

Letters

RESEARCH LETTER

Excess Deaths From COVID-19 and Other Causes, March-July 2020

Previous studies of excess deaths (the gap between observed and expected deaths) during the coronavirus disease 2019 (COVID-19) pandemic found that publicly reported COVID-19 deaths underestimated the full death toll, which includes documented and undocumented deaths from the virus and non-COVID-19 deaths caused by disruptions from the pandemic.^{1,2} A previous analysis found that COVID-19 was cited in only 65% of excess deaths in the first weeks of the pandemic (March-April 2020); deaths from non-COVID-19 causes (eg, Alzheimer disease, diabetes, heart disease) increased

sharply in 5 states with the most COVID-19 deaths.¹ This study updates through August 1, 2020, the estimate of excess deaths and explores temporal relationships with state reopenings (lifting of coronavirus restrictions).

Methods | Death data for 2014-2020 and population counts for the 50 states and the District of Columbia were obtained from the National Center for Health Statistics^{3,4} and US Census Bureau,⁵ respectively. Death counts from March 1, 2020, through August 1, 2020, were taken from provisional, unweighted data released on September 9, 2020.³ Connecticut and North Carolina were excluded due to missing data. A hierarchical Poisson regression model, described elsewhere,¹ was used to predict expected deaths based on historic norms. COVID-19 deaths included those in which COVID-19 was cited as an underlying or contributing cause. Data for deaths not attributed to COVID-19 were only available for underlying

Viewpoint pages 1491, 1493, 1495 and Editorial pages 1502 and 1504

Video

Table. Excess Deaths From March 1, 2020, to August 1, 2020, US and Selected States

Jurisdiction	Expected deaths (95% CI) ^a	Observed deaths (ratio of observed/expected)	Excess deaths		Mortality rate per 100 000 population	COVID-19 deaths ^b	Excess deaths attributed to COVID-19, % ^b	ED ⁹⁰
			No. (95% CI)					
United States ^c	1 111 031 (1 110 364-1 111 697)	1 336 561 (1.20)	225 530 (224 864 to 226 197)		72	150 541	67	18
Alabama	21 236 (21 148-21 325)	25 172 (1.19)	3936 (3847 to 4024)		81	2071	53	17
Alaska	1823 (1809-1837)	1851 (1.02)	28 (14 to 42)		4	0	0	18
Arizona	25 309 (25 209-25 409)	32 780 (1.30)	7471 (7371 to 7571)		104	3933	53	17
Arkansas	13 105 (13 040-13 169)	14 326 (1.09)	1221 (1157 to 1286)		41	585	48	16
California	110 296 (110 069-110 524)	127 298 (1.15)	17 002 (16 774 to 17 229)		43	10 388	61	18
Colorado	16 615 (16 539-16 692)	19 479 (1.17)	2864 (2787 to 2940)		50	1782	62	17
Delaware	3752 (3727-3777)	4651 (1.24)	899 (874 to 924)		93	482	54	18
District of Columbia	2521 (2503-2540)	3428 (1.36)	907 (888 to 925)		129	675	74	14
Florida	87 139 (86 935-87 343)	101 389 (1.16)	14 250 (14 046 to 14 454)		67	8517	60	17
Georgia	35 149 (35 027-35 270)	41 107 (1.17)	5958 (5837 to 6080)		57	3830	64	18
Hawaii ^d	4881 (4850-4913)	4828 (0.99)	-53 (-85 to -22)		-4	0	0	17
Idaho	5819 (5783-5855)	6377 (1.10)	558 (522 to 594)		32	178	32	19
Illinois	43 413 (43 276-43 550)	54 014 (1.24)	10 601 (10 464 to 10 738)		83	7037	66	16
Indiana	27 441 (27 337-27 545)	31 250 (1.14)	3809 (3705 to 3913)		57	2991	79	16
Iowa	12 410 (12 348-12 472)	13 416 (1.08)	1006 (944 to 1068)		32	922	92	16
Kansas	10 892 (10 836-10 948)	11 545 (1.06)	653 (597 to 709)		22	394	60	18
Kentucky	19 687 (19 603-19 772)	21 280 (1.08)	1593 (1508 to 1677)		36	815	51	18
Louisiana	18 974 (18 891-19 056)	24 026 (1.27)	5052 (4970 to 5135)		108	3820	76	18
Maine	6144 (6107-6181)	6273 (1.02)	129 (92 to 166)		10	64	50	18
Maryland	20 282 (20 196-20 368)	26 091 (1.29)	5809 (5723 to 5895)		96	3859	66	16
Massachusetts	24 301 (24 205-24 397)	32 562 (1.34)	8261 (8165 to 8357)		120	7886	95	9
Michigan	40 057 (39 926-40 188)	48 854 (1.22)	8797 (8666 to 8928)		88	5866	67	15
Minnesota	18 633 (18 550-18 715)	20 530 (1.10)	1897 (1815 to 1980)		34	1635	86	14
Mississippi	12 885 (12 821-12 949)	15 989 (1.24)	3104 (3040 to 3168)		104	1753	56	17
Missouri	26 409 (26 308-26 510)	28 580 (1.08)	2171 (2070 to 2272)		35	1280	59	18
Montana	4297 (4269-4325)	4379 (1.02)	82 (54 to 110)		8	26	32	21

(continued)

Table. Excess Deaths From March 1, 2020, to August 1, 2020, US and Selected States (continued)

Jurisdiction	Expected deaths (95% CI) ^a	Observed deaths (ratio of observed/expected)	Excess deaths		Mortality rate per 100 000 population	COVID-19 deaths ^b	Excess deaths attributed to COVID-19, % ^b	ED ⁹⁰
			No. (95% CI)					
Nebraska	6911 (6871-6952)	7447 (1.08)	536 (495 to 576)		28	315	59	17
Nevada	10 799 (10 743-10 856)	12 194 (1.13)	1395 (1338 to 1451)		46	888	64	17
New Hampshire	5025 (4993-5057)	5694 (1.13)	669 (637 to 701)		49	373	56	17
New Jersey	30 044 (29 934-30 153)	48 048 (1.60)	18 004 (17 895 to 18 114)		202	14 043	78	9
New Mexico	7590 (7546-7633)	8771 (1.16)	1181 (1138 to 1225)		56	671	57	16
New York	62 948 (62 779-63 116)	103 811 (1.65)	40 863 (40 695 to 41 032)		209	31 996	78	8
North Dakota	2989 (2968-3010)	3144 (1.05)	155 (134 to 176)		20	60	39	15
Ohio	49 491 (49 344-49 638)	55 946 (1.13)	6455 (6308 to 6602)		55	3379	52	18
Oklahoma	15 448 (15 376-15 520)	17 189 (1.11)	1741 (1669 to 1813)		44	639	37	19
Oregon	15 094 (15 023-15 165)	16 217 (1.07)	1123 (1052 to 1194)		27	338	30	20
Pennsylvania	53 964 (53 809-54 118)	63 070 (1.17)	9106 (8952 to 9261)		71	7595	83	14
Rhode Island ^c	4299 (4271-4327)	5239 (1.22)	940 (912 to 968)		89	979	104	12
South Carolina	20 479 (20 392-20 566)	24 488 (1.20)	4009 (3922 to 4096)		79	1877	47	19
South Dakota	3368 (3345-3391)	3549 (1.05)	181 (158 to 204)		21	103	57	20
Tennessee	30 810 (30 698-30 922)	33 999 (1.10)	3189 (3077 to 3301)		47	1191	37	19
Texas	83 179 (82 982-83 376)	100 951 (1.21)	17 772 (17 575 to 17 969)		62	10 026	56	16
Utah	7865 (7820-7910)	8818 (1.12)	953 (908 to 998)		30	311	33	20
Vermont	2383 (2366-2400)	2561 (1.07)	178 (161 to 195)		28	31	17	20
Virginia	28 020 (27 915-28 126)	32 582 (1.16)	4562 (4456 to 4667)		54	2394	52	19
Washington	23 393 (23 299-23 487)	25 803 (1.10)	2410 (2316 to 2504)		32	1505	62	19
West Virginia	9332 (9282-9383)	9495 (1.02)	163 (112 to 213)		9	74	46	17
Wisconsin	22 212 (22 120-22 305)	23 991 (1.08)	1779 (1686 to 1871)		31	964	54	19
Wyoming	1919 (1904-1933)	2079 (1.08)	160 (146 to 175)		28	0	0	18

Abbreviations: COVID-19, coronavirus disease 2019; ED⁹⁰, number of consecutive weeks during which 90% of total excess deaths occurred.

^a Seasonally adjusted death counts predicted by regression model.

^b COVID-19 deaths include deaths in which COVID-19 was identified as the underlying cause of death or a contributing cause (among multiple causes).

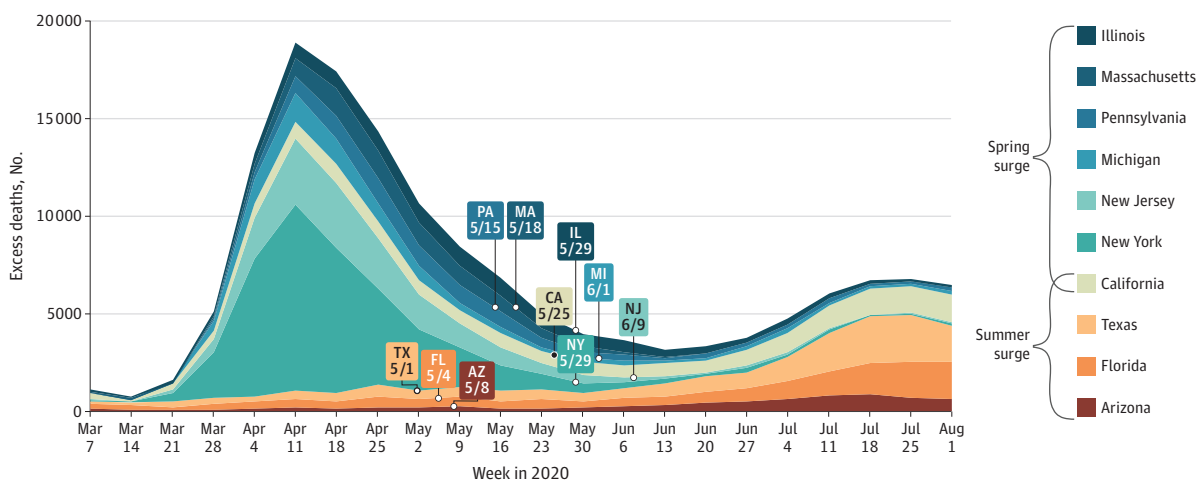
^c The US total was calculated as the sum of results for 48 states and the District

of Columbia. Data for Connecticut and North Carolina were omitted because of delays in reporting.

^d Hawaii experienced “negative” excess deaths because observed deaths were lower than would be predicted based on historic norms.

^e Likely due to observed deaths being less than predicted, COVID-19 deaths in Rhode Island exceeded the estimate for excess deaths.

Figure. Excess Deaths From March to July 2020 in Selected States



The figure plots weekly excess deaths for the 10 states with the largest number of excess deaths during March-July 2020. Reopening dates refer to the lifting of broad coronavirus disease 2019 restrictions, as reported by the *New York Times*.⁶

causes of death, including Alzheimer disease, heart disease, and 10 other grouped causes, defined elsewhere.¹ Reopening dates were obtained from the *New York Times*.⁶

To confirm the validity of observed increases in non-COVID-19 deaths, the Joinpoint regression program (version 4.8.0.1; Statistical Research and Applications Branch, National Cancer Institute) was used to specify the weeks (joinpoints) when slopes changed (as measured by the annual percentage change [APC]) and their statistical significance (2-sided test, .05 threshold). To estimate dispersion in the epidemic curve for each state, the number of consecutive weeks during which 90% of excess deaths occurred (ED⁹⁰) was calculated. All calculations were performed in SAS (version 9.4; SAS Institute) and R (version 3.6.1; The R Foundation).

Results | Between March 1 and August 1, 2020, 1 336 561 deaths occurred in the US, a 20% increase over expected deaths (1 111 031 [95% CI, 1 110 364 to 1 111 697]). The 10 states with the highest per capita rate of excess deaths were New York, New Jersey, Massachusetts, Louisiana, Arizona, Mississippi, Maryland, Delaware, Rhode Island, and Michigan. The states with the highest per capita rate of excess deaths changed from week to week (**Video**). The increase in absolute deaths in these states relative to expected values ranged from 22% in Rhode Island and Michigan to 65% in New York (**Table**). Three states with the highest death rates (New Jersey, New York, and Massachusetts) accounted for 30% of US excess deaths but had the shortest epidemics (ED⁹⁰ < 10 weeks). States that experienced acute surges in April (and reopened later) had shorter epidemics that returned to baseline in May, whereas states that reopened earlier experienced more protracted increases in excess deaths that extended into the summer (**Figure**).

Of the 225 530 excess deaths, 150 541 (67%) were attributed to COVID-19. Joinpoint analyses revealed an increase in deaths attributed to causes other than COVID-19, with 2 reaching statistical significance. US mortality rates for heart disease increased between weeks ending March 21 and April 11 (APC, 5.1 [95% CI, 0.2-10.2]), driven by the spring surge in COVID-19 cases. Mortality rates for Alzheimer disease/dementia increased twice, between weeks ending March 21 and April 11 (APC, 7.3 [95% CI, 2.9-11.8]) and between weeks ending June 6 and July 25 (APC, 1.5 [95% CI, 0.8-2.3]), the latter coinciding with the summer surge in sunbelt states.

Discussion | Although total US death counts are remarkably consistent from year to year, US deaths increased by 20% during March-July 2020. COVID-19 was a documented cause of only 67% of these excess deaths. Some states had greater difficulty than others in containing community spread, causing protracted elevations in excess deaths that extended into the summer. US deaths attributed to some noninfectious causes increased during COVID-19 surges. Excess deaths attributed to causes other than COVID-19 could reflect deaths from unrecognized or undocumented infection with severe acute respiratory syndrome coronavirus 2 or deaths among uninfected patients resulting from disruptions produced by the pandemic. Study limitations include the reliance on provisional data, inaccuracies in death certificates, and assumptions applied to the model.

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