RESEARCH LETTER

Rural-Urban Disparity in Mortality in the US From 1999 to 2019

The economic, social, and political challenges facing rural areas in the US have implications for the entire country. Even though rural-urban disparities in mortality from such diseases as chronic lung disease and cardiovascular disease have been described,[1,2] less is known about recent trends in rural-urban differences in age-adjusted mortality rates (AAMRs) overall in the US.

Methods | We analyzed all deaths occurring in the US using the US Centers for Disease Control and Prevention Wide-Ranging Online Data for Epidemiologic Research database from 1999 to 2019. We used the National Center for Health Statistics Urban-Rural Classification Scheme to create the following population categories per the 2013 US Census classification: large metropolitan area (≥1 million), small- or medium-sized metropolitan area (50 000-999 999), and rural area (<50 000).[3]

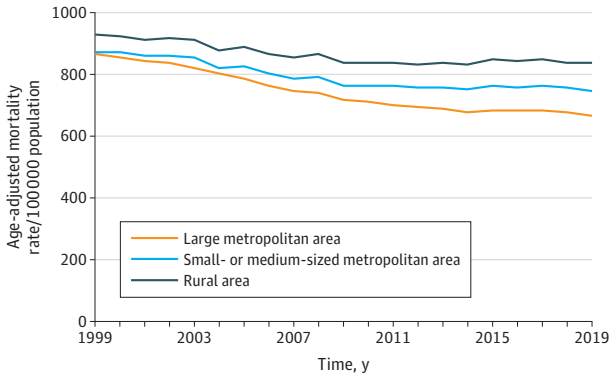
The AAMRs per 100 000 population were calculated by multiplying the age-specific death rate for each age group by the corresponding weight from the 2000 standard US population, summing across all age groups, and then multiplying by 100 000. We stratified the results by age, sex, and race/ethnicity. We also analyzed these subgroups among individuals aged 25 to 64 years.

We estimated the annual percentage change (APC) in AAMR using Poisson regression with log-link and robust standard errors and included an interaction term to test for differences in time trends. We performed all analyses using Stata version 16 (StataCorp), considering a 2-tailed $P < .05$ as statistically significant. The data were publicly available and deidentified and therefore informed consent was not applicable per HHS regulation 45 CFR 46.101(c).

Results | From 1999 to 2019, rural areas had the highest AAMRs. The overall AAMR in large metropolitan areas decreased from 861.5/100 000 to 664.5/100 000 and in rural areas it decreased from 923.8/100 000 to 834.0/100 000 ($P < .001$ for time trend) (**Figure** and **Table**). The absolute difference in the AAMRs between large metropolitan areas and rural areas increased from 62.3/100 000 (95% CI, 59.2/100 000-65.4/100 000) in 1999 to 169.5/100 000 (95% CI, 167.0/100 000-172.1/100 000) in 2019, which was an increase of 172%.

From 1999 to 2019, the AAMRs declined for all ages except for rural residents aged 25 to 64 years, in whom the AAMR increased from 398.7/100 000 to 447.0/100 000 (APC, 0.6%; 95% CI, 0.4%-0.7%). Across areas, men had greater AAMRs than women ($P < .001$); however, men experienced a greater APC reduction in the AAMRs. Among men, the AAMR in large metropolitan areas decreased from 1044.6/100 000 in 1999 to 789.6/100 000 in 2019 and in rural areas it decreased from 1140.4/100 000 to 977.3/100 000. Among women, the AAMR in large metropolitan areas decreased from 727.3/100 000 in 1999 to 560.0/100 000 in 2019 and in rural areas it decreased from 760.2/100 000 to 704.5/100 000.

Figure. Mortality Trends in the US From 1999 to 2019



Among men, the absolute difference in the AAMRs between large metropolitan areas and rural areas increased from 95.8/100 000 (95% CI, 90.4/100 000-101.2/100 000) in 1999 to 187.7/100 000 (95% CI, 183.6/100 000-191.8/100 000) in 2019. Among women, the absolute difference in the AAMRs between large metropolitan areas and rural areas increased from 32.9/100 000 (95% CI, 29.2/100 000-36.8/100 000) in 1999 to 144.5/100 000 (95% CI, 141.3/100 000-147.7/100 000) in 2019.

Non-Hispanic Black people had greater AAMRs than all other racial/ethnic groups across all 3 US Census-categorized areas ($P < .001$). However, the racial/ethnic group that experienced the smallest reductions in the AAMRs among all 3 areas was non-Hispanic White people in rural areas, decreasing from 900.5/100 000 in 1999 to 833.2/100 000 in 2019 (APC, −0.4%; 95% CI, −0.5% to −0.3%). Among rural residents aged 25 to 64 years, there were reductions in the AAMRs for non-Hispanic Black people, Asian people, and Hispanic people and increases in the AAMRs for non-Hispanic White people and Native American people.

Discussion | Rural residents experienced greater mortality and the disparity between rural and large metropolitan areas tripled from 1999 to 2019. Even though there were reductions in AAMRs for all ages, there was a 12.1% increase in the AAMR for rural residents aged 25 to 64 years, which was driven by an increasing AAMR among non-Hispanic White people. However, non-Hispanic Black people had greater AAMRs across all 3 US Census-categorized areas than all other racial/ethnic groups. These trends could be further exacerbated by rural hospital closures[4] and the COVID-19 pandemic.[5]

Table. Age-Adjusted Mortality Rates (AAMRs) per 100 000 Population per Year in the US, 1999-2019

	Total (N = 53 422 612)			Large metropolitan area (n = 26 305 365 [49.6%])			Small- or medium-sized metropolitan area (n = 16 825 867 [31.5%])			Rural area (n = 10 291 380 [19.3%])		
	AAMR/100 000 (95% CI)		APC, % (95% CI)	AAMR/100 000 (95% CI)		APC, % (95% CI)	AAMR/100 000 (95% CI)		APC, % (95% CI)	AAMR/100 000 (95% CI)		APC, % (95% CI)
	1999	2019	1999-2019	1999	2019	1999-2019	1999	2019	1999-2019	1999	2019	1999-2019
Overall	875.6 (874.5 to 876.7)	715.2 (714.4 to 716.1)	−1.1 (−1.2 to −0.1)[a]	861.5 (860.0 to 863.1)	664.5 (664.5 to 665.6)	−1.4 (−1.6 to −1.2)[a]	871.3 (869.2 to 873.3)	744.8 (743.3 to 746.4)	−0.9 (−1.0 to −0.7)[a]	923.8 (921.2 to 936.5)	834.0 (831.7 to 836.3)	−0.5 (−0.7 to −0.4)[a]
Age group, y												
<25	72.9 (72.4 to 73.4)	58.1 (57.7 to 58.6)	−1.3 (−1.5 to −1.1)[a]	69.8 (69.1 to 70.5)	54.2 (53.6 to 54.8)	−1.5 (−1.7 to −1.3)[a]	71.5 (70.5 to 72.5)	59.9 (59.0 to 60.7)	−1.1 (−1.3 to −0.9)[a]	86.4 (85.0 to 87.9)	70.9 (69.5 to 72.3)	−1.2 (−1.4 to −1.0)[a]
25-64	365.4 (364.4 to 366.4)	345.6 (344.8 to 346.5)	−0.4 (−0.6 to −0.2)[a]	356.0 (354.7 to 357.3)	304.1 (303.1 to 305.2)	−0.9 (−1.2 to −0.7)[a]	364.2 (362.4 to 366.0)	378.5 (376.8 to 380.1)	0.1 (−0.1 to 0.3)[b]	398.7 (396.1 to 401.2)	447.0 (444.4 to 449.6)	0.6 (0.4 to 0.7)[a]
≥65	5220.1 (5212.5 to 5227.7)	4073.8 (4068.3 to 4079.4)	−1.3 (−1.4 to −1.2)[a]	5155.9 (5145.2 to 5166.7)	3854.2 (3846.7 to 3861.7)	−1.5 (−1.7 to −1.4)[a]	5194.5 (5180.7 to 5208.3)	4167.8 (4157.9 to 4177.7)	−1.2 (−1.3 to −1.1)[a]	5426.8 (5409.2 to 5444.5)	4560.2 (4546.1 to 4574.4)	−0.9 (−1.0 to −0.8)[a]
Sex												
Male	1067.0 (1065.1 to 1069.0)	846.7 (845.3 to 848.1)	−1.2 (−1.4 to −1.1)[a]	1044.6 (1041.9 to 1047.4)	789.6 (787.7 to 791.4)	−1.5 (−1.7 to −1.3)[a]	1059.9 (1056.4 to 1063.5)	879.0 (876.4 to 881.5)	−1.0 (−1.2 to −0.8)[a]	1140.4 (1135.7 to 1145.0)	977.3 (973.6 to 981.0)	−0.8 (−1.0 to −0.6)[a]
Female	734.0 (732.7 to 735.3)	602.7 (601.7 to 603.8)	−1.1 (−1.2 to −0.9)[a]	727.3 (725.5 to 729.2)	560.0 (558.7 to 561.4)	−1.4 (−1.5 to −1.3)[a]	730.7 (728.3 to 733.1)	628.5 (626.5 to 630.4)	−0.8 (−0.9 to −0.7)[a]	760.2 (757.1 to 763.4)	704.5 (701.7 to 707.4)	−0.4 (−0.5 to −0.3)[a]
Race/ethnicity[c]												
Non-Hispanic White	859.8 (858.6 to 861.0)	736.8 (735.7 to 737.8)	−0.8 (−0.9 to −0.7)[a]	845.3 (843.6 to 847.0)	688.3 (686.9 to 689.7)	−1.1 (−1.2 to −0.9)[a]	856.8 (854.6 to 858.9)	753.0 (751.2 to 754.8)	−0.7 (−0.8 to −0.6)[a]	900.5 (897.8 to 903.3)	833.2 (830.6 to 835.7)	−0.4 (−0.5 to −0.3)[a]
Non-Hispanic Black	1150.1 (1145.7 to 1154.4)	870.7 (867.8 to 873.7)	−1.6 (−1.8 to −1.4)[a]	1138.2 (1132.7 to 1143.6)	837.8 (834.3 to 841.4)	−1.8 (−2.0 to −1.6)[a]	1158.8 (1149.8 to 1167.7)	997.2 (911.6 to 924.0)	−1.4 (−1.6 to −1.2)[a]	1199.1 (1186.8 to 1211.3)	978.9 (968.9 to 988.8)	−1.2 (−1.3 to −1.0)[a]
Asian or Pacific Islander	519.7 (513.7 to 525.6)	383.5 (380.8 to 386.2)	−1.5 (−1.7 to −1.4)[a]	490.9 (484.1 to 497.7)	366.0 (363.0 to 369.0)	−1.5 (−1.6 to −1.3)[a]	576.1 (563.5 to 588.7)	444.3 (437.7 to 450.9)	−1.4 (−1.5 to −1.2)[a]	772.3 (733.7 to 811.0)	452.1 (435.7 to 468.5)	−2.0 (−2.7 to −1.3)[a]
Native American/ Alaska Native	780.9 (764.8 to 796.9)	561.2 (553.3 to 569.2)	−1.5 (−1.7 to −1.3)[a]	507.3 (484.5 to 530.2)	331.6 (321.6 to 341.6)	−2.2 (−2.5 to −2.0)[a]	698.6 (670.7 to 726.6)	565.9 (551.4 to 580.5)	−0.9 (−1.1 to −0.8)[a]	1092.1 (1061.7 to 1122.5)	870.7 (853.0 to 888.4)	−0.8 (−1.1 to −0.5)[a]
Hispanic	676.4 (671.9 to 680.9)	523.8 (521.5 to 526.1)	−1.5 (−1.7 to −1.3)[a]	652.1 (646.8 to 657.5)	502.4 (499.6) to 505.1)	−1.5 (−1.7 to −1.4)[a]	703.7 (694.2 to 713.2)	568.1 (563.3 to 572.9)	−1.3 (−1.5 to −1.1)[a]	818.7 (800.1 to 837.2)	579.1 (569.7 to 588.6)	−1.6 (−1.9 to −1.3)[a]
Aged 25-64 y by race/ethnicity												
Non-Hispanic White	338.9 (337.8 to 339.9)	354.4 (353.3 to 355.5)	0.2 (0.1 to 0.4)[d]	323.7 (322.2 to 325.3)	307.6 (306.2 to 309.1)	0.3 (−0.5 to −0.1)[d]	343.2 (341.3 to 345.2)	380.3 (378.3 to 382.3)	0.5 (0.4 to 0.7)[a]	371.3 (368.7 to 374.0)	439.1 (436.2 to 442.1)	0.8 (0.7 to 1.0)[a]
Non-Hispanic Black	656.1 (652.0 to 660.2)	515.4 (512.5 to 518.3)	−1.6 (−1.9 to −1.2)[a]	649.8 (644.9 to 654.8)	488.8 (485.4 to 492.3)	−1.8 (−2.2 to −1.5)[a]	647.0 (638.6 to 655.4)	551.4 (545.3 to 557.6)	−1.1 (−1.4 to −0.7)[a]	715.4 (702.4 to 728.5)	617.0 (606.3 to 627.8)	−0.9 (−1.3 to −0.6)[a]
Asian or Pacific Islander	177.1 (173.6 to 180.7)	145.6 (143.5 to 147.7)	1.1 (−1.4 to −0.8)[a]	163.1 (159.2 to 167.0)	132.2 (129.9 to 134.4)	−1.2 (−1.6 to −0.9)[a]	213.8 (205.0 to 222.6)	192.0 (186.3 to 197.7)	−0.6 (−1.0 to −0.2)[d]	301.5 (274.3 to 328.6)	217.5 (202.3 to 232.7)	−1.1 (−2.0 to −0.2)[d]
Native American/ Alaska Native	385.5 (374.3 to 396.7)	369.6 (362.0 to 377.3)	−0.2 (−0.5 to 0.1)[b]	250.6 (235.5 to 265.6)	193.6 (185.2 to 201.9)	−1.4 (−1.9 to −1.0)[a]	361.3 (341.6 to 381.1)	379.4 (365.2 to 393.6)	0.4 (0.1 to 0.6)[d]	562.1 (538.7 to 585.6)	656.8 (636.5 to 677.0)	0.8 (0.6 to 1.1)[a]
Hispanic	284.3 (281.2 to 287.3)	240.3 (238.5 to 242.0)	−1.2 (−1.5 to −0.8)[a]	275.1 (271.5 to 278.8)	223.4 (221.3 to 225.4)	−1.4 (−1.8 to −1.1)[a]	295.6 (289.1 to 302.1)	276.6 (272.7 to 280.4)	−0.7 (−1.0 to −0.4)[a]	341.3 (328.3 to 354.4)	283.7 (276.0 to 291.4)	−0.7 (−1.0 to −0.4)[a]
Aged 25-64 y by sex												
Male	464.2 (462.6 to 465.8)	439.9 (438.5 to 441.3)	−0.4 (−0.6 to −0.2)[d]	452.0 (449.8 to 454.1)	390.8 (389.1 to 392.5)	−0.9 (−1.2 to −0.7)[a]	462.8 (459.8 to 465.7)	480.3 (477.7 to 483.0)	0.1 (−0.1 to 0.3)[b]	505.5 (501.5 to 509.6)	552.7 (548.6 to 556.8)	0.4 (0.2 to 0.6)[a]
Female	271.1 (270.0 to 272.3)	254.2 (253.2 to 255.2)	−0.4 (−0.5 to −0.2)[a]	265.4 (263.8 to 267.0)	220.7 (219.5 to 222.0)	−1.0 (−1.2 to −0.8)[a]	270.0 (267.8 to 272.2)	280.1 (278.1 to 282.1)	0.2 (−0 to 0.3)[b]	293.1 (290.0 to 296.1)	339.9 (336.6 to 343.1)	0.8 (0.7 to 0.9)[a]

Abbreviation: APC, annual percentage change.

[a] Statistically significant ($P < .001$).

[b] Not statistically significant.

[c] Reported by the funeral director as provided by an informant (typically the next of kin) or on the basis of observation in the absence of an informant.

[d] $P < .05$.

One limitation is that the rural population decreased from 16.0% in 1999 to 14.0% in 2019, although this would not account for the findings. To reverse increasing rural-urban disparities, researchers, funders, and policy makers must understand the factors worsening rural health and design programs and policies accordingly.

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COMMENT & RESPONSE

Expansion of Health Care Services in the US

To the Editor The recent Viewpoints[1,2] regarding health care policy and the new Biden administration plans propose the goal of achieving access to health care for every American. Unfortunately, an important question remains that these plans fail to answer: who is going to provide this care?

Zhang et al[3] have shown that in the current system there is a substantial shortage of US physicians to provide medical care. Proposed plans that increase the number of people receiving health care in the US do not increase the number of physicians to provide care to these 20 million to 30 million new patients. This problem is magnified by the maldistribution of physicians in the US. Large metropolitan areas have relative surpluses of physicians compared with more rural areas; as a physician practicing rheumatology in southern Appalachia, I encounter patients with health care coverage who have had difficulty finding primary care practitioners.

This shortage and maldistribution is not limited to primary care. Although the current number of rheumatology fellowship slots does not fulfill the future needs of the US health care system, more American College of Rheumatology physicians are listed in the city of Philadelphia than in the entire state of Tennessee.[4] Numerous studies show that a large percentage of physicians establish their medical practice in proximity to where they trained,[5] so increasing fellowship positions in the northeastern US is not likely to help patients in medically underserved areas.

Until meaningful approaches that increase physician training and placement are developed, particularly in underserved regions, we will not reach true health care for all.

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In Reply We agree with Dr Morris that health care professional shortages, and especially maldistribution of physicians and nurses, could detract from any health reform designed to reduce the number of uninsured individuals. The adequacy of the supply of health care professionals and the inequitable distribution of trained professionals by geography and specialty have been long-standing issues in state and federal health policy.

Programs as diverse as Medicare's graduate medical education support and the National Health Service Corps (as well as a number of other initiatives) have been enacted over decades to deal with health care worker shortages. But as Morris' examples illustrate, they have not entirely solved the skewed distribution of health care professionals.

Our proposals addressed to the Biden administration to expand health coverage are necessary but insufficient.[1] The administration should also propose legislation and regulations that incentivize training of more health care professionals, especially those who meet the needs of underserved communities. Innovative ideas for a more fair distribution of