 15 | -305 | 10 |
| 2747 | *Rural* | 144.8(127.5,164.5) | 127.2(113.8,142.2) | 79.1(78.2,80.0) | 26 | 114 | 22 | -88 | 4 |
| 966 | *Rural* | 144.7(127.9,163.6) | 130.5(116.8,145.8) | 78.3(77.0,79.6) | 27 | 65 | 65 | -38 | -38 |
| 2638 | *Rural* | 144.5(123.0,169.8) | 119.4(105.6,135.1) | 78.8(77.7,80.0) | 28 | 315 | 9 | -287 | 19 |
| 197 | *Metropolitan* | 144.3(128.8,161.7) | 135.9(122.0,151.4) | 79.1(77.5,80.6) | 29 | 18 | 56 | 11 | -27 |
| 2651 | *Rural* | 144.3(120.4,172.9) | 110.5(97.3,125.5) | 79.1(77.9,80.1) | 30 | 905 | 37 | -875 | -7 |

*Notes.* CI = Confidence interval; CMF = Comparative mortality figure; LE = Life expectancy; SMR = Standardized mortality ratio.

SMR and CMF were rescaled by multiplying by 100.

Metropolitan corresponds to *dong*, urban to *eup*, and rural to *myeon*.

Supplementary Table 5. Comparison of the top 30 small-areas with low mortality as measured by CMF with their results for SMR and LE: findings from the National Health Information Database of Korea, 2013–2017

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Type | CMF(95% CI) | SMR(95% CI) | LE(95% CI) | SMR rank(lowest to highest) (1) | CMF rank (lowest to highest)(2) | LE rank(highest to lowest)(3) | (1) - (2) | (1) - (3) |
| 1016 | *Metropolitan* | 49.4(42.4,57.7) | 51.4(44.1,59.9) | 89.8(88.9,90.8) | 1 | 1 | 2 | 0 | -1 |
| 1864 | *Metropolitan* | 55.3(50.3,60.8) | 57.7(52.5,63.4) | 88.6(88.0,89.3) | 2 | 4 | 4 | -2 | -2 |
| 1290 | *Metropolitan* | 58.2(49.1,69.0) | 57.8(48.9,68.3) | 89.2(87.9,90.5) | 3 | 5 | 3 | -2 | 0 |
| 1270 | *Metropolitan* | 59.1(51.9,67.4) | 57.0(50.2,64.7) | 87.7(86.8,88.6) | 4 | 3 | 12 | 1 | -8 |
| 2776 | *Metropolitan* | 59.5(54.9,64.5) | 60.3(55.6,65.4) | 87.9(87.4,88.5) | 5 | 10 | 6 | -5 | -1 |
| 231 | *Metropolitan* | 60.2(52.1,69.4) | 55.3(48.2,63.5) | 87.6(86.5,88.7) | 6 | 2 | 14 | 4 | -8 |
| 502 | *Metropolitan* | 60.3(53.6,67.8) | 61.2(54.5,68.7) | 88.0(87.0,89.0) | 7 | 11 | 5 | -4 | 2 |
| 3360 | *Metropolitan* | 60.5(54.4,67.4) | 58.5(52.6,65.0) | 87.5(86.8,88.2) | 8 | 7 | 17 | 1 | -9 |
| 3115 | *Metropolitan* | 60.7(53.5,68.8) | 59.8(52.8,67.7) | 87.6(86.8,88.5) | 9 | 8 | 13 | 1 | -4 |
| 318 | *Metropolitan* | 60.7(55.0,66.9) | 57.8(52.5,63.6) | 87.7(87.0,88.4) | 10 | 6 | 11 | 4 | -1 |
| 1298 | *Metropolitan* | 61.0(54.3,68.6) | 60.0(53.4,67.4) | 87.8(87.0,88.7) | 11 | 9 | 8 | 2 | 3 |
| 311 | *Metropolitan* | 62.2(56.9,68.0) | 62.7(57.4,68.5) | 87.6(86.9,88.2) | 12 | 17 | 15 | -5 | -3 |
| 1111 | *Metropolitan* | 62.8(56.1,70.2) | 63.3(56.6,70.8) | 86.9(86.2,87.7) | 13 | 21 | 32 | -8 | -19 |
| 2665 | *Metropolitan* | 63.0(55.4,71.6) | 62.8(55.3,71.4) | 87.7(86.7,88.6) | 14 | 18 | 10 | -4 | 4 |
| 1303 | *Metropolitan* | 63.1(57.7,69.1) | 64.2(58.7,70.2) | 87.4(86.7,88.1) | 15 | 26 | 19 | -11 | -4 |
| 1480 | *Metropolitan* | 63.7(58.3,69.5) | 63.3(58.2,68.9) | 87.2(86.6,87.9) | 16 | 22 | 25 | -6 | -9 |
| 1756 | *Metropolitan* | 63.8(59.1,68.9) | 62.5(57.9,67.5) | 87.0(86.5,87.5) | 17 | 15 | 31 | 2 | -14 |
| 1371 | *Metropolitan* | 64.1(58.8,69.9) | 62.8(57.7,68.4) | 86.9(86.3,87.4) | 18 | 19 | 35 | -1 | -17 |
| 2828 | *Metropolitan* | 64.3(57.4,71.9) | 64.4(57.6,72.0) | 87.2(86.3,88.0) | 19 | 27 | 26 | -8 | -7 |
| 3214 | *Metropolitan* | 64.4(57.5,72.3) | 63.8(57.0,71.4) | 87.9(87.0,88.7) | 20 | 24 | 7 | -4 | 13 |
| 1269 | *Metropolitan* | 64.7(57.5,72.8) | 63.4(56.7,70.9) | 87.8(86.8,88.7) | 21 | 23 | 9 | -2 | 12 |
| 2728 | *Metropolitan* | 64.8(56.8,74.0) | 64.8(56.9,73.8) | 87.6(86.5,88.6) | 22 | 28 | 16 | -6 | 6 |
| 3067 | *Metropolitan* | 65.3(58.1,73.4) | 62.5(55.7,70.1) | 87.4(86.5,88.2) | 23 | 16 | 21 | 7 | 2 |
| 2232 | *Metropolitan* | 65.3(59.0,72.4) | 63.2(57.2,69.9) | 86.8(86.1,87.5) | 24 | 20 | 37 | 4 | -13 |
| 2568 | *Metropolitan* | 65.8(58.6,73.8) | 65.9(58.8,73.8) | 86.7(85.8,87.6) | 25 | 34 | 39 | -9 | -14 |
| 879 | *Metropolitan* | 66.2(59.1,74.1) | 64.1(57.5,71.5) | 86.7(85.8,87.5) | 26 | 25 | 43 | 1 | -17 |
| 965 | *Metropolitan* | 66.2(60.8,72.1) | 65.2(59.9,70.9) | 87.1(86.5,87.7) | 27 | 30 | 27 | -3 | 0 |
| 1427 | *Metropolitan* | 66.6(61.6,72.0) | 65.2(60.3,70.5) | 86.5(86.0,87.1) | 28 | 31 | 50 | -3 | -22 |
| 2103 | *Metropolitan* | 66.8(58.3,76.4) | 65.2(57.1,74.4) | 86.7(85.7,87.6) | 29 | 32 | 44 | -3 | -15 |
| 1871 | *Metropolitan* | 66.8(60.8,73.3) | 61.6(56.3,67.5) | 86.6(86.0,87.3) | 30 | 13 | 45 | 17 | -15 |

*Notes.* CI = Confidence interval; CMF = Comparative mortality figure; LE = Life expectancy; SMR = Standardized mortality ratio.

SMR and CMF were rescaled by multiplying by 100.

Metropolitan corresponds to *dong*, urban to *eup*, and rural to *myeon*.



Supplementary Figure 2. Scatter plots and correlation coefficients [r] for SMR, CMF, and LE over all areas and stratified by urbanity: findings from the National Health Information Database of Korea, 2013–2017.

*Notes.* CMF = Comparative mortality figure; LE = Life expectancy; SMR = Standardized mortality ratio.

SMR and CMF were rescaled by multiplying by 100.

Metropolitan corresponds to *dong*, urban to *eup*, and rural to *myeon*.

Supplementary Table 6. Age structure, observed and expected deaths using national age-specific mortality in 2015 and age-specific mortality of the standard population, and their differences in small-areas with the minimum, maximum, and median SMR: findings from the National Health Information Database of Korea, 2013–2017

| Age group |  Age-specific mortality of the SP (1) | National age-specific mortality in 2015(2) | (1)-(2) | 　 | Study population 1 | 　 | Study population 2 |  | Study population 3 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 　 | POP(%) | EXP | OBS | EXP-OBS(%) | 　 | POP(%) | EXP | OBS | EXP-OBS(%) |  | POP(%) | EXP | OBS | EXP-OBS(%) |
| 0 | 0.00057 | 0.00282 | -0.00225 |  | 124(0.3) | 0.07 | 0.35 | -0.28(-4.0) |  | 871(3.4) | 0.50 | 2.46 | -1.95(89.6) |  | 1016(1.0) | 0.58 | 2.86 | -2.28(-30.0) |
| 1-4 | 0.00014 | 0.00065 | -0.00051 |  | 548(1.3) | 0.08 | 0.36 | -0.28(-4.1) |  | 2319(9.1) | 0.33 | 1.52 | -1.19(54.6) |  | 3591(3.4) | 0.50 | 2.35 | -1.85(-24.3) |
| 5-9 | 0.00009 | 0.00009 | 0.00000 |  | 872(2.1) | 0.08 | 0.08 | 0.00(0.0) |  | 763(3.0) | 0.07 | 0.07 | 0.00(-0.1) |  | 3834(3.7) | 0.35 | 0.34 | 0.01(0.1) |
| 10-14 | 0.00009 | 0.00009 | 0.00000 |  | 1329(3.2) | 0.13 | 0.11 | 0.01(0.2) |  | 509(2.0) | 0.05 | 0.04 | 0.00(-0.2) |  | 4229(4.0) | 0.40 | 0.36 | 0.03(0.5) |
| 15-19 | 0.00025 | 0.00021 | 0.00004 |  | 2122(5.1) | 0.53 | 0.44 | 0.09(1.3) |  | 1112(4.4) | 0.28 | 0.23 | 0.05(-2.1) |  | 5836(5.6) | 1.46 | 1.22 | 0.25(3.2) |
| 20-24 | 0.00034 | 0.00033 | 0.00001 |  | 2628(6.4) | 0.89 | 0.86 | 0.03(0.4) |  | 2033(8.0) | 0.69 | 0.67 | 0.02(-1.0) |  | 7617(7.3) | 2.59 | 2.51 | 0.08(1.1) |
| 25-29 | 0.00046 | 0.00047 | -0.00001 |  | 2356(5.7) | 1.09 | 1.11 | -0.02(-0.3) |  | 3477(13.6) | 1.61 | 1.64 | -0.03(1.5) |  | 7795(7.4) | 3.61 | 3.68 | -0.07(-1.0) |
| 30-34 | 0.00062 | 0.00061 | 0.00001 |  | 2521(6.1) | 1.57 | 1.54 | 0.03(0.5) |  | 4963(19.5) | 3.09 | 3.03 | 0.06(-2.8) |  | 9756(9.3) | 6.07 | 5.95 | 0.12(1.6) |
| 35-39 | 0.00085 | 0.00080 | 0.00005 |  | 2433(5.9) | 2.07 | 1.95 | 0.12(1.8) |  | 2718(10.7) | 2.31 | 2.17 | 0.14(-6.3) |  | 8352(8.0) | 7.10 | 6.68 | 0.42(5.5) |
| 40-44 | 0.00129 | 0.00126 | 0.00003 |  | 3014(7.3) | 3.88 | 3.78 | 0.10(1.5) |  | 1454(5.7) | 1.87 | 1.83 | 0.05(-2.2) |  | 7918(7.6) | 10.20 | 9.94 | 0.26(3.5) |
| 45-49 | 0.00200 | 0.00197 | 0.00003 |  | 3588(8.7) | 7.19 | 7.08 | 0.12(1.7) |  | 1386(5.4) | 2.78 | 2.73 | 0.05(-2.1) |  | 8096(7.7) | 16.23 | 15.97 | 0.27(3.5) |
| 50-54 | 0.00305 | 0.00296 | 0.00009 |  | 4208(10.2) | 12.81 | 12.44 | 0.38(5.5) |  | 1588(6.2) | 4.84 | 4.69 | 0.14(-6.5) |  | 9305(8.9) | 28.33 | 27.50 | 0.83(11.0) |
| 55-59 | 0.00428 | 0.00416 | 0.00012 |  | 4352(10.5) | 18.64 | 18.10 | 0.55(8.0) |  | 1079(4.2) | 4.62 | 4.49 | 0.14(-6.2) |  | 8953(8.5) | 38.35 | 37.23 | 1.13(14.8) |
| 60-64 | 0.00631 | 0.00615 | 0.00016 |  | 3565(8.6) | 22.51 | 21.92 | 0.59(8.5) |  | 569(2.2) | 3.59 | 3.50 | 0.09(-4.3) |  | 6375(6.1) | 40.25 | 39.20 | 1.05(13.8) |
| 65-69 | 0.00989 | 0.00943 | 0.00046 |  | 2772(6.7) | 27.43 | 26.15 | 1.28(18.6) |  | 275(1.1) | 2.72 | 2.59 | 0.13(-5.8) |  | 4634(4.4) | 45.85 | 43.72 | 2.13(28.1) |
| 70-74 | 0.01789 | 0.01710 | 0.00079 |  | 2256(5.5) | 40.35 | 38.59 | 1.77(25.7) |  | 143(0.6) | 2.56 | 2.45 | 0.11(-5.1) |  | 3435(3.3) | 61.44 | 58.75 | 2.69(35.4) |
| 75-79 | 0.03260 | 0.03152 | 0.00108 |  | 1542(3.7) | 50.27 | 48.60 | 1.66(24.2) |  | 87(0.3) | 2.84 | 2.74 | 0.09(-4.3) |  | 2269(2.2) | 73.96 | 71.52 | 2.45(32.2) |
| 80-84 | 0.05894 | 0.05670 | 0.00224 |  | 800(1.9) | 47.15 | 45.36 | 1.79(26.1) |  | 71(0.3) | 4.18 | 4.03 | 0.16(-7.3) |  | 1068(1.0) | 62.94 | 60.55 | 2.39(31.5) |
| 85+ | 0.12728 | 0.13056 | -0.00328 |  | 322(0.8) | 40.98 | 42.04 | -1.06(-15.4) |  | 71(0.3) | 9.04 | 9.27 | -0.23(10.7) |  | 707(0.7) | 89.99 | 92.30 | -2.32(-30.5) |
| Total | 　 | 　 | 　 | 　 | 41352(100.0) | 277.73 | 270.85 | 6.87(100.0) | 　 | 25488(100.0) | 47.96 | 50.14 | -2.18(100.0) | 　 | 104786(100.0) | 490.23 | 482.63 | 7.59(100.0) |
| SMR |  |  |  |  | $100∙\left(1-\frac{6.87}{277.73}\right)=$ 97.5 |  | $100∙\left\{1-(\frac{-2.18}{47.96})\right\}= $104.6 |  | $100∙\left(1-\frac{7.59}{490.23}\right)= $98.5 |

Notes. EXP = Expected number of deaths; MR = Mortality ratio; OBS = number of observed deaths; POP = Population; SMR = Standardized mortality ratio; SP = Standard population.

SMR and CMF were rescaled by multiplying by 100.